UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL SCIENCE

Competing Perspectives on United States Domestic and Foreign Nuclear Power Policies and Nuclear Technology Relationships with Japan 1954-1974

by

Anthony G. McGrew

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ABSTRACT

FACULTY OF SOCIAL SCIENCE

POLITICS

Doctor of Philosophy

COMPETING PERSPECTIVES ON UNITED STATES DOMESTIC AND FOREIGN NUCLEAR POWER POLICIES AND NUCLEAR TECHNOLOGY RELATIONSHIPS WITH JAPAN 1954-1974

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This thesis explores the politics of international nuclear technology transfer by focusing upon civil nuclear cooperation between the United States and Japan in the period 1954 to 1974 .

It examines in some historical detail the domestic development of the US nuclear power industry and its transnational expansion under the Atoms for Peace programme . Moreover the relationship between US domestic and foreign atomic policy in this period is given considerable emphasis . How and why the United States promoted and encouraged both the establishment , as well as the later institutionalisation , of the international nuclear non-proliferation regime is a major point for discussion .

In exploring the nature of the civil nuclear relationship between the United States and Japan the study concentrates upon how the latter's reliance upon American nuclear technology and capital , for the development of its nuclear programme , imposed significant constraints upon its political autonomy .

The study concludes by assessing the value of three competing theoretical perspectives - realism , liberal-pluralism and neo-marxism - in accounting for the impact of technology upon world politics . These three perspectives are discussed in the initial theoretical chapter and evaluated more rigorously in the concluding chapter .

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The production of such a substantial piece of work requires much secretarial effort and I express my deep gratitude to Anne particularly but also , Mary , and Sue who laboured many a hour over a very uncooperative word processor .

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LIST OF ABBREVIATIONS

ACDA - US Arms Control and Disarmament Agency
AEB - Atomic Energy Bureau of the STA Japan
AEC - US Atomic Energy Commission
AIF - US Atomic Industrial Forum ; the nuclear industry's pressure group
BWR - Boiling Water Reactor
DOD - Department of Defense (Pentagon)
DOS - Department of State
FBR - Fast Breeder Reactor
GCR - Gas cooled Reactor (Magnox)
JCAE - Joint Committee on Atomic Energy US Congress
IAEA - International Atomic Energy Agency
JAEC - Japan Atomic Energy Commission
JAIF - Japan Atomic Industrial Forum ; the nuclear industry's pressure group
LWR - Light Water Reactor
MITI - Ministry of International Trade and Industry (Japan)
MOF - Ministry of Finance (Japan)
PDRP - Power Demonstration Reactor Program
PWR - Pressurised Water Reactor
STA - Science and Technology Agency (Japan)

LIST OF INTERVIEWEES

The following individuals gave greatly of their time and were extremely receptive to my questioning .

Mr . A. Crane , Energy Program , Office of Technology Assessment Washington DC.

Mr. R. Deming , OES , Department of State , Washington DC.

Dr. W. Donnelly , Congressional Research Service , Washington DC.

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Mr. W. Spodak , Government Programs , Westinghouse Corporation , Washington DC.

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Mr. R. Williamson , ACDA , Department of State , Washington DC.

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CHAPTER ONE - TECHNOLOGY AND COMPLEXITY IN WORLD POLITICS : COMPETING PERSPECTIVES

Technology , according to Langdon Winner , 'is a word whose time has come ' .(1) This is evident not least in the fact that a voluminous literature now exists surveying the impact of technological change upon the social and political fabric of advanced industrial societies . From the radical critiques of Habermas , Marcuse , and Ellul , who point to the dangers posed by technological ' progress ' to human freedom and political democracy , to the celebration by Bell of the technologically induced ' post-industrial society ' technology is conceived as a primary agent for social and political change .(2) Yet curiously the literature on international relations displays a relative neglect of this most vital topic ; there are , for instance , few academic studies of the impact of technological change upon the nature of world politics .(3) As Kintner and Sicherman surprisingly remark :

> Compared with the plethora of books and critics analysing the impact of technology on man's morality , his future , and public policy , the literature concerned directly with the impact of technology on international politics is meager .(4)

This study is conceived , in a very humble way , as one contribution towards making that literature somewhat less meagre .

Much of the existing literature provides a valuable analysis of the role which technology plays in shaping the environment in which states operate . Thus Kintner and Sicherman's study assesses how far technology conditions the

behaviour of states in the international system and Grainger evaluates the nature of technology as a substantive issue-area in international politics . (5) Nau, on the other hand , adopts a rather original focus by examining the question of how far technology can be viewed as an autonomous variable in international politics .(6) Using the case of nuclear reactor development in Europe he analyses the nature of technological cooperation from the perspective of whether technology or politics is the main determinant of patterns of cooperation in the international system . This connects directly with a number of fundamental themes which permeate much of the contemporary literature on international relations and technological change : how far is technological progress leading to the demise of the nation-state and the transformation of the international system ? Is technology a harbinger of a world society , shrinking the globe and spinning tightly knit webs of interdependence between states so locking mankind into a common destiny ? Or is technology merely an instrument of state power in which the strong and powerful come to dominate the weak ? There are , as Vogler points out , no conclusive answers to these broad questions since "...it appears that almost every assertion can be countered by a contrary analyses , frequently based upon the same set of inconclusive evidence . " (7) An observation with which many others agree , including Kintner and Sicherman who conclude their own study by suggesting that "...the impact of technology is paradoxical."(8)

If there are no conclusive answers to these general

questions then perhaps the fault lies in the questions themselves . Perhaps the questions are so huge in their intellectual compass and evoke such bitter academic controversy that the quest for some form of ultimate objective truth is entirely misplaced . All that may be possible is for the analyst to sketch out the competing claims of different schools of thought and assess how far each provides a coherent , consistent and rigorous explanation of the impact of technology upon international politics. In essence this is the approach adopted in this study for it commences by delineating the major schools of thought within the academic study of international relations and how these conceive of , and explain , the complex relationship between technology and world politics . The rationale for this will become more evident as the chapter unfolds .

1.1 Defining Terms and the Substance of the Study

Technology to most individuals conjures up images of machines , gadgets , and tools : the hardware of advanced industrial society . But technology is much more than simply a set of physical products or artefacts . Even the ordinary dictionary definition of the word , which defines technology as the ' science of practical or industrial art ; ...application of science ' , recognises that its modern meaning embraces much more than simply ' things ' or products . Besides being an artefact the word technology also implies the application of scientific knowledge whether that be for instance in the design of a new computer or the design of an organisation , such as a University . Accordingly Ellul defines technology in terms of "...the

totality of methods rationally arrived at and having absolute efficiency (for a given stage of development)in every field of human activity ."(9) In this definition technology emphasises methods as well as products . But as Winner indicates this is rather too broad a conception of technology .

According to Winner technology should be conceived as encompassing three distinct elements .(10) The first is the actual tools or hardware ; this he regards as the apparatus , the ' physical devices of technical performance ' .(11) But associated with any machine or appliance are certain technical activities "...skills ,methods , procedures and routines - that people engage in to accomplish tasks ..".(12) This Winner calls technique which is a fundamental component of any piece of technological apparatus . Finally , technology also refers to modes of social organisation , which ensure that the apparatus and techniques achieve their defined objectives or purposes . Thus a bureaucracy or a factory are forms of social organisation bringing together techniques and apparatus to achieve rational-productive ends .(13)

For Winner the word ' technology ' defines three inter-related dimensions: the technical apparatus ; the techniques which go with that apparatus ; and the modes of social organisation which are essential to the efficient exploitation of that technical apparatus . What such a definition provides is an important clarification of the nature of technology . Accordingly , in the context of this study nuclear technology takes on a quite different meaning

than is normally the case . Rather than simply referring to the actual hardware , the power reactors or fuel processing facilities , nuclear power technology here includes the techniques and the forms of social organisation which are necessary to sustain the generation of electricity using atomic energy . Thus in discussing civil nuclear power technology , the word technology signifies not only the actual facilities and apparatus , such as power reactors , (without which the production of electricity from the atom would be impossible) but also the techniques , like for instance nuclear safety procedures and codes , as well as the highly centralised production and distribution systems , which are an equally necessary ingredient of this particular technical mode of electricity generation .

1.1.1 The Focus of the Study

It would seem appropriate at this point , having established the concept of technology in the nomenclature of this study , to examine very briefly the intellectual and empirical focus of the thesis .

As implied earlier there are two distinct levels of enquiry around which the current literature on technology and international relations clusters . At one level , the higher order level , the focus is upon how far technology can be considered an autonomous engine of change which is transforming the landscape of world politics .(14) Nestling below this is a second order of enquiry which is concerned with exploring the ways in which states exploit technology as an instrument or a new issue-area of foreign policy . Whilst these are legitimate and extremely vital areas of intellectual enquiry there is a sense , as referred to

earlier , in which they lead to inconclusive answers since the initial questions are themselves so broad.

Rather than focus upon these broad questions what is called for is some form of synthesis of the existing literature which surveys the analytical strengths and weaknesses of contemporary theorising about the impact of technology upon world politics but which also can offer some insights into how far and in what ways that theorising is deficient . Accordingly the approach adopted here is one of synthesis ; it is not in any respect an attempt to propound a new and original theory of the impact of technology upon world politics . Instead the goal of this study is much more modest ; it is concerned with answering the question : how far and in what ways do the major schools of international theory adequately explain the impact of technology upon the nature of world politics ?

One of the primary motivations for approaching the subject of technology and world politics in this way arises from the empirical focus of the study . For in examining the origins and consequences for world politics of the massive outflow of civil nuclear technology from the United States , under the ' Atoms for Peace ' plan , the author was left with the uneasy feeling that none of the major schools of international theory could by themselves account for he complexity evident in this particular issue-area . Initially , the study had been predicated upon the basis of demonstrating the limitations of traditional realist analyses of the ramifications of technology for international politics but as the research progressed it

became increasingly evident that equally powerful critiques could be levelled at the two other main schools of thought , liberal- pluralist and marxist analyses . As a result the research was transformed from a critique of realism into a comparative evaluation of the utility of competing theoretical perspectives in accounting for the complex inter-relationship between technology and world politics . Precisely what this entails and how the study is organised is explained in the remainder of this chapter .

1.1.2 Organisation of the Chapter

There are four key sections in this chapter . Directly following on from this section the discussion turns to the substance of the competing theoretical perspectives . This will entail a brief examination of the nature of the contemporary study of international relations and some explanation of why the ' inter-paradigm ' debate , as Banks refers to it , has come to dominate the agenda and the discourse of theoretical enquiry .(15) Within this section the three major theoretical perspectives - realism , liberal-pluralism , and neo-marxism - on world politics will be explicated with particular attention given to how each conceives of and explains the impact of technology upon the dynamics of world politics .

Developing out of this discussion the next section will attempt to highlight some common themes which cut across the discussion of technology in each of the three perspectives identified above . Essentially , the object is to identify the key themes , issues and concepts which will form the intellectual backbone of the remainder of this study . Flowing out of this will be a brief third section

which will articulate the central questions and problematiques of the study . This will establish the framework of enquiry for the empirical study in chapters 2 to 5 of the international ramifications arising out of the domestic development and transnational expansion of the US civil nuclear industry . The fourth and final section of the chapter describes the organisation of the thesis and how this complements the underlying framework of enquiry . But the chapter commences with a substantive overview of how technology has been conceived in the theoretical literature on international relations .

1.2 Technology , the State and World Politics : Competing Perspectives

In his highly original study of nuclear reactor development in Western Europe , Nau concludes :

> If one conclusion emerges clearly from the preceding analysis , it is the trite but sobering conclusion that actor behaviour in technological areas is complex and multidimensional . No one analysis can account for all this complexity .(16)

To explain the impact of technology therefore requires an appreciation of the central ideas in each of the major schools of international relations theory . But what are these schools of thought or theoretical perspectives ?

1.2.1 The Crisis in International Relations Theory

In Kuhnian terms international relations , as a discrete discipline within the social sciences , is in somewhat of a crisis ridden state . (17) Whereas , with some stretching of definition , the period up to the 1970's could be regarded as one in which the realist , or state-centric , ' paradigm'

dominated the field of study the events , and the theoretical developments of the 1970's , challenged its claim to intellectual supremacy . As Puchala and Fagan remarked , in their seminal article , the 1970's were testament to a discipline in search of a perspective .(18) But this search has proved somewhat illusory for there has been no return to a ' normal science 'of international relations (if it ever existed) in which the basic assumptions both about what is to be explained , and how , are taken for granted by the community of scholars . Rather , the 1980's has witnessed the resurgence of a further ' great debate ' , along the lines of the behaviouralist - traditionalist dispute in the 1960's , in which the academic warriors representing the major paradigms or perspectives confront each other in an intellectual version of the cold war .(19) This ' inter-paradigm ' debate is distinguished , however , by the fact that it lacks any genuine sense of intellectual argument ; the protagonists appear less willing to challenge the validity or utility of opposing perspectives than to assert the intellectual purity of their own position . The consequence of this is that the contemporary period is marked more by a mood of crisis and fragmentation within the discipline than a belief that academic progress is being made .

What distinguishes the contemporary period from the ' classical ' confrontation between idealism and realism , in the inter-war period , and the behaviouralist-traditionalist dispute in the 1960's , is the concentration upon substantive as opposed to primarily normative or methodological issues . Whereas , according to Lijphart ,

the idealist-realist controversy in the inter-war period was essentially a contest between opposing normative ideas about how the system should be organised to best preserve peace , it was conducted very much within the state-centric paradigm .(20) States were regarded as the major actors in world politics and the question posed was whether traditional balance of power mechanisms or collective security arrangements guaranteed peace and stability . Similarly , in the 1960's , the publication of ' Contending Approaches to International Relations ' marked a further period of intellectual debate , although in this case it was concerned much more with methodological questions than issues of substantive focus . (21) What placed figures like Hedley Bull and James Rosenau on opposite sides of this debate was not a conflict over what the study of international relations should be about so much as a difference of opinion over how it should be studied . (22) Traditionalists , like Bull , argued for an essentially historical approach to explaining international politics whereas behaviouralists like Rosenau or Banks , sought to establish a cumulative science of international behaviour .(23) But the protagonists did not differ in their assumptions of what it was that was to be explained ; both shared a common view of the nature of world politics . As Vasquez has indicated both behaviouralists and traditionalists accepted the tenets of realism and the state-centric paradigm .(24) Only with the onslaught of the post-behavioural ' revolution ' did the subject matter itself come under the academic microscope .

Intellectually , the post - behavioural revolution had its roots in the domestic turmoil and political upheavals in the United States in the late 1960's . A combination of intense social conflict and the horrors of the Vietnam war undermined the intellectual foundations of both behaviouralism and traditionalism . Both were condemned for concealing a deeply conservative ideology in a shroud of academic respectability . The post-behavioural revolution therefore sought to bring morality back into the study of world politics . As a result , according to Pettman , the question of substance , as opposed to technique , was forced to the top of the academic agenda . (25)

Whilst David Easton was welcoming the ' post-behavioural' era in his address to the American Political Science Association in 1969 Marxist orthodoxy too was under increasing attack in European universities .(26) The emergence of the New Left , epitomised by the establishment of the New Left Review , marked a significant transformation in Marxist social and political theory which had important ramifications for the study of world politics . Economic issues , patterns of inequality , and the political economy of world politics came in for increasing scrutiny . Combined with the concentration in post-behavioural approaches to international relations , upon new actors, new forces and new issues in world politics orthodox realism , as Puchala and Fagan noted , appeared increasingly to lack intellectual credibility . (27)

According to Lijphart the post-behaviouralists adopted an essentially Grotian image of world politics , stressing order and community , in opposition to the classical

realist view which championed the Hobbesian image of the international system as a state of nature . (28) This Grotian image was a product of the belief that the world of the 1970's had been radically transformed by economic and technological progress such that realism "...could no longer account for anywhere near the full variety of significant international events ."(29) A new school of theory emerged , borrowing heavily from the liberal-pluralist analyses of American domestic politics , which sought to explain the puzzling complexities of world politics .

Central to the theoretical concerns of this new school was the attempt to explain the emergence of a vast new array of actors and issues in world politics . As described by Keohane and Nye , in their path-breaking work ' Power and Interdependence ' , international politics in the 1970's could no longer be understood as struggle for power between states but had to be conceived as the politics and management of complex interdependence .(30) World politics had been transformed , according to Morse , and in the process had become , in the words of Hanreider , increasingly ' domesticated ' .(31) There was no longer held to be any real distinction between domestic and international politics with the consequence that the analytical insights of pluralism were transferred to the arena of world politics ; but so too were its intellectual weaknesses .

Developing in parallel with his liberal-pluralist approach to world politics were a variety of neo-marxists accounts of world politics .(32) Having shaken off

some of the intellectual liabilities of theories of imperialism these new approaches sought to explain how the structure of the world economy shaped the character of world politics . (33) In doing so they provided a radical alternative to both realism and liberal-pluralist approaches . But this contributed further to the fragmentation of the study of international relations . Little wonder that Puchala and Fagan characterised the 1970's as a decade in which the discipline was in ' search of a perspective .'(34)

In the contemporary period international relations has entered what Maghoori and Ramberg label ' the third great debate .'(35) No one school of thought or perspective dominates the field even though , in the wake of the New Cold War , realism has made a significant intellectual revival .(36) As Smith , Banks , as well as Little and McKinlay , argue the contemporary study of international relations is one in which the major intellectual traditions are in competition with one another to establish a new theoretical hegemony .(37) For some scholars this is a sign of hope but for others is symptomatic of a much more profound intellectual crisis .(38) In what follows the emphasis will be upon how far each of these intellectual traditions can illuminate our thinking and theorising with regard to the impact of technology upon world politics .

1.2.2 Perspectives on World Politics

In a recent essay Banks remarks that :

All discussions of world affairs rests upon assumptions about which things are the ones which really matter .(39)

These ' assumptions ' are important for they tend to

structure the whole exercise of intellectual enquiry in any field . This is particularly the case in the social sciences where conflicting ideological assumptions can lead to radically different interpretations of the same social phenomenon . The assumptions which guide enquiry are crucial to the theories and explanations which social scientists construct yet they are often implicit in their work . (40) It therefore seems sensible to focus this study initially upon the major perspectives which guide academic enquiry into the impact of technology upon world politics . By doing so the aim is to establish a set on intellectual reference points within which to compare and evaluate specific theories or explanations of the relationship between technology and world politics . But what is a perspective ?

Earlier the notion of ' schools of thought ' in international relations was introduced . This is often used as a synonym for a ' perspective ' since they both refer to general theories or analytical accounts of phenomenon which share certain basic common assumptions about the world . But a ' perspective ' is distinct from from both a theory and a paradigm . Whereas a theory attempts to provide an explanation of particular phenomena , a ' perspective ' merely seeks to isolate , select , and edit the facts into some coherent pre-theoretical order upon which the social scientist can then construct a theoretical edifice . Perspectives , moreover , are by definition ideological in character since they contain certain values , beliefs , and generalisations about the social world which are not open to empirical verification .(41) What in the social sciences

distinguishes different theories from one another is not so much the explanations which they produce but rather the underlying assumptions or perspectives upon which they are based .

A ' perspective ' is also to be distinguished from Kuhn's concept of a paradigm . In talking about the worldviews or intellectual frameworks which guide scientific enquiry Kuhn refers to the notion of a paradigm .(42) But the notion of a paradigm implies something much more rigorous , comprehensive , and coherent than a perspective which by definition admits to being selective and partial . Moreover , a paradigm is open to falsification in a way in which a perspective in the social sciences is not .(43) Thus the notion of perspective , rather than the more frequently (mis)used notion of paradigm , is utilised throughout this study .

In the remainder of this section the emphasis moves away from definitional matters to issues of substance , specifically how the impact of technology upon world politics is conceived within each of the three major perspectives : realism ; liberal-pluralism ; and neo-Marxism.

1.2.3 Realism : Technology as an Instrument and Symbol of State Power

Realist descriptions of international politics , such as those of Hans Morgenthau or Kenneth Thompson , share a common conception of the world in which sovereign nation-states are caught in a permanent struggle for power and security .(44) According to these realist thinkers because

there is no over-arching centre of authority in the international system , since each state retains sovereign power within its own territory , the international arena lacks the degree of social and political order which characterises the domestic domain . As a result they describe the international system as being anarchic , something akin to Hobbe's state of nature in which life is short , nasty and brutish . (45) Facing such a hostile environment the state , like Macchiavelli's Prince , has but one primary duty and that is to ensure national security by acquiring the power to defend itself against potential enemies . International politics , as Morgenthau observed , is therefore an unending struggle for power .(46)

Within this basic vision realists tend to interpret the role and impact of technology upon international politics strictly in relation to the exercise and aggrandisement of state power. Technology is not considered an autonomous force for change but rather is conceived as largely subservient to the laws of international politics . Thus technology is often discussed as an instrument of state power , a means by which the state can further its national interest . Blake and Walters , for instance , write that :

> All states want to harness science and technology to national economic , social , and security policies .(47)

Or alternatively technology is conceived as a means to enhance the military and industrial capabilities of the state . As Morgenthau notes :

> The technology of modern warfare and communications has made the overall development of heavy industries an indispensable element of national power...the competition among nations for power transforms itself largely into competition for the production of bigger , better , and more elements of war.(48)

Far from viewing technology as something which elludes human or political control, as do many modern writers , realists stress how , in the international sphere , it is largely subservient to the underlying struggle for power and security . This conclusion follows naturally from the basic principles of realist thought .

Realism , as Carr so lucidly described in his classic inter-war study of international relations , has an impressive intellectual pedigree .(49) Contemporary realism draws upon a rich intellectual heritage , from Chinese and Greek philosophers, to the philosophers of the Enlightenment , and the European realpolitik tradition . But realist thinking is not , as some believe , trapped in some ancient mode of analysis which bears little relationship to the modern world ; it has undergone a significant evolution in recent years with classical realism giving way to a contemporary ' neo-realism ' . Yet as Keohane convincingly argues neo-realism and classical realism are based upon common fundamental principles of analysis .(50)

In a recent essay Keohane identifies three intellectual assumptions which frame all realist analyses of world politics .(51) These are :

(1) that the state is the primary actor in world politics or as Dougherty and Pfaltzgraff phrase it "... international affairs are , after all , a matter of relations between governments and not peoples ."(52) This does not mean that realists ignore other actors on the international stage , such as multinational corporations or international institutions . Rather , as Bull argues , it is

an explicit claim about which are the most significant units in determining the pattern of world politics .(53) As Gilpin indicates the myriad of new international actors crowding the international stage in the post-war era only exist with the consent of states :

> ...transnational actors and processes are dependent upon peculiar patterns of inter-state relations...From this perspective the multinational corporation exists as a transnational actor today because it is consistent with the political interests of the worlds' dominant power , the United States .(54)

This state-centric conception of world politics is perhaps one of the most critical distinguishing characteristics of realism as a mode of analysis .

(2) states act according to a rational calculus and always seek to pursue the national , as opposed to any sectional , interest . The state , according to Allison , is therefore conceived as a unitary actor which can articulate a clearly defined national interest and make strategic calculations about how best to pursue it . (55) In his excellent study of the state and the use of force in American foreign policy, Krasner concludes that :

> This investigation has shown that the state has purposes of its own . The national interest does have an empirical reality... (56)

(3) states seek power since only power provides security and the potential to promote or defend the national interest in any sphere of activity . In seeking power states place a premium on developing their technological and industrial capabilities because ever since the industrial revolution , and more particularly in the contemporary era , "...modern technology has become the primary source of national power and prosperity ."(57) Power in the modern

world is therefore vitally dependent upon industrial and technological strength .

To these three principles should be added a fourth :

(4) the separation of domestic and foreign policy . For most realists domestic and foreign policy are quite distinct activities and operate in quite radically different arenas . Consequently foreign and domestic policy , as well as international and domestic politics are conceived as discrete fields of enquiry requiring distinctly different modes of analysis .

From this brief overview of the basic principles of realism it should be apparent that the critical concepts in the realist conceptual vocabulary are : power ; the state ; and the national interest . Of these power is central to realist analyses for without power resources the state is virtually incapable of autonomous action . But how is power conceived in this perspective ?

Power , as Taylor has shown in his analysis of realist writings , is largely considered in terms of capabilities or attributes .(58) The hierarchy of power in the international system , which conditions the behaviour of all states , is therefore essentially a hierarchy of military , industrial , and technological capabilities . Exactly where a state fits into this power hierarchy is a function of its military , industrial , economic and technological capabilities for it is these which ultimately determine its war making potential ; the primary measure by which its power can be judged . And it is in this context of relative power capabilities that , for realists , technology becomes so crucial . For as

Morgenthau noted :

> The fate of nations and of civilisations has often been determined by a differential in the technology of warfare for which the inferior side was unable to compensate in other ways .(59)

In the nuclear era technology has become , more than ever before , a critical determinant of national power . For technology not only enhances military capabilities but also augments the industrial and economic capabilities which are essential ingredients of state power . Blake and Walters note that :

> Indigenous scientific and technological capability is widely associated with great power status in the world politics . (60)

And Gilpin concludes that in the modern era :

> Great Power status accrues only to those nations which are leaders in all phases of basic research and which possess the financial and managerial means to convert new knowledge into advanced technologies ...it appears unlikely that any nation or group of nations can ever again asp ire to a dominant role in international politics without possessing a strong , indigenous scientific and technological capability . International politics has passed from the era of traditional industrial nation states to one dominated by the scientific nation states .(61)

Technology, for realists , has therefore become a crucial source of power in the late twentieth century world .

Power is also important to realists in accounting for the nature of international order . Peace and stability in the international system , since the days of the concert of Europe , have , according to most realist analyses , arisen through the workings of the balance of power mechanism .(62) Whilst modern day neo-realists continue to accept the primacy of the balance of power they have also sought to explain the emergence of the myriad of international regimes , such as the international nuclear non-proliferation regime

, which bring order to whole areas of international and transnational activity .

International regimes , which can be broadly defined as international arrangements for governing inter-state and transnational activities in a given sector , bring states together into co-operative relationships to manage common problem areas . (63) But how do realists explain such cooperation , particularly the formation of international regimes , when they believe the world is characterised by anarchy ? The answer to this question , suggest neo-realists , is to be found in the role of dominant or hegemonic states who use their power to establish an international order which reflects and promotes their economic , political or security interests . (64) Thus , for instance , in the post-war period the United States , as the Western world's hegemonic power , established an international economic order which reflected its economic and political interests . Other states participated in this order not because they were compelled to but because it was in their national interests to do so . Thus international regimes come about not through altruism but because a hegemonic state (i.e. one which "...is powerful enough to maintain the essential rules governing inter-state relations and willing to do so") establishes a form of international order which is conducive to the maintenance of its primacy in world politics .(65) Nau , for instance , writes that in areas of technological cooperation :

> The advocacy of global machinery to manage new technologies may be in the interests of those who will produce most of the hardware and exercise most of the influence in global arrangements . Indeed , global

institutions created by dominant powers may often serve to perpetuate the influence of those powers far beyond the point where this influence is justified by real power .(66)

Accordingly , the existence of international regimes and cooperative structures does not signal , as some have argued , the rise of world government but rather illustrates the exercise of hegemonic power and the reality of rational self-interest . Keohane puts this well noting that :

> International regimes should not be interpreted as elements of a new international order beyond the nation-state . They should be comprehended chiefly a arrangements motivated by self-interest : as components of a system in which sovereignty remains a constituent principle .(67)

If power is a vital ingredient in realist explanations of international order it is equally as salient in their explanations of change . To realists such as Gilpin significant change in international politics is a product of the redistribution of power in the international system . (68) As the relative power capabilities of states alters so too does their position in the hierarchy of power . Thus Morgenthau writes that :

> ...it is inevitable that the leading industrial nations should be indentified with the great powers , and a change in industrial rank , for better or worse , should be accompanied or followed by a corresponding change in the hierarchy of power .(69)

This can have profound consequences for as the power of the hegemonic state is eroded it loses its ability to police the international regimes that it may have established . (70)

According to realist theories without a hegemonic power able to enforce the rules , international regimes tend to break down and international order evaporates unless a new hegemon arises and stamps a new vision of order upon the international system . Underlying this cyclical process

of the rise and decline of hegemonic powers in the international system is the constant redistribution of power which , it is suggested , is brought about largely through technological change . As Gilpin argues the :

> diffusion of military and economic technology from more advanced societies is a key element in the international redistribution of power ...At best , states can only slow the diffusion of the technology underlying their military or economic power ; they cannot prevent it , especially today in a world in which technology rests on easily accessible scientific knowledge .(71)

Since all states strive to acquire or develop both civil and military technology so as to enhance their relative power in the world there is a continuous process of technological diffusion . Technology , whether civil or military , is therefore of primary importance to realists in accounting for the nature and the processes of change in world politics .

Realists , however , deny strongly that technology has in any sense transformed the nature of world politics : the impact of technological change , they argue , reinforces rather than overthrows the fundamental laws of international politics . This is perhaps best illustrated , as Vogler suggests , by the voluminous literature which exists analysing the impact of nuclear technology upon the nature of world politics . (72) Whereas some scholars , such as Hertz , once argued that the advent of nuclear weapons brought with it the demise of the state because it was no longer able to protect its population , and others that war or the threat of war was no longer a rational instrument of state policy , convinced realists continue to argue that the advent of the nuclear age has not altered the basic rules of

international politics which have held since Greek times and before . (73) Nor do realists share the optimism of many liberals that technological advance is shrinking the world and bringing about greater political unity . On the contrary suggests Bull , instant communications highlight cultural and political differences and so contribute to heightening international conflict much more than cooperation .(74) As Morgenthau forcefully comments the ideological , political , and national divisions in the world have not been eradicated by technological progress :

> ...quite the contrary , the world is today further removed from moral and political unification than it was under much less favourable technological conditions .(75)

Technology , in this realist perspective , is therefore far from being an agent for the transformation of world politics .

To summarise . Realism asserts that technology is not an autonomous force in world politics but rather is simply one significant dimension of the struggle for power between states . Moreover , because technology is both a source and an instrument of national power , it is therefore subject to strong political control and direction by the state to ensure that it contributes to the achievement of national goals . As a result technology is conceived as subservient to the laws of international politics , to the struggle for power and security in a hostile world ; or in more technical jargon , in the realist perspective :

> ...political forces constitute the independent variables and technological phenomena constitute the dependent variables .(76)

Moreover , as Morgenthau has written , realists assert the autonomy of the political sphere of action and most would

autonomy of the political sphere of action and most would accept Kintner and Sicherman's view that :

> The dominant impact of technology on international politics is to reinforce sovereignty even as the problems engendered by technological advance expose the weaknesses of the nation-state concept.(77)

Realism is therefore highly pertinent to the empirical focus of this study , which explores the impact of civil nuclear technology upon international politics , since as Nau observed :

> Any study of the peaceful uses of atomic energy is likely to highlight the political factors promoting technological development . Because of its security implications , the development of civilian nuclear power was , at the outset , and , in considerable part ,still remains a primary activity of governments .(78)

1.2.4 The Liberal-Pluralist Perspective : The Primacy of Technology

Modernisation , according to Morse , has transformed the nature of international relations .(79) Technological and economic progress , he argues , have brought about a tightening web of global interdependence with the result that the fate of all states is bound together in the politics of ' spaceship earth ' . World politics is therefore concerned more with the management of interdependence than the pursuit of national power . Technology , it is suggested , has been crucial in forming the bonds of interdependence which link states and societies together . For the revolutions in communications and transport technology have contributed to and sustained a level and complexity of transnational activity which is dissolving the traditional boundaries between domestic and international politics . The political organisation of the

world into separate , sovereign nation-states is being challenged , it is argued , by the growth of transnational forces which are beyond the control of any single , even the most powerful , state .As Gilpin has pointed out , for liberal-pluralists , the modern problematique in world politics is defined in stark terms :

> International society , we are told , is increasingly rent between its economic and its political organisation . On the one hand , powerful economic and technological forces are creating a highly integrated transnational economy , blurring the traditional significance of national boundaries . On the other hand , the nation-state continues to command men's loyalties and to be the basic unit of political decision . As one writer has put the issue , ' The conflict of our era is between ethnocentric nationalism and geocentric technology .'(80)

This conception of an increasingly interdependent world , in which power is diffused amongst many organisations as well as states , may not be universal in its application . Indeed most pluralists recognise that it probably only describes the character of relationships between advanced industrial societies . As Joseph Nye indicated :

> It is when we look at relations between the advanced industrial societies that the state-centric realist assumptions are most misleading .(81)

Consequently Keohane and Nye , in their seminal work ' Power and Interdependence ' , devised an alternative framework to that of realism for trying to understand and explain the nature of contemporary world politics . (82)

Keohane and Nye characterise modern world politics in terms of ' complex interdependence ' . This describes an environment in which states are bound together in a powerful web of overlapping systems of political , economic , technological and cultural interaction . Rather than, as

in the realist perspective , states being conceived as discrete entities with a hard shell they are regarded in the pluralist perspective as increasingly penetrated by external forces and actors . Hoffman used a culinary metaphor to describe the nature of complex interdependence suggesting that in the traditional realist view :

> ...states were like boiled eggs . War , the minute of truth , would reveal whether they (or which ones) were hard or soft . Interdependence breaks eggs into a vast omelette .(83)

According to Keohane and Nye the world of complex interdependence exhibits three major characteristics : multiple channels of contact between states ; a fluctuating political agenda ; and the decline of military force as the determining factor in inter-state relations .(84) Each of these three characteristics will now be examined in a little more detail.

(1) Multiple Channels of Contact

In pointing to the reality of multiple channels of contact between states Keohane and Nye's analysis reflects the growing recognition , amongst many scholars in the 1970's , that the state was no longer the sole actor on the world stage , nor the monolithic entity assumed by realists .(85) Pluralists draw an important distinction between the state , broadly the sphere of public or governmental institutions , and civil society , generally taken to be the sphere of private activity . Though the distinction is a crude one pluralists utilise it to highlight the fact that relations between states are highly complex involving many different forms of interaction . Keohane and Nye distinguish between inter-governmental ,

transgovernmental , and transnational relations .

Inter-governmental relations refer to the formal official channels of interaction between states through Embassies and Foreign Office's . But juxtaposed with these formal interactions , pluralists point to the vast array of transgovernmental activity in which government departments develop their own regularised channels of contact and communication with their functional equivalents in foreign governments . Transgovernmental relations , according to Keohane and Nye , are defined as :

> ...sets of direct interactions among sub-units of different governments hat are not controlled or closely guided by the policies of Cabinets or Chief Executives of those governments .(86)

Thus , for instance , as Russell indicates Finance Ministries within the major Western countries are in constant contact with one another .(87) Such transgovernmental activity is particularly evident in highly technical areas where traditional diplomacy has given way to the technical experts .

One of the factors which has encouraged the massive expansion of transgovernmental activity in the post-war period has been the enormous explosion in the number of international organisations covering every conceivable aspect of inter-state relations . Through international institutions , such as the World Health Organisation or the International Atomic Energy Agency , the relevant experts representing different national governments come to develop very effective transgovernmental communication networks .

At a societal level pluralists identify a mass of transnational activity which cuts across national societies

linking them together in complex ways . Transnational relations includes not only interactions between national societies , such as trade or communications , but also the activities of transnational organisations , such as multinational corporations whose operations span many national economies .(88) Although transnational activity and transnational organisations have always existed what makes them so significant in the modern era , argue Keohane and Nye , is that they create interdependencies between societies which the governments of those societies attempt to 'manage ' because of the domestic political and economic consequences of failing to do so . (89) The advent of the welfare or interventionary state therefore has given transnational activity and transnational organisations a political salience and analytical significance which was not the case in previous historical epochs .

One of the consequences of these multiple channels of contact between states is to make it increasingly difficult to accept the realist view that the state is the only significant actor in world politics . Pluralists not only point to a plethora of other actors , such as transnational organisations and international institutions , but also question whether the state itself can be regarded as a monolithic rational actor, emphasising both the fact that governments are constituted by an array of bureaucracies , each with different responsibilities and interests , and the existence of a plethora of transgovernmental activity .

(2) A Fluctuating Political Agenda

Whereas realists conceive the international political agenda

to be dominated by power and security issues , Keohane and Nye argue that with the explosion in the number of actors in the world system there is no longer a clear hierarchy of issues .(90) In fact world politics encompasses a tremendously broad agenda since , as Hanreider and others have argued , the traditional distinction between high policy issues (power and security) and low policy issues (welfare) has been dissolved with the emergence of the welfare state .(91) Indeed some would argue that the international agenda has been ' domesticated ' as states try to cooperate with one another to manage the effects of international interdependence . (92) World politics is thus concerned as much with welfare issues , like trade , the environment , technological cooperation , health ,and so on , as it is with the question of warfare .

(3) The Decline of Military Force

The final factor which Keohane and Nye identify as creating the basis for complex interdependence is the declining utility of military force in relations between states .(93) Although they reject the notion that military force is no longer an important constituent element of world politics they argue that , in relation to the diversity of goals which states now pursue , military power can at best only play a marginal role in their achievement . Thus it would be entirely counterproductive for the United States to use or threaten to use military force against Japan in order to rectify its long-standing trade imbalance ; other instruments and forms of power therefore become crucial in an interdependent world . Moreover , the existence of nuclear weapons so heightens the risks involved in the use

of force between states that military power has lost the fungibility it had in previous historical periods . As Keohane and Nye comment " ...the recourse to force seems less likely now than at most times during the century before 1945 ."(94)

If military power is no longer the determining factor it once was in world politics then it follows also that , with the rise of new forms of power , actors other than states can come to exert a significant influence in world politics . Multinational corporations , for instance , often control immense industrial , economic and technological capabilities so giving them enormous potential power, should they care to exercise it , in their dealings with other international actors , be they states or international organisations . Terrorist groups too have demonstrated the political vulnerability of even the most militarily powerful states as well as usurping the traditional monopoly of states over the exercise of force . Complex interdependence therefore brings into relief the ability of non-state actors to exercise new forms and instruments of power in the pursuit of their own sectional interests .

Under the conditions of complex interdependence , which Keohane and Nye argue describes most convincingly relations between advanced industrial states , politics becomes a highly pluralist process in which cooperation replaces conflict as the dominant mode of behaviour . Because of the nature of interdependence between states and the consequent erosion of the distinction between foreign and domestic policy governments seek to establish co-operative

structures in order to achieve both domestic and international goals . Morse elaborates upon this profound change noting that :

> Conflictual or political activities , therefore , take place within the context of predominantly cooperative arrangements . Plays for power or position among ...modernized states occur in the non-zero- sum worlds of the IMF and NATO rather than in predominantly conflictual arenas .(95)

World politics in this perspective thus becomes a process of mutual adjustment , bargaining , and the exercise of power amongst both state and non-state actors conducted within over-arching structures of co-operation . Thus Keohane and Nye define world politics as :

> ...political interactions between any significant actors whose characteristics include autonomy , the control of substantial resources relevant to a given issue-area , and participate in political relations across state lines .(96)

Pluralists thus conceive of world politics in terms of a global system in which there are many different types of actors , where power and different power resources are widely diffused , and in which there are many arenas within which political interactions occur over a wide variety of issues .

As with pluralist analyses of domestic politics , so pluralist analyses of world politics slice up reality into discrete issue-areas or policy arenas . Within each issue-area , such as for example the international monetary issue-area or the international civil nuclear cooperation issue-area , the analytical focus is upon how the prevailing patterns of influence and power amongst the participants condition domestic as well as international policy outcomes . In effect pluralist analyses of world

politics are almost overwhelmingly concerned with explaining how the relationships of interdependence between the units of world politics are managed at the international level .

Interdependence is a central concept in the pluralist perspective . Oran Young defines interdependence as the :

> ...extent to which events occurring in any given part or within any given component unit of the international system affect ...events taking place in each of the other parts or component units of the system.(97)

But Keohane and Nye refine this notion further by introducing the concepts of sensitivity and vulnerability to differentiate between the mere interconnectedness of societies and societal interdependence .(98) Thus they distinguish between the state's sensitivity to external events meaning a :

> ...liability to costly effects imposed from outside before policies are altered to change the situation.(99)

and its vulnerability , meaning a :

> ...liability to suffer costs imposed by external events even after policies have been altered .(100)

An example might clarify this distinction . Compare the predicaments of the US and Japan during the Arab oil embargo in 1973 . Whilst the US was undoubtedly affected by the embargo , since only a small percentage of its oil imports came from the Middle East it was merely sensitive to rather than vulnerable to its continuation . Japan , on the other hand , was reliant on the Arabs for 80% of its oil imports ; it was therefore not just sensitive to the effects of the embargo but highly vulnerable . One source of power for actors in the international arena therefore comes from being able to manipulate the vulnerabilities and

sensitivities of other actors .

One of the consequences of interdependence is that it can create enormous problems for the management of domestic policy in advanced industrial states . For decisions and actions taken within one state can have dramatic and unintended repercussions for other states domestic arrangements or policies . Moreover , interdependence erodes the autonomy of states since to achieve even domestic policy objectives may require the cooperation of foreign governments or transnational actors . In effect interdependence brings about a certain loss of control by governments over whole areas of public policy . This is a profound challenge to the advanced industrial state which depends for its political legitimacy upon being able to deliver to its citizens sustained economic and technological progress . As a consequence in an attempt to exert greater control over transnational activity and the resultant interdependencies states are forced to create international regimes .

Regimes , as noted previously , are defined in terms of the sets of arrangements , norms , rules , principles , and sets of decision-making procedures which govern areas of international activity .(101) So for instance the nuclear non-proliferation regime consists of rules about the conduct of international nuclear commerce , norms of behaviour such as the peaceful use of atomic energy , principles like that of reciprocity and safeguards , and decision-making procedures in the form of the International Atomic Energy Agency and other forums of multilateral diplomacy such as the Nuclear Suppliers Group . The non-proliferation regime

therefore brings order , stability and predictability into one highly important issue-area and reconciles the desire of states and companies to exploit nuclear technology and nuclear trade without undermining international , as well as their own , security . In this pluralist perspective international regimes thus bring order into world politics . But how do pluralists explain the establishment of regimes ?

Unlike realists , who argue that regimes are created by hegemonic powers , most pluralist explanations highlight the functional necessities of international cooperation . Accordingly , regimes come about because it is in the interests of states to co-operate to manage the unintended consequences of interdependence or to reap greater benefits , such as heightened security or faster economic growth , through collective action than they could ever hope to achieve through national efforts alone . Thus Keohane suggests that :

> Whether a hegemon exists or not , international regimes depend upon the existence of patterns of common or complementary interests that are perceived or capable of being perceived by political actors . This makes common action to produce joint gains rational .(102)

and he goes on to state that :

> The dominance of a single great power can contribute to order in world politics , in particular circumstances , but it is not a sufficient condition and there is little reason to believe that it is necessary .(103)

Hidden within the intellectual foundations of this view is an implicit Mitranian functionalism , that needs and common problems are conducive to , if not the primary determinants of , international cooperation .(104)

This implicit functionalism also surfaces in pluralist accounts of processes of change . Pluralists tend to lay

enormous stress upon the role of technology in integrating the world and creating common problems for all states , such as for example pollution or proliferation , which can only be dealt with through collective action . Technology is overwhelmingly conceived as a force for political and economic integration which has its own dynamic and one which undermines the role of the state in world politics . States , it is often pointed out , cannot even protect their own populations from nuclear attack because of the nature of modern ballistic missile technology . In Young's view :

> ...rapid and continuous developments in a variety of areas such as communications , transport , and military technology have caused an effective shrinking of the world and have led to a situation in which the state , nation-state , and state system are increasingly obsolete and ineffective structures for the achievement of humanity's security and welfare .(105)

Therefore , as Skolnikoff argues :

> Global technology thus tends to force decision-making away from the decentralized national government level toward centralised international political machinery .(106)

Moreover , it is technology which is conceived as the engine of transnationalism . For as Huntingdon observes it is the advent of rapid and sophisticated global communications and transportation technology which underpins the existence of transnational organisations , such as the multinational corporation , and the existence of a global economy .(107) And in the cultural sphere the emergence of satellite and other communications technology has contributed to the global dissemination of cultural and ideological values on a scale never before imaginable . Modern communications technology too heightens the awareness and sensitivity of groups , politicians and

bureaucracies in one society to the domestic events , actions, and policies pursued in other societies with consequent implications for the conduct and nature of domestic political activity . For instance , in relation to the empirical study of this thesis , the widely reported nuclear related accidents in the United States in the 1970's provoked enormous opposition to nuclear power in Japan since the latter was reliant upon US nuclear power technology .

In the pluralist perspective technology is a prime ingredient of the changing nature of world politics and the growth of complex interdependence . Technological progress , which is largely perceived as an autonomous force in society , underpins what Morse refers to as the process of modernisation which he argues :

> ...has resulted in the integration of individual national societies , which face problems that can be solved in isolation with decreasing reliability . In other words , modernisation has transformed not only the domestic setting in which foreign policy is formulated ; by creating higher levels of interdependence among the diverse national societies , it has also transformed the general structures of international society .(108)

Or as Brezezinski concluded :

> Under the pressures of economics , science and technology, mankind is moving steadily towards large scale cooperation . Despite periodic reverses , all human history clearly indicates progress in this direction.(109)

To summarise . In the pluralist perspective technology is conceived as a major contributor to the transformation of world politics . Technological progress , it is argued , has established new actors , new issues , new arenas ,and new instruments of power thereby creating a more pluralistic and cooperative world in which a new form of world politics is

rapidly emerging .

This pluralist perspective would seem highly relevant to the empirical study of the thesis since relations between the United States and Japan appear to be characterised by the conditions of complex interdependence . The existence of multiple levels of contact between both societies , the extensive political agenda of cooperation , and the insignificant role of military force in their relationship would , at least on the surface , appear to describe a structure of complex interdependence . This perspective may therefore usefully offer a valuable explanation of the sources , nature and political ramifications of civil nuclear cooperation between both countries .

1.2.5 The Neo-Marxist Perspective : Technology as International Order

Whilst neo-Marxist studies of international politics tend to focus , like their liberal-pluralist counterparts , on the impact of modernisation upon states and societies the similarities end there .(110) For neo-marxists conceive of modernisation as essentially capitalist modernisation : an historical process which creates a global structure of inequality which in turn determines the nature of world politics . Although , as with the pluralist perspective , there are many different intellectual currents in neo-marxism there is a general acceptance that modern capitalism is now global in its scope . This world (or international) capitalist order is characterised by a world-wide system of production and exchange based upon multinational

corporate capital . And , it is argued , it has created a spatial division of the world into core , peripheral , and semi-peripheral centres of economic and political power .(111) Technology is perceived as a determining factor in assisting and reinforcing this structural division of the world , for it is the lifeblood which sustains and reproduces the dominance of core states , such as the United States , as well as multinational corporate capital , within this global capitalist order . In this neo-marxist perspective technology is therefore conceived as a mode and a mechanism of domination .

Whilst there is considerable debate within neo-marxist circles about whether or not the nature of contemporary international capitalism marks a new stage in the overall development of capitalism there is an acceptance that the current situation differs markedly from earlier periods .(112) In particular the growth of the multinational corporation in the post-war period has not only created a new international division of labour but also led to a world-wide system of production and exchange . This in turn has brought with it the internationalisation of banking and finance capital . As a result national economies have been increasingly penetrated and interconnected to such an extent that it is impossible for any state to control its own domestic economy . As Murray and Warren point out this economic inter-penetration is particularly evident amongst the advanced Western industrial states . (113) Like pluralists then neo-marxists point to a growing level of interconnectedness amongst national societies brought about by economic forces and transnational actors . However , they

explain its origins and consequences in radically different terms .

Most neo-marxists subscribe to the view that the emergence of world capitalism has been brought about by the international expansion of American corporate capital . In the aftermath of the second world war the US was the worlds dominant capitalist power and so reconstructed the international capitalist order to reflect the interests of American capital .(114) This facilitated the massive expansion of US multinational corporations abroad and in particular their penetration of other Western economies . Although there is disagreement about how one explains the push behind US corporate expansion abroad there is a general acceptance that it led to the restructuring of the global economy , bringing about the closer integration of national economic systems in the West and between North and South . (115)

In Sunkel and Fuenzelida's view contemporary world capitalism has a number of distinctive features . (116) Not only has it established a world market which integrates consumers and producers across the globe but also , through the massive expansion of multinational corporations , it is increasingly organising production on a world scale . This has encouraged in turn a new international division of labour in which corporate production activities are functionally and geographically differentiated . Thus management , research and development , finance , and all the highly skilled or capital intensive activities are concentrated in the advanced industrial countries whilst

manufacturing and other unskilled functions are carried out where labour is cheaper.(117) Whilst the global expansion of the multinational co-operation leads to an economic differentiation between the roles which national economies play in the world market it also links together those sectors of national economies which depend most heavily upon the continued expansion of world system of production and exchange . Thus the growth of world capitalism leads to a polarization in the domestic socio-economic structures of states as some social and economic sectors are integrated into the world capitalist order whilst other sectors are marginalized .(118) It is the high technology and financial sectors of national economies which are the most tightly integrated into this system of global production since they are so vital to the continued expansion of world capitalism .

Multinational corporations are regarded as the primary engines of this new world capitalist order. As Hymer notes :

> Through its propensity to nestle everywhere , settle everywhere , and establish connections everywhere , the multinational corporation destroys the possibility of national seclusion and self-sufficiency and creates a universal interdependence...It creates hierarchy rather than equality , and it spreads its benefits unequally .(119)

The global spread of multinationals thus creates a particular structure of relations between states . Whilst the core states benefit most from their activities this , it is argued , is only achieved at the expense of states on the world's periphery .(120) Multinationals thus establish relations of dependence between core and periphery states . But the continued dominance of multinational corporate

capital is reliant upon maintaining a high level of technological innovation to sustain the process of capital accumulation which funds corporate expansion . Since this requires vast research and development resources the role of the state , in core areas of the world , becomes crucial in providing both direct and indirect assistance to big business . Often this is channelled through defence contracts which support much advanced research and development in virtually all the high technology sectors of industry . There is therefore a strong symbiotic relationship between the state , multinational corporations , and technological innovation . The dominance of multinationals in the world market and core states in the world system is therefore attributable not just to their superior industrial , military or organisational capabilities but also to their ability to generate autonomous technological innovation .

The operation of this world capitalist system generates a complex matrix of relations between states and societies encompassed by the world system . On the one hand it creates a hierarchical relationship between core states and peripheral states in which the dominance of the former is based upon their vastly superior industrial , financial , and technological superiority . A structure of dependence is thereby erected in which the economic and industrial development of the :

> ...dependent nations occurs as are reflex of the expansion of the dominant nations , and is geared towards the needs of the dominant economies -i.e. foreign rather than national needs . in the dependent countries imported factors of production e.g. capital and technology ...become the central determinants of economic development

and socio-political life .(121)

On the other hand the expansion of world capitalism also brings about an increasing polarisation within all states between those sectors of society integrated into , and reliant upon , the existence and reproduction of transnational capital and those sectors largely reliant upon the maintenance and reproduction of national capitalism . (122) The development of world capitalism thus sets in motion a process of international or transnational integration combined with a process of national disintegration . But the development of world capitalism could not take place unless there was some form of international or world order which was conducive to its expansion .

As Cox , Wallerstein , Block and others have argued the phenomenal growth of world capitalism in the post-war period has been underwritten by US hegemony . (123) Through its military power it has secured a hospitable environment for the expansion of transnational capitalism . Moreover , because it was the dominant capitalist state it utilised its economic and political power to establish a liberal international economic order which contributed enormously to the extensive US multinational corporate penetration of all the major Western economies . But even though the regimes and order created under US direction initially benefited it the most this did not mean that they were the product of coercion or imposition by the hegemonic power . Far from it , for as Keohane and also Cox have argued , US hegemony relied upon an underlying consensus amongst Western states about the form which that world order should take .(124)

According to Keohane :

> American hegemonic leadership in the post-war period presupposed a rough consensus in the North Atlantic area , and later with Japan , on the maintenance of international capitalism , as opposed to socialism or a pattern of semi-autarchic national capitalisms . This consensus can be viewed , in Gramscian terms , as the acceptance by its partners of the ideological hegemony of the United States . Such acceptance rested , in turn , on the belief of leaders of secondary states that they were benefiting from the structure of order that was being created ... American leaders did not construct hegemonic regimes simply by commanding their weaker partners to behave by prescribed ways . On the contrary the had to search for mutual interests with their partners , and they had to make some adjustments themselves in addition to demanding that others conform to their design ...(125)

Thus in comparison with realist notions of hegemony which emphasise the importance of ' raw ' power in creating order , or pluralist notions which emphasise functional cooperation , neo-marxist explanations give weight to the ideological consensus which underpins international order . Thus Cox describes hegemony not , as do realists , in terms of the exercise of dominance but rather :

> A hegemonial structure of world order is one in which power takes a primary consensual form , as distinguished from a non-hegemonic order in which there are manifestly rival powers and no power has been able to establish the legitimacy of its dominance .(126)

Under this US inspired order international state structures , regimes and international organisations , were established to regulate growing interdependence and to police the international capitalist order . Thus the US , as Cox argues , institutionalised its hegemony by the creation of international regimes and international organisations which in effect internationalised the American state .(127) Policy processes became internationalised too as governments attempted to reconcile domestic demands with the expanding

requirements of a world economy . Moreover , the domestic structural arrangements of the US economy were internationalised as the symbiotic relationship between government , multinational business , and high technology was reflected in the determination of international policy outcomes :

> As national economies became more integrated into the world economy , it was the larger and more technologically advanced enterprises that adapted best to the new opportunities . A new axis of influence linked international policy policy networks with the key central agencies of government with big business . (128)

In this neo-marxist perspective there is therefore a very strong connection between the nature of the domestic production relations in the hegemonial state and the nature of the international order which it supports .

Whilst emphasis is placed upon the role of the US in maintaining a stable international order forces for change exist which tend to undermine this stability . As Hymer has argued the expansion of international production through the multinational corporation tends to create a process of uneven development .(129) By this he means that the benefits of international production are spread unevenly and that development on the periphery is heavily constrained by its dependence upon the core states . (130) In particular since technological innovation is centralised within the core states and the multinationals , prospects for autonomous economic and political development on the periphery are considerably constrained . But paraodoxically the diffusion of technology through international production leads also to the emergence of challenges to the hegemony of dominant powers . Thus Japan by the late 1960's , having adapted US

technology very effectively , began to erode the American primacy in the world economy . The decline of US economic power is thus conceived as a natural product of the workings of capitalism on a world scale . Competition and the process of capital accumulation makes it increasingly difficult for the hegemon to sustain its dominance as the spread of international production bring about new centres of economic power . World capitalism , like its domestic variant , thus contains its own internal contradictions .

But there is also a further dimension to change . For the economic and political burdens of being the hegemonic power lead , it is argued , to domestic crises which further undermine the hegemon's ability to sustain its dominant position in the world order .(131) Domestic factors and domestic politics thus come to play a significant role in shaping the hegemon's policies and actions rather than the overall needs of the world capitalist order being given primacy . In the 1971 economic crisis the Nixon administration , for instance , overthrew the rules of the international economic order in order to pursue specifically national economic interests . Domestic factors and socio-political forces are therefore emphasised very strongly , in the neo-marxist perspective , in explanantions of the hegemon's international role . Moreover , because of the integrated nature of the world economy any domestic crises or significant changes in domestic political or economic arrangments in the hegemonic state has dramatic consequences for all other societies .

In assessing the impact of technology and technological innovation upon world politics neo-

marxists analyses tend to converge upon three distinct points . Firstly , technology is conceived primarily as a mode of domination in the contemporary world . Those states and economies dependent upon foreign technology lose their autonomy and become dependent upon foreign capital . As Stewart notes :

> Technological dependence has as an important consequence a severe dilution of economic control...(132)

Technology thus reinforces the structures of dominance and dependence in world politics . Secondly , technology is regarded as a crucial element in the world capitalist order . Whereas technology , in the liberal perspective , is considered to bring progress and to create interdependence , in the neo-marxist perspective it is conceived as being harnessed completely to the expansion and reproduction of capitalism on a world scale .(133) Technology is therefore understood as a force which not only contributes to the spatial expansion of capitalism but also to deepening its roots in every ' nook and cranny ' in the world economy . Far from being a neutral ' tool ' technology is conceived as a powerful force for transforming and reordering societies to reflect the requirements of capitalism . Thirdly , and finally , the process of technological innovation is not perceived as autonomous but as geared totally to the process of capital accumulation . In crude terms , technology is subservient to the profit-motive .

To summarise . Neo-marxist approaches to world politics stress how the structure of the world economy and the

dynamics of world capitalism condition the nature of global political and economic development . Technology is conceived as both a force for change as well as for reinforcing the established structure of global economic relations . Thus the impact of technology on world politics is generally described , not in the lexicon of progress , but in terms of the extension and reproduction of the world capitalist order . How then might this perspective shed light upon the empirical study of this thesis ? Camilleri has one answer for he suggests the American inspired global dissemination of civil nuclear technology can only be understood as part of the consolidation of the post-war world capitalist order :

> ...quite apart from its Cold War implications , nuclear fission came increasingly to be seen by America's policy making elite as an important element in the post-war reconstruction of the international capitalist order and in the continued dominance of American economic and political power . Nuclear technology was thus integrated into an elaborate programme which sought to usher in a new phase of capital accumulation generating growth for the capitalist world as a whole while at the same time buttressing the monopoly position of US capital .The establishment of a technologically-complex , capital-intensive industry likely to yield cheap and abundant energy was deemed essential if the programme of capitalist expansion was to gain added impetus and proceed unhindered by considerations of future energy scarcity . (134)

The neo-marxist perspective thus offers a further potential insight into the development of the US nuclear industry , the impetus for its international expansion , and the political consequences of that expansion for those states , like Japan , which became reliant upon American nuclear technology .

1.3 Comparing the Perspectives on the Impact of Technology on World Politics

Each of the three perspectives offers distinctive insights

into the role and the impact of technology on world politics . This is because they slice into reality at different angles and their intellectual starting points are quite distinct . In many respects the perspectives are distinguished from one another more by the initial questions they ask than the answers they provide . Partly for this reason , and also because each embodies quite different methodological and epistemological approaches , there is no sense in which a ' grand synthesis ' of these perspectives could ever be created .(135) This is point about which there is probably unanimous agreement amongst the proponents of each perspective . But this does not mean that the search for understanding is therefore prematurely halted ; rather , as many political scientists have argued , comparing and contrasting the insights provided by different theories is one of the most useful ways to enhance our knowledge when there are no commonly agreed or externally imposed epistemological rules for judging between competing world views .(136) As Reynolds concludes :

> It is the contention of the author that , in so far as this field of study is concerned , the apparent choice of different modes of explanation , which hinges on the notion that one is more likely to lead to the truth than another , has no justification . The choice , as will be argued later in this work , is essentially one of taste . For while some arguments are better than others , no one argument contains the whole truth , and thus invalidates the rest .(137)

Having noted that both a synthesis and an objective validation of these perspectives appears impossible any intellectual effort seems best deployed in comparing them . The concern of this study is therfore largely to suggest the strengths and weaknesses of each of the perspectives both in

explaining the international expansion of the US nuclear industry and its political consequences and , at a more general level , in accounting for the impact of technology upon world politics .

1.3.1 Some Points of Comparison

Although each of the three perspectives slices into a complex reality from distinctive angles there are a number of specific themes upon which they all focus . These may usefully be compared since they have an important bearing upon the nature of this study .

All three perspectives have something valuable to suggest about the relationship between domestic politics and the nature of international politics . Whereas for realists the two are quite distinctive spheres of activity for the pluralist and neo-marxists they are irretrievably inter-connected . Pluralists consider the nature of modern interdependence to have broken down the barriers between domestic and international politics such that the separation of domestic policy from foreign policy appears as an illusion . Neo-marxists , on the other hand , conceive the symbiotic relationship between huge multinational corporate businesses and the state to be the determining factor in the formulation and implementation of both foreign and domestic policy . But for realists domestic factors are only significant to the extent to which they impinge upon the accumulation and exercise of state power .

Power is important in all three perspectives although how it is conceived and explained differs in each . Thus realists stress the primacy of military power ;

pluralists the fact that power is multi-dimensional and issue-specific ; and neo-marxists , structural notions of power based upon the position of a state or actor within the structure of world capitalism . There are in fact similarities here between realists and neo-marxists who point to the importance of the structure , or hierarchy of power, in the world in shaping the nature of world politics . They also agree that the sources of hegemony in the world system derive essentially from industrial , economic , technological and military might .

Hegemony raises the issue of order in world politics . Whereas for pluralists order is established and maintained through the creation of international regimes , which arise from the need of all states to manage the relationships of interdependence in which they are enmeshed , for realists stability comes about through the balance of military power and the imposition , by the hegemon , of its preferred form of international order . This has something in common with neo-marxist explanations of the nature of world order except that there are important differences . Neo-marxists not only stress that the world order is necessarily a capitalist one but also that international regimes arise out of an underlying ideological consensus about the nature of that order rather than simply the exercise of coercion by the hegemonic power .

Of course regimes and the world order are subject to change . In the neo-marxist and realist perspectives order and regimes decay because the inevitable redistribution of economic and military power in the world erodes the ability of the hegemon to police the system. But whilst both accept

the inevitability behind the redistribution of power each explains it as arising from radically different sources . In the neo-marxist perspective it is the consequence of the laws of motion of world capitalist development ; for realists the product of the competition for power amongst states in an anarchic system . Whilst pluralists too accept the inevitability of change they see its consequences not in terms of the erosion of order and decline of regimes but as quite the opposite . Modernisation , they argue , brings about increasing levels of international cooperation and thus greater order within the international system . Economic and technological change are conceived as transforming world politics into a more cooperative and orderly environment in which there is no requirement for a hegemonic power to establish or impose the rules in each issue-area since it is in the interests of all states to establish the collective management of collective problems . This is a radically different interpretation of the nature and consequences of international change .

There is some common ground between the perspectives on the question of state autonomy . The extent to which a state's behaviour, either domestically or in the international system , is determined by external forces is a matter of great debate within all three perspectives .(138) Most pluralists would argue that the webs of interdependence created by a global economic and political system effectively remove the states ability to control its domestic and foreign policies and so severely constrain its political autonomy , even though it still remains

sovereign . This is not a statement with which neo-marxists would entirely disagree since they consider the structure of the world economy imposes dependence upon some and so dissolves their political autonomy . However , they stress that it is dependence rather than interdependence which reduces state autonomy. Realists adopt a different position equating autonomy with power and the hierarchy of power in the world ; whilst no states are completely autonomous the higher up the power hierarchy , or the greater the relative power capabilities of the state, then the greater its autonomy . Moreover, realists emphasise the political importance of sovereignty and thus tend to disregard the neo-marxist and pluralist assertions that the autonomy of states in the domestic sphere can be undermined by international or external factors .

Finally , and most importantly given the focus of this study , the role ascribed to technology in each of the perspectives deserves some attention . In realist analyses technology is not ascribed any particularly special status rather it is conceived mainly as both an instrument and a source of state power . In this respect it is regarded as subservient to the struggle for power and security between states . Thus , for instance , the nuclear arms race is explained in terms the underlying military competition for power and advantage rather than as a product of a technological dynamic . Yet for pluralists technology operates as a transforming force in world politics but one which appears largely outside the control of politicians or the state . Indeed , there is a kind of latent technological determinism evident in the pluralist perspective , in which

technology is conceived as creating a ' global village ' in which cooperative structures replace the old decaying framework of inter-state relations . Modernisation it is suggested has transformed the nature of world politics into a game of complex interdependence , in which there are many players , many issues , and a diffusion of power , and in which cooperation , rather than conflict , is the norm . This vision of the world is very far removed from that of the neo-marxist perspective which conceives of technology as another medium through which capitalism , as an economic system , reproduces itself on a global scale . Technology in this perspective may bring ' progress ' but it is a particular form of progress which creates a global economic structure of dominance and dependence . Within this structure those states dependent upon foreign capital and technology lose much of their political autonomy and the scope for indigenous , self-generated economic development . In this perspective technology acts as a transmission belt for a particular mode of socio-economic organisation and for increasing the control of the hegemonic capitalist state over its subordinates . Accordingly , technology is conceived as ' legislating ' for a specific kind of world order : a capitalist world order .

This brief comparison of the three perspectives generates some interesting points of convergence and divergence . Although the appearance is one of competing perspectives the reality is much more complex ; the explanations they provide may , in some respects , complement rather conflict with one another . How then do

these perspectives connect to the empirical content of this thesis ?

1.4 The Transnational Expansion of the US Nuclear Industry

This thesis is concerned with isolating the forces which contributed to the massive international expansion of the US nuclear industry throughout the 1950's and 1960's . It also seeks to explore the impact of this internationalisation both upon US foreign atomic policy and the development of civil nuclear power industries abroad , specifically in Japan which , during the period of the study (1954-1974), was America's largest nuclear customer . In so doing one object is to assess how far each or any of the three perspectives introduced above can provide a convincing account of the events to be described . A second objective is to be able , if possible , to draw some general conclusions about the impact of technology on world politics .

1.4.1 The Nature and Logic of the Study

Ever since its discovery nuclear fission has presented somewhat of a Faustian bargain to mankind . On the one hand it offers the potential of a nearly infinite source of energy whilst on the other hand it has the most awesome destructive potential of any modern scientific discovery . The exploitation of this discovery in the technology of nuclear weapons and the technology of civil nuclear power are thus intimately connected . Consequently there must have been some very powerful reasons behind the determined US drive , throughout the 1950's and 1960's , to disseminate nuclear technology and materials , through

its Atoms for Peace Programme , on a scale never since repeated with any other technology .

The Atoms for Peace programme and its subsequent evolution over the years to 1974 pose a number of interesting puzzles to the student of international relations . In exploring this issue-area a number of questions constantly reappear : Was Atoms for Peace driven by commercial or security interests ? ; How did US foreign atomic policy throughout this period connect with domestic development of the civil atom ? ; Through what means did the US promote adherence to its evolving non-proliferation regime ? ; To what extent did the US government encourage and support the transnational expansion of the domestic nuclear industry ? ; What were the political and other consequences of reliance upon US nuclear technology ?

In the study which follows a careful historical examination of the forces shaping the domestic development of the US nuclear industry and its international expansion , together with its consequences for the development of nuclear power in Japan , will offer some firm empirical evidence from which the answers to these questions can be constructed . Moreover , at a higher level of enquiry , the study will provide a most vital opportunity to assess how far each of the three main perspectives introduced earlier offer convincing interpretations of the role and impact of technology upon contemporary world politics . These two different levels of enquiry therfore form the ' intellectual boundaries ' which structure this study .

1.5 Organisation of the Study

The study is organised into three related but distinct parts . Chapters 2 and 3 explore the relationship between government and industry in the development of civil nuclear power in the United States during the period 1945 to 1974 . These chapters examine the tensions between national security demands and the desire of private industry to exploit the new technology for profit . They also explain how the US created the industrial basis for its technological and commercial hegemony in the world nuclear market . Chapter 4 analyses the forces which assisted and promoted the transnational expansion of the domestic nuclear industry . It explains how the conflict between non-proliferation and commercial objectives was resolved in the evolving non-proliferation regime ; how the US utilised its hegemonic position to mold that regime to reflect its own commercial and security interests ; and highlights the intensely complex relationship between domestic and foreign atomic policy . Finally , Chapter 5 explores the political consequences of reliance upon US nuclear technology , and US corporate penetration of national nuclear industries , by focusing upon Japan . It is concerned with evaluating how far reliance upon foreign technology and capital compromised its political autonomy in the nuclear issue-area . The study then returns , in Chapter 6 , to the three perspectives , and the questions introduced above , in an effort to discover what light each sheds upon the international politics of the civil atom .

CHAPTER ONE FOOTNOTES

(1) Winner Langdon Autonomous Technology MIT Press London 1977 p4

(2) See Habermas J. Toward a Rational Society Heneiman London 1971 ; Marcuse H. One-Dimensional Man Beacon Books New York 1964 ; and Ellul J. The Technological Society A.Knopf New York 1964 . On the post-industrial society see Bell D. The Coming of the Post-Industrial Society Peregrine London 1979 .

(3) On this point see Vogler J. ' Technology and Change in International Relations ' in Buzan B. et al eds. Change and the Study of International Relations Frances Pinter London 1981 . Kintner and Sicherman make the same point too . See Kintner W.R. and Sicherman H. Technology and International Politics Lexington Books London 1975

(4) ibid p34

(5) ibid and Granger J.V. Technology and International Relations W.H.Freeman San Francisco 1979

(6) See Nau H. National Politics and International Technology John Hopkins University Press Baltimore 1974

(7) Vogler op cit

(8) Kintner and Sicherman op cit p139

(9) Quoted in Winner op cit p9

(10) Winner op cit p9-13

(11) ibid p11

(12) ibid p12

(13) ibid p12

(14) This is the case with works such as Morse E. Modernization and the Transformation of International

Relations Free Press new York 1976 and Sprout H. and Sprout M. Towards a Politics of the Planet Earth Van Nostrand New York 1971

(15) See Banks M. ' The Inter-Paradigm Debate ' in Light M. and Groom A.J.R. International Relations Frances Pinter London 1981

(16) Nau op cit p246

(17) On this notion of paradigm and crisis in the study of international relations see Banks op cit and Lijphart A. ' The Structure of the Theoretical Revolution in International Relations ' International Studies Quarterly v18 no 1 March 1974 pp41-74 as well as Pettman R. Human Behaviour and World Politics MacMillan London 1975.

(18) See Puchala D. and Fagan S. ' International Politics : The Search for a Perspective ' International Organisation v28 no. Spring 1974 pp247-266

(19) This is reflected in the volume by Maghoori R. and Ramberg B. Globalism versus Realism - International relations Third Great Debate Westview Press Boulder 1982 . See especially ch.1

(20) see Lijphart op cit

(21) see Knorr K. and Rosenau J. eds. Contending Approaches to International Politics Princeton University Press Princeton 1969

(22) See the essays by Bull and Rosenau in ibid

(23) As Reynold's and others have pointed out this clash of views was based upon very idealistic notions of what constituted historical and scientific explanation . See Reynolds C. Theory and Explanation in International Politics Martin Robertson London 1973 Ch1 to 3

(24) See Vasquez J.A. The Power of Power Politics Frances Pinter London 1983

(25) See Pettman op cit p18

(26) On the post-behavioural outlook see Easton D. ' The New Revolution in Political Science ' American Political Science Review v58 no4 December 1969 pp1051-1061 . On the developments in Marxism see Carnoy M. The State and Political Theory Princeton University Press Princeton 1984 .

(27) Puchala and Fagan op cit

(28) Lijphart op cit .

(29) Puchala and Fagan op cit

(30) See Keohane R. and Nye J. Power and Interdependence Little Brown Boston 1977 . Their earlier edited work Keohane R. and Nye J. eds. Transnational Relations and World Politics Harvard University Press 1971 was also path-breaking in its own way .

(31) See Morse op cit and Hanreider W. ' Dissolving International Politics : Reflections on the Nation-state ' American Political Science Review v72 no 4 pp1276-1287

(32) On these developments see Holsti K.J. The Dividing Discipline : Hegemony and Diversity in International Theory Allen and Unwin London 1985 ch 4.

(33) ibid

(34) Puchala and Fagan op cit

(35) Maghoori and Ramberg ch1 op cit

(36) see Holsti op cit Ch1 , 5 and 7

(37) See Smith S. ' International Relations Theory '

Teaching Politics 1985 ; Banks op cit ; and McKinlay D. and Little R. Global Problems and World Order Frances Pinter London 1986 .

(38) Banks believes it is a sign of progress .

(39) ibid

(40) On this point see McKinlay and Little op cit Ch 1 and also Garfinkel A. Forms of Explanation Yale University Press London 1981

(41) See McKinlay and Little op cit

(42) See his The Structure of Scientific Revolutions Chicago University Press 1970 ; for an application of his approach to international relations theory see Lijphart op cit

(43) See the discussion in Masterman M. ' The Nature of a Paradigm ' in Lakatos I. and Musgrave A. eds. Criticism and the Growth of Knowledge Cambridge University Press Cambridge 1970 . And also see Pettman op cit pp6-13

(44) Their most important works are probably : Morgenthau H. Politics among Nations A.Knopf New York 2nd edition 1967 ; and Thompson K. Political Realism and the Crisis of World Politics Princeton University Press Princeton 1960

(45) On this see Wight M. Power Politics Penguin London 1986 ch 8 and also Waltz K. Theory of International Politics Addison -Wesley New York 1979

(46) Morgenthau op cit ch1

(47) See Blake D. and Walters R. The Politics of Global Economic Relations Prentice-Hall New York 1976 p145

(48) Morgenthau op cit p113

(49) See Carr E.H. The Twenty Years Crisis MacMillan London 1962

(50) See Keohane R. ' Theory of World Politics : Structural

Realism and Beyond ' in Keohane R. ed. Neorealism and its Critics Columbia University Press New York 1986

(51) ibid

(52) This is quoted in Dougherty J. and Pfaltzgraff R. Contending Theories of International Relations J.B.Lippincott New York 1971 p83

(53) See Bull H. The Anarchical Society MacMillan London 1977 p264

(54) See Gilpin R. ' Transnational Economic Relations ' in Keohane and Nye eds. 1971 op cit

(55) This is discussed in his seminal work Allison G. Essence of Decision Little Brown Boston 1971 Ch1

(56) See Krasner S. Defending the National Interest Princeton University Press Princeton 1978 p320

(57) Kintner and Sicherman op cit p139

(58) This is to be found in Taylor T. ' Power Politics ' in Taylor T. ed Approaches and Theory in International Relations Longman London 1978

(59) Morgenthau op cit p114

(60) Blake and Walters op cit p145

(61) quoted in ibid

(62) On the balance of power mechanism consult the excellent work by Clark I. Reform and Resistance in the International Order Cambridge University Press Cambridge 1981 and also Claude I. Power and International Relations Random House New York 1962 .

(63) On the definition of regimes consult Young O. ' International Regimes ' World Politics v32 1980 p331

(64) This is described as hegemonic stability theory and was

initially raised in Keohane and Nye op cit 1977 . A detailed discussion of this theory can be found in Keohane R. ' The Theory of Hegemonic Stability and Changes in International Economic Regimes ' in Holsti O. ed Change in the International System Westview Press Boulder 1980 . for a critique see Snidal D. ' The Limits of Hegemonic Stability Theory ' International Organisation v39 Autumn 1985 pp579-614

(65) Keohane and Nye op cit p44

(66) Nau op cit p31

(67) See Keohane R. After Hegemony Princeton University Press Princeton 1984 p63

(68) This is discussed at length in Gilpin R. War and Change in World Politics Cambridge University Press Cambridge 1981

(69) Morgenthau op cit p113

(70) This , as Keohane discusses , is one of the primary predictions of hegemonic stability theory . See Keohane 1984 op cit ch 3 .

(71) Gilpin 1981 op cit p177

(72) See Vogler op cit

(73) See Gilpin 1981 op cit and Waltz op cit

(74) See Bull op cit p 275

(75) Morgenthau op cit p253

(76) Nau op cit p23

(77) Kintner and Sicherman op cit p144

(78) Nau op cit p33

(79) Consult Morse op cit

(80) See Gilpin in Keohane and Nye eds. 1971 op cit

(81) Nye in Goodwin G.L. and Linklater A. eds. .

New Dimensions of World Politics Croom Helm London 1975 p37

(82) Consult Ch 1 and 2 of Keohane and Nye 1977 op cit

(83) Hoffman S. Primacy or World Order McGraw-Hill New York 1980 p117

(84) This is discussed more fully in Keohane and Nye 1977 op cit Ch2

(85) On this see : Wagner R.H. ' Dissolving the State : Three Recent Perspectives on International Relations ' International Organisation v28 no 3 1974 pp435-467 ; Mansbach R.W. , Ferguson Y. and Lampert D. The Web of World Politics - Non-State Actors in the Global System Prentice-Hall New York 1976 ; Rosenau J. ' International Studies in a Transnational World ' Millenium v5 no1 Spring 1976 pp1-20 . For a critique of this emphasis upon transnationalism see : Northedge F. ' Transnationalism : the American Illusion ' Millenium v5 no 1 Spring 1976 pp21-27

(86) See Keohane R. and Nye J. ' Transgovernmental relations and International Organisation ' World Politics v27 October 1974 no 1 pp39-62

(87) Consult Russell R.W. ' Transgovernmental Interaction in the International Monetary System ' International Organisation v27 no4 Summer 1973 pp431-464 .

There are also other valuable studies of transgovernmental activity :

Meltzer R.I. ' The Politics of Policy Reversal ' International Organisation v30 no 4 1976 p469

Sundelius B.A. ' Transgovernmental Interactions in the

Nordic Region ' Cooperation and Conflict v12 1977 pp63-85

Keohane R. ' The IEA : State Influence and Transgovernmental Politics ' International Organisation v32 no 4 1978 p929

(88) On this consult Huntingdon S. ' Transnational Organisations in World Politics ' World Politics v25 April 1973 pp333-368

(89) See Keohane and Nye 1971 op cit p375

(90) See Keohane and Nye 1977 Ch 2 op cit

(91) This is posited by Hanreider op cit and also Morse op cit .

(92) This is Hanreider's (ibid) view . But also see the interesting article by Paarlberg R. ' The domestication of American Foreign Policy ' Public Policy v18 no2 1970 pp245-264

(93) Keohane and Nye 1977 op cit p27

(94) ibid p29

(95) Morse E. ' The Transformation of Foreign Policies ' World Politics v22 no 3 1970 pp371-392

(96) Keohane and Nye 1971 op cit p379

(97) Young O. ' Interdependencies in World Politics ' International Journal v24 1969 pp726-750 . But see also : Morse E. ' Interdependence in World Affairs ' in Rosenau J. ed et al World Politics Free Press New York 1976 ; Cooper F. The Economics of Interdependence McGraw-Hill New York 1968 ;

Rosecrance R. and Stein A. ' Interdependence : Myth or Reality ? ' World Politics v26 no1 October 1973 p1-27 . For a critique of the notion of growing interdependence see : Waltz K. ' The Myth of National Interdependence ' in

Kindleberger C. ed The International Corporation MIT Press Boston 1970

(98) See Keohane and Nye 1977 op cit p8-13

(99) ibid p13

(100) ibid

(101) This is how they are defined by Keohane and Nye 1977 op cit but for a more contemporary and detailed discussion of definitions see : Young O. ' Regime Dynamics - the Rise and Fall of International Regimes ' International Organisation v36 no2 1982 pp277-297 ; and Keohane 1984 Ch 4 op cit

(102) Keohane ibid p78

(103) ibid p46

(104) Functionalism is a theory which suggests that modernization and the existence of common human needs is a powerful force for creating collective and cooperative action in a world of sovereign nation-states . Moreover it goes on to suggest that as the benefits of international cooperation become obvious to citizens their allegiance to the nation-state will gradually be transferred to those international organisations which provide for their welfare . See Mitrany D. The Functional Theory of Politics Martin Robertson London 1975 ; Taylor P. and Groom A.J. R. eds Functionalism University of London Press London 1975 ; and Pentland C. ' Functionalism and Theories of International Political Integration ' in Groom and Taylor .

(105) Young 1969 op cit

(106) See Skolnikoff E. Science , Technology , and American

Foreign Policy MIT Press Boston 1967 p312

(107) Huntingdon op cit

(108) Morse 1970 op cit

(109) Quoted in Nau op cit Ch 1

(110) They focus upon the creation of dependence and underdevelopment rather than progress . See Holsti op cit ch 4

(111) This is taken from Wallerstein op cit . But see in the light of his critics his recent discussion of this structure in Wallerstein I . Historical Capitalism Verso London 1983

(112) On this debate consult : Brewer A. Marxist Theories of Imperialism RKP London 1980 ; Owen R. and Sutcliffe B.eds Studies in the Theory of Imperialism Longman london 1975 ; and Rowthorn R. ' Imperialism in the 1970's - Unity or Rivalry ? ' in Radice op cit.

(113) See Murray R. ' The Internationalisation of Capital and the Nation-state ' and Warren B. ' How international is capital ? ' both in Radice op cit

(114) This is the view of neo-marxists such as Mandel , Wallerstein and Arrighi . See Mandel E. Europe versus America ? Contradictions of Imperialism Verso London 1972 ; Wallerstein 1983 op cit ; Arrighi G. ' A Crisis of Hegemony ' in Amin S. Dynamics of Global Crisis MacMillan London 1982

(115) This is discussed in Sunkel O. ' Transnational Capitalism and National Disintegration in Latin America ' Social and Economic Studies v22 no1 1973 pp132-176

(116) See Sunkel O. and Fuenzelida E. ' Transnational Capitalism and National Development ' 1977 mimeo

(117) On this see Hymer S. ' The multinational corporation and the law of uneven development ' in Cohen R. et al eds . The Multinational Corporation - A Radical Approach Papers by S.H.Hymer Cambridge University Press Cambridge 1979

(118) Sunkel op cit

(119) Hymer op cit

(120) See Wallerstein 1983 op cit

(121) Bodenheimer S. ' Dependency and Imperialism : The Roots of latin-american Underdevelopment ' Politics and Society v1 no 3 1971 pp327-357

(122) Sunkel op cit

(123) On this question of the role of US hegemony see Cox R.W. ' Gramsci , Hegemony and International Relations 'Millenium v12 no2 1983 pp162-175 ; Wallerstein I .The Politics of the World Economy Cambridge University Press Cambridge 1984 ; Block F. The Origins of International Economic Disorder University of California Press Berkeley 1977.

(124) Keohane 1984 op cit Ch 3 , p137-138 ,p177-179 ; and also Cox R.W. ' Social Forces , States and World Orders : Beyond International Relations Theory ' Millenium v10 no2 1981 pp126-155

(125) Keohane 1984 op cit p138-139

(126) Cox 1981 op cit

(127) ibid

(128) ibid

(129) Hymer op cit

(130) ibid and see Bodenheimer op cit

(131) This is discussed in Keohane 1984 op cit and Arrighi op cit

(132) See Stewart F. Technology and Underdevelopment MacMillan London 1978 p138

(133) Hymer op cit

(134) Camilleri J. The State and Nuclear Power Harvester Press Brighton 1984 p35

(135) On this point see Holsti op cit Ch 4

(136) This is discussed in Reynolds op cit Ch2 and Ch9

(137) ibid p24

(138) On the question of the autonomy of the state see the excellent analysis in relation to domestic politics in : Nordlinger E. The Autonomy of the Liberal Democratic State Harvard University Press Cambridge Mass. 1981

Chapter Two - Establishing a Framework for Domestic Development of the Civil Atom

One of the immediate, but little recognized, challenges to American democracy in the early post war years was not so much the Soviet threat as the military atom. Developed in total secrecy under the complete control of the President and the military, the Manhattan project contravened many of the basic liberal-democratic principles upon which the Republic had been founded. With the defeat of Japan, in the aftermath of the bombing of Hiroshima and Nagasaki, attention was directed at tackling the difficult problems of integrating the military atom into civil society and to establishing the purposes to which this awesome technology was to be put. This chapter seeks to explore how and why the state, in such a predominantly free enterprise economy, came to acquire the directive role that it did in the structure of domestic control and the development of the civil atom. Moreover, throughout particular emphasis is given to the consequences of the visible tension between national security requirements and the civil exploitation of atomic energy. In relation to the latter, this chapter attempts to explain how the demands of private enterprise and the political pressures to forge ahead rapidly with the development of nuclear power led, within less than a decade, to radical alterations to the framework of domestic control of atomic energy erected in the immediate post war years.

2.1 The Politics of Immediate Post War Control

Even before the first atomic bomb had destroyed Hiroshima, in August 1945, planning for the post-war [domestic and international] control of the atom had become a salient issue on the agenda of American policy makers. From 1942 development of the atomic bomb had been the sole preserve of General Leslie Groves and his Manhattan Engineering District team.(1) But as the

objectives of the Manhattan 'project' inched closer to realization concern about the key issues of post war development and control of atomic energy began to surface amongst many of those who were attached to the project; as well as amongst those chosen few, like Vannevar Bush and James Conant, (upon whom the President depended most for advice on atomic energy matters), who had a knowledge of it. In an attempt to shape the official policy agenda two reports were commissioned, in late 1944, from scientists working within the MED. These reports were to examine: the direction of post war nuclear research; the industrial possibilities for nuclear energy; and the crucial question of control.(2)

In November 1944 the first of the reports, the 'Prospectus on Nucleonics' (or the Jeffries report as it became known), was completed. It recommended both international control of the atom and simultaneously the need for the United States to maintain supremacy in all aspects of atomic energy development. It also suggested that there were likely to be many civil uses for atomic energy and specifically for electricity generation. In this regard it is interesting to note that the report talked in terms of an independent, ipso facto 'private' nuclear industry.(3) The Tolman report, the second of those commissioned, also came to similar (although more detailed) conclusions about the prospects for post war atomic energy utilization and mechanisms of control. In particular, the Tolman Committee was exercised mainly by the problem of domestic control, which it envisaged as being discharged by a Federal Government authority, rather than international control upon which it avoided commenting. Both reports, however, sketched out the possibilities for post war development of the atom, particularly its industrial applications, and raised explicitly the political question of domestic organization and control of the atom. Although the reports had little observable impact on policy formulation they did help to legitimize the determined efforts of Bush and Conant to orientate American government and military thinking towards domestic and

international strategies for managing the impact of the inevitable atomic 'revolution'.[4]

It was essentially the international situation and the politics of inter-allied diplomacy which determined the pace and the focus of policy discussions on the atomic issue throughout 1945. Following the Yalta Conference of February 1945, the President came under increasing pressure to accept international control, rather than denial and secrecy as the solution to the acute policy dilemma which faced the United States. Simply stated that dilemma involved not wishing to give away the atomic 'secret' but at the same time not wishing to endanger, through a unilateral policy of denial and secrecy, the increasingly fragile inter-allied cooperation which was regarded as essential to the creation of Roosvelt's new post war international order.[5] Roosvelt died, however, without making any firm policy commitment to international control and before policy had chrystalized within the elite band of atomic policy makers. Thus when Truman was sworn in and informed of the atomic bomb (about which he was entirely ignorant) one of his immediate actions was to establish an Interim Committee to survey and report on the problem of international and domestic control of the atom.[6]

Military developments, however, snatched control over the pace and direction of post war atomic planning, from the Interim Committee. The most momentous and shattering development was the dropping of Little Boy on Hiroshima on the morning of August 6th 1945, followed by the attack, with a plutonium bomb, on Nagasaki three days later. Immediately the question of the control and use of atomic research was forced into the public arena. Maintaining the wartime system of military control of the atom under a shroud of secrecy, was challenged by the demands of Congress, scientists, and the public to make the atom subservient to the democratic system.[7]

In an attempt to educate public opinion about the technicalities of the bomb the administration allowed publication of the Smyth Report.[8]

Whether intentional or not publication ensured that accusations of technical or scientific ignorance could not legitimately be used as a means to exclude politicians, and the wider public, from participation in any decision making concerning the dissemination and use of this awesome technology. As Hewlett and Anderson commented:

> The ultimate responsibility for the nation's policy on the questions raised by atomic energy rested with its citizens. Heretofore, military security had restricted their consideration to the scientists and a few high officials. Now the great political and social questions that might affect all mankind for generations were open for the people to debate and decide through their elected representatives. Men of science, Smyth hoped, would use the present semi-technical account to explain the potentialities of atomic bomb to their fellow citizens and help them reach wise decisions ...Here lay the real significance of the Smyth Report.(9)

Whilst the public and Congress digested the report, the War Department, in consultation with the Interim Committee, was engaged in drafting legislation for the domestic control of atomic energy.(10) Although a bill was to be introduced with the opening of Congress, in September 1945, the President delayed forwarding it until major differences between the State Department and War Departments' drafts were reconciled.(11) This delay also provided an opportunity to canvass Congressional opinion on a number of procedural and presentational matters.(12) It was therefore not until October 3rd 1945 that the President, with a bold statement to Congress of the administration's policy on post war control of the atom, initiated one of the most significant national debates in American history.

2.1.1 The 1946 Atomic Energy Act

The administration's draft legislation was introduced into Congress by Representative May and Senator Johnson following the President's address. Immediately procedural problems came to the fore since no single Congressional committee had jurisdiction over its content. As a result a young Democratic Senator from Conneticutt, Brian McMahon, successfully introduced into the Senate a resolution calling for the creation of a

Special Committee on Atomic Energy.[13] It later proved to be the forerunner to the powerful Joint Committee on Atomic Energy.

Hearings on the administration's bill, or as it became known the May - Johnson bill, generated considerable public controversy which, in turn, mobilized and fused together disparate organized interests into a coherent alliance against its passage. Opponents of the bill argued that it would involve an excessive degree of military control over the atom and that the mechanisms for Congressional oversight of atomic energy matters were insufficient, if not non-existent. As Hewlett and Anderson note:

> Under persistent questioning, Bush admitted that except for power over appropriations and the basic act, Congress would divest itself of all control over atomic energy. (14)

This, combined with the fears about military control, was sufficient to ensure united opposition to the bill from both the scientific community, which had spawned the Federation of Atomic Scientists on October 31st 1945 to lobby against the bill, and those Congressmen deeply concerned by its constitutional and democratic implications. Congressional deliberations on the May - Johnson bill provoked a major national debate since the legislation appeared to flout some of the most basic constitutional principles of American liberal democracy. Commenting upon the bill, Allardice and Trapnell emphasise the deep public suspicions that were aroused during the hearings:

> In its efforts to get from General Groves a whole lot more information than he thought they needed, the Committee ran head on into what some considered the arch-military resistance to public participation in the business of government. (15)

Added to these suspicions, many scientists recognized the restrictions which would be placed upon the peaceful uses of atomic energy if the proposed degree of military participation in the control of the new technology remained unaltered.(16) Nor did the bill deal adequately with the critical problem of international control. Indeed there was an explicit assumption that the two should be kept quite separate; General

Groves himself had noted in testimony to the Special Committee that,

> We must recognize the clear distinction between domestic control and international control. The two can and should logically be separate. (17)

This statement provided further ammunition for those, like the atomic scientists, who opposed the bill because it would damage efforts to achieve international control. Given the enormous opposition to the May-Johnson Bill it seems hardly surprising that McMahon began drafting competing legislation. This was introduced formally into the Senate on December 20th 1945. Shortly thereafter the administration withdrew its backing and support for the May-Johnson legislation (once defeat looked imminent) and the McMahon Bill took center stage in the Congressional debate.

Initial hearings on the McMahon bill were held in January 1946 and lasted through until April when an ammended version was reported out of the Special Committee.(18) From this stage the bill's passage was still not guaranteed since a controversy raged over several of its important proposals sections.(19) Three major issues came to dominate the Congressional and broader public debate on the bill: military versus civilian control of the atom; public versus private development of atomic energy; and international control.

Whilst the arguments for military control of the atom had been swept away with the demise of the May - Johnson bill, the Army and War Department launched an aggressive lobbying campaign against the McMahon bill. Not only did the military desire greater control over the new Atomic Energy Commission than that outlined in the bill, but also greater restrictions on the dissemination of all information on atomic matters. Such restrictions were opposed vehemently by scientists and industrialists since it was recognized that they would cripple independent scientific research as well as the peaceful exploitation of the atom. A compromise on these issues was reached: the new Commission would remain civilian in nature whilst being advised on the military applications of atomic energy

by a Military Liaison Committee. But the bill's emphasis upon dissemination of nuclear technology and knowledge was replaced by an emphasis upon denial and control. This had considerable congressional support since the recent arrest of 22 persons in Canada on charges of releasing 'bomb secrets' to the Russians had created a certain degree of hysteria, further encouraged by reports of Soviet intransigence and actions in Europe, so legitimizing the military's case for denial and secrecy.(20)

This change in Congressional mood impacted directly on the further question of public versus private exploitation of atomic energy. Once the emphasis shifted to denial and control, as opposed to the dissemination of scientific information, the prospects for independent research or private exploitation of atomic energy became increasingly negligible. So arose an inherent contradiction between the military's demands for security and the requirements of a private enterprise economy; a contradiction which was later responsible for a radical restructuring of the public-private relationship established by the McMahon bill.

What provoked the most vigorous debate was the bill's provision for public ownership of all nuclear materials, technology, and the outlawing of private patents in the nuclear field. Such controls meant that the exploitation of nuclear power would be a public monopoly, a situation which appeared antithetical to the core values of the American economic system. Nonetheless, equipped with arguments about national security requirements, together with arguments about the need to ensure that a private monopoly did not emerge from those corporations which, as a result of the Manhattan project, had privileged access to nuclear technology, proponents of a public monopoly were on safe political territory.(21) Even the most conservative members of Congress, which in 1946 was dominated by Republicans, supported the concept of a public monopoly. One of the key drafters of the bill later remarked on:

> the curious paradox that conservative men, actuated by the most profoundly conservative of all emotions, the desire to achieve security, were forced to resort to the radical expedient of state socialism.(22)

Finally, the most 'vital' political issue raised by the McMahon bill was that of international control of the atom: vital, at least for many, since they perceived in such plans the potential for a revolutionary transformation in the nature of international politics. But for the framers of the McMahon Bill this historic design was transcended by a more mundane technical problem: that of the precise relationship between the set of domestic controls, as laid down in the bill, and an as yet unknown system of international controls which might, or might not, be agreed within the United Nations. Whilst American policy on international control had been fully debated in Congress, following the publication of the famous Acheson-Lilienthal report, and proposals had been presented to the UN on June 14th 1946 by the US Special Representative Bernard Baruch, there was no possibility of accurately predicting the final outcome to the UN negotiations.(23) Yet there remained an urgent need to press ahead with domestic legislation. This posed a delicate political problem for the proponents of international control, (amongst whom were the President, key Congressmen and members of the administration), since it became crucial to ensure that the framing of domestic legislation did not, or could not, prejudice either negotiations for, or any possible agreement upon, measures of international control. If not a contradiction here was an explicit political tension between the necessity for domestic organization of the atom, underwritten as it was by immense organized political pressure, and an equally felt desire for an international framework of control. As might be expected the resolution of this tension between conflicting demands and interests, was expressed in a compromise amendment to the bill which the Senate Report noted:

> provides that to the extent any provision of the bill ... conflicts with the provisions of an interntional arrangement hereafter approved by the Senate or the Congress, the provision is to be considered of no further force or effect.(24)

In essence then domestic control over the atom would not contradict future international controls but the former were to remain solidly in place until agreement on the latter had been ratified by Congress.

On July 26th 1946 a Conference report on the McMahon bill was agreed by both the Senate and the House. The three major controversies which had both fuelled Congressional debate on the McMahon bill, and had helped determine the structure of domestic control, were laid to rest as the heavily amended bill was signed into law by the President on August 1st 1946. This new law (PL 79-585) established the basic administrative structure of domestic control over atomic energy; a structure which had a decisive influence upon the development of civil nuclear power in the United States in the ensuing three decades. It is upon this basic structure that the chapter now sharpens its focus.

2.2 The Structure of Domestic Control

The major aims of the McMahon Act, as laid down in its preamble, were:

> subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise and promoting world peace.(25)

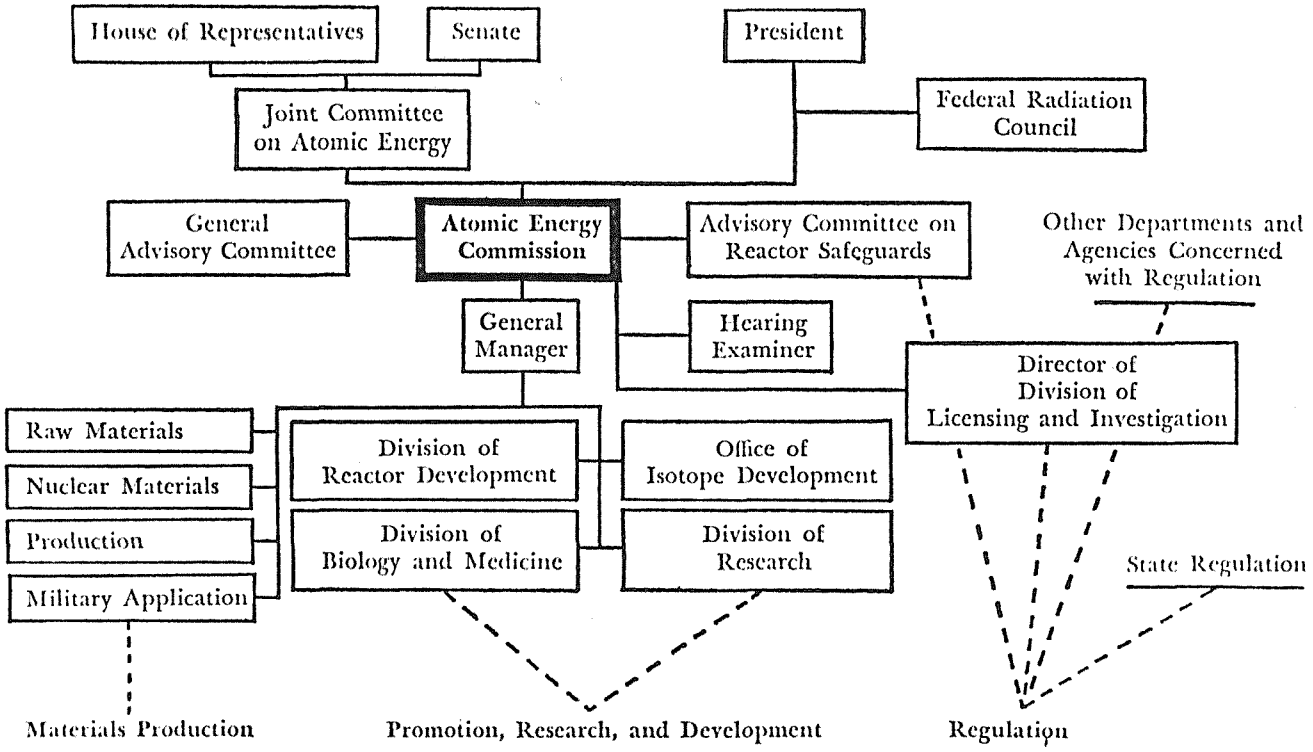
This rather comprehensive list was bequeathed to the organs of control established by the act, namely the Atomic Energy Commission (AEC) and the Joint Committee on Atomic Energy, together with the President.

2.2.1 The Atomic Energy Commission

Formally, it was the AEC which exercised governmental control over all atomic energy matters and in order to carry out its responsibilities it was given unprecedented powers. It retained ownership of all nuclear

materials and production facilities; controlled the production of military materials, atomic research and development, the transfer, use and dissemination of all scientific and technical information on atomic energy; and retained jurisdiction over the implementation of all international agreements. (26) In many respects the AEC was a much more autonomous and powerful body than the MED since it had a greater degree of formal independence from executive direction and control. This formal independence is illustrated by the limitations, established in the act, upon the President's powers over the Commission. In effect the President appointed (subject to Congressional approval) each of the five commissioners, who were collectively responsible for the AEC's activities, but to fixed terms of office (5 years).(27) The only other significant formal power of the President was that relating to the military application of atomic energy; yet even this was partly exercised by the Military Advisory Committee. (28) So the Commissioners, operating as a collegiate body, were vested with enormous independent powers with respect to virtually all aspects of policy on atomic energy utilization and exploitation. Day to day management of the AEC's activities resided with a General Manager [see figure 1] appointed by the Commission.(29)

Figure 1 - 1 Atomic Energy Organization in the United States



Source: Hodgetts 5 Administering the Atom for Peace Prentice-Hall, N.Y. 1964 p.33.

In determining policy the commission was required, by the legislation, to consult, keep informed, and generally to take into account the views or recommendations of the advisory bodies also established by the McMahon act. Most important amongst these was the Military Liaison Committee, consisting of representatives of the armed forces. The MLC was responsible for advising the Commission on all military applications of atomic energy, and anything which had a bearing on such applications.(30) Clearly given the Commission's responsibility for atomic weapon's production, combined with the emerging Cold War, the views of this committee were seldom ignored and throughout the early years nuclear weapons production dominated the AEC's activities.(31) A fact which upon reflection is somewhat ironical given the initial congressional determination to establish civilian control of the atom.

The second advisory organ established by the act was the General Advisory Committee whose remit included advising, 'the Commission on scientific and technical matters relating to materials, production, and research and development...'(32) Membership of the committee was restricted to civilians which in effect meant scientists. Although significant in the formulation of Commission policies during the early years, achieving notoriety for its advice on the H-bomb, it later experienced a demotion to an inconsequential role.(33)

Despite the existence of these advisory bodies and its intimate connections with the military, the Commission's grip over atomic policymaking (throughout the period of this study) was never relinquished to other organs of the executive nor to any other bodies. Indeed the AEC always fought tenaciously to protect its autonomy and its powers. The only real challenge to its predominance over policy came, not from the executive, but surprisingly from the legislature and specifically the Joint Committee on Atomic Energy.

2.2.2 Joint Committee on Atomic Energy

In their seminal study of the Joint Committee on Atomic Energy (JCAE) Green and Rosenthal emphasize that:

> The creation of a Joint Committee was discussed rather superficially, with emphasis on the fact that it would provide Congress with the means for intimate contact with the Commission's activities, that it would be an instrument for flexibility and change, and that it would play a watchdog role.(34)

This proved to be very much of an under estimation of the role that the JCAE came to play in the formulation of atomic energy policy. Indeed Allardice and Trapnell, in their study of the AEC, suggest that:

> A case could probably be made that the influence of the Joint Committee on Atomic Energy on the operations of the AEC has at times distorted if not violated the theory of the separation of powers.(35)

A point which will be illustrated frequently in this study.

What gave the JCAE its unique influence over the AEC was the fact that, as Green and Rosenthal state:

> It was clearly designed to be more powerful within its particular jurisdiction area ... than other committees were in theirs. Unlike the regular standing committees, the JCAE was established, not by rules of the two houses ... but by a separate law.(36)

In establishing a joint committee, consisting of seven members of each House, the McMahon act formalized the JCAE's powers by giving it: sole jurisdiction over all atomic energy legislation; the ability (and requirement) to initiate its own investigations into all AEC activity;, and imposing upon the AEC the requirement to 'keep the joint committee fully and currently informed with respect to the commission's activities.'(37) These were unprecedented statutory powers for a Congressional committee and the JCAE made extensive use of them to influence the direction of policy. Moreover, as the JCAE developed its role it also assimilated further powers including jurisdiction over AEC programme expenditures.(38) Because of its extensive powers the JCAE came to perform much more than merely a 'watchdog role'. Its organizational structure consisting of a main committee, seven sub-committees, and a permanent staff, combined with its statutory powers,

encouraged it to go beyond a purely legislative and reactive role.(39) On many key issues it initiated policy, as for example on the question of amending the 1946 Atomic Energy Act, and the development of civil nuclear power. Far from being passive the JCAE was crucial in the formulation of all aspects of civil nuclear power policy throughout the period of this study. So significant was the JCAE, that Green and Rosenthal concluded that:

> The Joint Committee on Atomic Energy is, in terms of its sustained influence in Congress, its impact and influence on the Executive, and its accomplishments, probably the most powerful Congressional committee in the history of the nation. There can be little doubt that, had Congress chosen to deal with atomic energy through conventional Congressional committies, the history of the atomic-energy program would have been quite different. Almost certainly, the national investment in atomic energy would have been substantially less and the present level of technology considerably lower.(40)

Just how considerable the role of the JCAE was, in comparison with that of the AEC, the executive branch generally and private organized interests, will be analysed in the remainder of this chapter which examines the development of commercial nuclear power from the passage of the McMahon Act through until 1954.

2.3 National Security versus Industrial Participation: 1947-1953

On January 1st 1947 the AEC formally accepted responsibility for the operation and management of all the atomic energy facilities which had been the MED's responsibility.

With this act civilian control over the atom was inaugurated. It was expected this might bias the direction of atomic energy development more towards civilian, as opposed to military requirements. But, in these early years civil development of the atom was very restricted since the political environment was particularly inhospitable to a proposed shift of resources away from meeting pressing military needs. The emergence of the 'National Security State', as Yergin refers to the United States in this early Cold

War period, with the exaggerated fear of the Communist threat, and the policy of containment, contrived to reinforce and legitimize the demands of the military planners, particularly in respect of nuclear weapons.(41) Those demands included sustained expansion in production of atomic materials and weapons.(42) Consequently any developmental or experimental work related to civil uses of nuclear energy was regarded very much as incidental, or secondary, to 'national security' requirements. Military necessity triumphed over commercial possibilities since:

> Atomic power ... was speculative, uncertain, and obviously expensive and difficult. There seemed to be no justification for undertaking such a major effort at that time. For these reasons, reactor development under the AEC was, for almost two years, a relatively minor program.(43)

What the AEC had to weigh against the 'speculative nature' of atomic power was the stark reality of a negligible nuclear weapons' stockpile in the context of: a serious escalation in the confrontation between the 'superpowers'; military perceptions of the inferiority of American conventional forces; and a coresponding emphasis, by military planners, on nuclear weapons.(44) It is not surprising therefore that the AEC's activities and policies were geared primarily to meeting military demands.

Whilst this placed considerable constraints upon the development of atomic energy, it did not entirely negate it since basic research work continued and so did the construction of reactors for military purposes. Advances in reactor and materials technology were made but wholly at the financial expense of the state. Whilst the private contractors who built and operated AEC facilities could not exploit this accumulating knowledge it nonetheless provided them with a significant advantage should atomic energy ever be commercialized.

Military domination of the AEC's activities in this early period, although precluding civil development, in effect subsidized and promoted the development of the technical and engineering infra structure necessary to sustain a private nuclear power industry. This is particularly evident

with the Navy's development of the submarine thermal reactor which eventually emerged into the civil sector as the pressurized water reactor (PWR).

To maximize the benefits from limited resources available for research and development on civil uses of atomic energy the AEC, in 1948, centralized responsibility for nuclear reactor design and engineering at the Argonne National Laboratory, (ANL). Following discussion within the Commission a plan for the construction of five different experimental reactor types was approved in late 1948.(45) This experimental programme demonstrated the AEC's initial commitment to the realization of power reactor technology. The objectives of this programme were to prove and evaluate the technical and engineering feasibility of different reactor concepts; to advance reactor technology, and to engage private industry further in experimenting with, and developing, reactor technologies which in the long run might have a commercial future. Involving private industry was very much an explicit objective of AEC policy in this experimental phase of reactor development; an objective which was underlined by David Lilienthal, then Chairman of the AEC, in a speech to industrialists in late 1947.

> The AEC pledges that American industry and engineering will be kept informed of developments in this field...Atomic energy is your business...and you have a right to know. More than that, unless industry does know, and unless it is a participant, atomic energy development will suffer and we shall have failed in our obligation to the public.(46)

The experimental reactor programme was given added emphasis, along with the AEC's commitment to reactor development, with the creation of the Reactor Development Division, under the direction of Dr. Lawrence Hafstaad, in early 1949.(47) Until then AEC activities were dominated by the Military Applications Division (established under the terms of the McMahon Act) which was not regarded as suitable for promoting reactor development. Hafstaad's new division took responsibility for the direction of the experimental reactor programme and for the formulation of policy with

respect to the longer term development of reactor technology and its applications.

One of the projects within the experimental programme was the submarine thermal reactor (STR) which had been proposed by the Navy's Nuclear Power Branch. This project became a joint AEC-Navy venture, although the reactor itself was to be constructed by Westinghouse[48]. From the STR emerged the PWR design, which became the basis for the US nuclear powered submarine programme commencing with Nautilus in 1955. The STR also became the basis of the Navy's aircraft carrier reactor project which was sanctioned in 1951. However, this latter project, was cancelled in late 1953 following cuts in the Federal budget introduced by the first Eisenhower administration. Not wishing to allow the STR/PWR design to be abandoned, particularly after significant research, development and construction costs had been incurred in its promotion, the AEC decided to reorientate it towards civil use. As a result, in October 1953, the Shippingport project was sanctioned; a project involving the construction of the first demonstration, as opposed to experimental, PWR plant capable of electricity generation.[49] It was a landmark in the development of civil nuclear power not only because it demonstrated the real potential of nuclear energy but also because it signalled an emerging separation between the civil and military exploitation of the atom. Until then all AEC reactor projects, including these in the experimental reactor programme, had a primarily military purpose with civil applications being regarded as largely incidental.[50] Shippingport, although a direct product of naval reactor development, aimed to produce electricity for the privately owned Duquesne Light Company; it was, in other words, to be the nations first civil nuclear plant.[51] Three factors encouraged this separation of military and civil nuclear reactor development: a more aggressive AEC policy towards civil exploitation of the atom; political pressures for expanded civil reactor development from the JCAE; and the Eisenhower administration's growing

commitment to civil nuclear power. These same three factors also combined to force onto the national agenda radical reform of the 1946 Atomic Energy Act.

Somewhat paradoxically it was the needs of the military which eventually convinced the AEC of the desirability of separating civil and military reactor development. The Soviet atomic test in 1949, combined with the outbreak of war in Korea gave added urgency to the Truman administration's national security policy as laid down in NSC-68.(52) That document called for a significant expansion of military capability both conventional and nuclear.(53) In order to meet the expansion of nuclear capability the AEC had to construct further facilities for the production of plutonium; added to which it had responsibility for implementing Truman's decision to develop the H-bomb.(54) These extra demands created enormous pressures on the AEC and very quickly led to a search for ways in which military and civil needs might be combined so that civil development was not restricted even further. One solution was offered by Monsanto Chemical Corporation which proposed private construction and operation of dual purpose (power and plutonium producing) reactors.(55) This, it was argued, would meet the AEC's needs for military plutonium, allow private industry greater participation in reactor development, and hasten the prospects for economically viable civil nuclear power.(56) A further joint proposal came forward from Detroit Edison and Dow Chemical Corporation, in late 1950, for a survey of privately financed dual purpose reactors.(57)

The AEC reacted rather favourably to these proposals, partly because the dual purpose reactor concept seemed to offer a possible resolution to the conflict between immediate military needs and longer term civil development, but also partly because it cohered with other objectives, particularly that of involving private industry, as far as the law allowed, in the development of nuclear power. It therefore initiated an Industrial

Participation Programme in early 1951 which aimed to encourage industry to become more acquainted with reactor technology.[58]

Several cooperative ventures arose in response to the Industrial Participation Programme. In May 1951 four industrial study groups, all of which involved cooperation between different companies, were established.[59] Study groups formed the basis of the programme since they permitted private industry the opportunity to evaluate the technical and economic prospects for civil reactor development. From the AEC's perspective too they had a number of very crucial functions. These groups, which amongst other things were completely privately financed, were an attempt to reduce the obstacles to private industry's involvement, and particularly investment, in power reactor development. They were also a means by which industry could evaluate the technical and economic viability of different reactor concepts, based on data from the AEC's experimental reactors. Finally the programme provided the AEC with informed views and corporate opinions about those factors which it was felt constrained further private involvement in the development of nuclear power. In many respects it was the AEC which benefitted most from the study groups.

For a number of reasons the Industrial Participation Programme attracted considerable interest from private industry and by 1954 some thirteen study group s were in existence.[60] But that interest was tempered by financial caution such that 'the participating companies showed little interest in actually funding research and development work.'[61] This was made abundantly clear in the first study group reports in 1952.[62] What also emerged from the AEC's internal review of the programme was a recognition that the commitment to dual-purpose reactors was misplaced since it became clear that it was not feasible to optimise both plutonium production and electricity generation.[63] Equally, the necessity for dual-purpose reactors became less urgent as new weapons material production facilities came on line in 1953.[64] Thus later study

groups in the programme moved away from a focus on dual-purpose reactor designs concentrating upon designs for electricity generation only, as well as generic aspects of reactor technology and operation.(65) By 1953 the AEC came to view the future development of civil nuclear reactors as being quite separate from military development. As Allen notes,

> From mid-1953 on, the AEC's program for developing power reactors was separated from efforts to perfect military applications of nuclear power including plutonium production. The commercial potential of civilian power reactors would henceforth be determined without dual-purpose design...(66)

What was also instructive about the Industrial Participation Programme was that whilst it was successful in engaging private industry more deeply with civil power reactor technology it was obvious to the AEC that the next logical step, namely private investment in its development, would not be forthcoming until nuclear technology was made more commercially attractive.(67) The dominant policy issue facing the AEC in 1953 was therefore how to entice industry into the construction and operation of demonstration plants, as opposed merely to encouraging the study of different reactor designs. One inducement was the proposal for a 'Five Year Reactor Development Program', involving joint AEC-industry participation in reactor construction, submitted for JCAE consideration in early 1954.(68) The second inducement involved consideration of revising the McMahon Act to allow private investment in nuclear reactor development.(69) But these proposals were in themselves very much a response to political pressure from the JCAE.

Throughout the early 1950s the JCAE was deeply concerned by what it perceived as the AEC's complacency in promoting power reactor development. This concern was compounded by its early relationship with the AEC which had been particularly difficult.(70) In 1949 the JCAE had accused the AEC of total mismanagement. This was followed by its aggressive promotion of the H-bomb which contradicted the advice given to the President by the AEC. Now it seemed to be edging towards a confrontation over power reactor

development. What stirred the JCAE into action was the feeling, amongst many members of the Committee, that the AEC's power reactor policy lacked both a coherent direction and a necessary urgency.(71) Consequently, in mid August 1952 the then Chairman of the JCAE, Senator Carl Durham (Democrat, N. Carolina) wrote to the AEC informing them of proposed hearings in 1953 on power reactor development, and requesting a clear statement of the AEC's policy.(72) This precipitated a major internal re-examination of the AEC's policies and, in March 1953, a report was submitted to the National Security Council for its approval.

Hearings on Atomic Power Development and Private Enterprise were held by the JCAE in June and July 1953.(73) Gordon Dean, the Chairman of the AEC, introduced the AEC's 'Statement of Policy on Nuclear Power Development' noting that it was a policy which clearly aimed at establishing 'the development of nuclear power as a national objective', and which the AEC believed was best achieved through the 'encouragement of free enterprise and private investment.'(74)

The AEC's policy statement itself proposed major changes in the legislative framework for managing the atom in order to encourage civil development.(75) Although such radical legislative change had been discussed before, notably during the early phase of the Industrial Participation Programme, the AEC was now proposing the revision of the McMahon Act. During the 1953 hearings members of the JCAE and representatives of private industry welcomed the AEC's policy. Representative of such support is the comment of a Westinghouse executive, during the hearings, that:

> under present atomic energy law, enterprise is not free ... Relax the controls, and judging by past experience, our economic system will find its own ways of helping to bring atomic energy to fruition.

Out of these first major JCAE hearings emerged a robust consensus between industry, AEC, and Congress upon the need to amend the McMahon Act. This consensus was built upon the desire to give priority to civil

nuclear power development and the belief that this was best achieved through private enterprise. In response to this 'consensus' the President recommended to Congress, in early February 1954, that the McMahon act be amended.

The JCAE's hearings on atomic power and private enterprise paved the way for the 1954 Atomic Energy Act and demonstrated the crucial role of the Committee in initiating and facilitating debate upon, and major changes to, atomic energy policy. In many respects the AEC's policy statement on the McMahon act demonstrated its 'reactive' nature. This was further underlined by JCAE demands, proposed at the end of the hearings, for a 'three to five year program of specific research and development projects'.(77)

The AEC responded to this with the announcement, in early February 1954, of the 'Five Year Reactor Development Programme'.(78) This was the AEC's first concerted attempt at developing a comprehensive programme of purely civil reactor development. Central to the programme was the construction of five different reactor types, funded entirely by the AEC, from which it was hoped sufficient technical and economic data would arise to enable an evaluation to be made of the most promising design for the construction of a demonstration, and eventually commercial, plant. (See Table 1)

In fact the major, and most costly component of the programme, the Shippingport PWR project, was in reality a demonstration, rather than an experimental, plant. This project had been 'integrated' into the programme, although it was in many respects quite independent from it.(79) The rationale for this was mainly political since the Shippingport project had been the victim of the administration's 1953 budget cuts and was only reprieved by skillful Congressional action by the JCAE, following intense lobbying by the AEC.(80) Its inclusion in the reactor development programme invested the project with greater legitimacy since it made it a

Table 1 - 1

The Five Year Experimental Reactor Program

Reactor Concept	Name	Location	Scheduled Completion Date	Moderator	Coolant	Fuel	Heat Output (kw)	Electrical Output (kw)
Pressurized Water	Pressurized Water Reactor (PWR)	Shippingport, PA.	1957	Ordinary water	Ordinary water	Slightly enriched uranium	264,000	60,000
Boiling Water	Experimental Boiling Water Reactor (EBWR)	Argonne Nat. Laboratory near Chicago, IL.	1956	Ordinary water	Ordinary water	Natural and highly enriched uranium	20,000	5,500
Sodium Graphite	Sodium Reactor Experiment (SRE)	Laboratory near Santa Susana, CA.	1957	Graphite	Sodium	Slightly enriched uranium	20,000	6,000
Fast Breeder	Experimental Breeder Reactor-2 (EBR-2)	National Reactor Test Station, ID.	1958	None	Sodium	Uranium-plutonium alloy	62,500	16,500
Homogeneous	Homogeneous Reactor Experiment-2 (HRE-2)	Oak Ridge National Laboratory, TN.	1957	Heavy water	Heavy water	Highly enriched uranium in UO_2SO_4 solution	5,000	300
	Homogeneous Thorium Reactor (HTR)	Not selected	1959	Heavy water	Heavy water	Highly enriched uranium in UO_2SO_4 solution	65,000	16,000

Source - Dawson, F.G. Nuclear Power: Management and Development of Technology Washington University Press, Seattle 1976 p.85.

fundamental component of a coherent development strategy rather than an expensive one-off project.

One implication of both the development programme and the Shippingport 'saga' was that the significance of the JCAE's role in the determination of civil nuclear policy was reinforced. A further ramification was the tacit acceptance of the 'institutionalized' separation of civil and military reactor development; a policy with which the Eisenhower administration whole heartedly agreed.

Following his inauguration in January 1953 the new President instituted a number of changes in both domestic and foreign policy. Two developments were of enormous significance to the development of civil nuclear power. Firstly, there was a drastic change in government fiscal policy with the emphasis shifting to budgetary restraint. This immediately (as noted previously) impacted upon AEC activities with the forced cancellation of the Shippingport project in early 1953. Such a policy also placed a general constraint upon AEC expenditure so that it was unlikely ever to find itself in a position to fund a significant reactor development programme. A number of policy implications flowed from this. In particular it reinvigorated the existing emphasis upon private enterprise involvement in power reactor development. This is turn gave added urgency to the case for reviewing the McMahon Act to liberalize the domestic framework of control over atomic energy. Both these developments too sat very happily alongside the new Republican administration's avowed ideological commitment to free enterprise.

The second major policy shift was in respect of foreign atomic energy policy. Since the failure of attempts, through the UN, to establish international control of the atom, the US had denied cooperation, in atomic matters, even to its closest allies. Apart from a minor ammendment to the McMahon Act in 1951, allowing very limited international exchange of information, the Truman administration, throughout its term of office,

remained wedded to a policy of secrecy and denial. With the Eisenhower administration came a revolutionary change in policy which was in part attributable to its 'New Look' foreign policy.(81) Following months of internal debate, the President announced to the UN, in December 1953, a complete reversal of American policy with a proposal for international cooperation in the peaceful uses of atomic energy.(82) 'Atoms for Peace', as the programme was nick-named, was to usher in a new era involving the global dissemination of nuclear technology to meet the 'free world's' growing energy requirements. It was an initiative which also confirmed and reinforced the drift of the domestic policy debate twards revision of the McMahon Act.

The Eisenhower administration's policies toward atomic energy were strongly supportive of expanded domestic and international civil development. The administration stressed a greater role for private enterprise in power reactor development and a clear separation of military and civil uses of atomic energy. Moreover, it accepted there was a degree of urgency in demonstrating the feasibility of power reactor technology, since as Allen comments:

> Eisenhower believed strongly that building a nuclear electricity generating plant having no military function would demonstrate both US technological superiority and US intentions to develop peaceful uses of atomic energy.(83)

The administration also believed, as did the AEC, the JCAE, and industry, that the development of civil nuclear power could only be achieved by removing one fundamental constraint: the McMahon Act. By late 1953 it was evident that a major common concern amongst all these groups was the restrictive nature of the McMahon Act. Acting upon the general consensus for reform the administration formulated a package of ammendments to the McMahon Act, which the President duly submitted to Congress on February 17th 1954.(84)

2.4 Liberalization of Controls: The 1954 Atomic Energy Act

The President's message to Congress established three broad objectives which the proposed amendments to the McMahon Act aimed to achieve, namely:

> First, widened cooperation with our allies in certain atomic energy matters;
> Second; improved procedures for the control and dissemination of atomic energy information; and
> Third, encouragement of broadened participation in the development of peacetime uses of atomic energy in the United States.(85)

With respect to this latter objective the President reiterated the administration's strongly held view that only private enterprise involvement in the development of nuclear power would ensure maximum benefit to the US economy. As he stated in his message:

> Before our scientists and engineers lie rich possibilities in the harnessing of atomic power. The Federal Government can pioneer in its development. But, in this undertaking, the enterprise, initiative, and competitive spirit of individuals and groups within our free economy are needed to assume the greatest efficiency and progress at the least cost to the public.(86)

In some respects the development of nuclear power was being posed, by the administration, as a test for the private enterprise system to demonstrate its superiority over state socialism of the Soviet kind. Undoubtedly this was intimately connected with its early ideological crusade against communism, as espoused in the New Look foreign policy.(87)

Following the President's message the AEC forwarded to Congress two draft bills designed to ammend respectively the domestic and international sections of the 1946 Act. The proposed ammendments to domestic controls over atomic energy came as no great surprise to the JCAE since in late 1952 the AEC had consulted the JCAE on a series of detailed changes to the law.(88) Many of the JCAE's comments on those proposals had been incorporated into the proposed bill. What was new to the JCAE was the proposal, contained in the second draft bill, for international cooperation in both civil and military atomic energy matters. These provisions bore

the stamp of the President's Adviser on Atomic Energy matters Lewis Strauss, and the military, rather than that of the AEC.(89)

The two bills generated considerable concern amongst senior members of the JCAE since it was perceived that they gave far too much discretion and authority to the President, particularly with respect to international cooperation; would aggravate those Democrats who wanted greater public investment in nuclear power; and raise the fears of many Republicans that international cooperation could lead to the erosion of US technological and military superiority in the nuclear field.(90) Moreover, it was believed that should the bills go forward separately both could easily be defeated in Congress because neither would attract sufficient political support. (91) Consequently, Representative Cole and Senator Hickenlooper, (Chairman and Vice Chair of the JCAE respectively) with the assistance of the JCAE staff, redrafted them, combining both into a single, coherent piece of legislation.(92)

In mid April the Cole-Hickenlooper bill, as it was referred to, was introduced into the House and the Senate. Although this new draft bill was quite different from the two original AEC sponsored bills, it nonetheless invited extensive opposition in its passage through Congress.(93)

On at least two occasions the bill was nearly lost, or referred back, because of the strength of opposition to its more controversial provisions.(94) Far from neutralizing conflict over the revision of the McMahon Act, the Cole-Hickenlooper bill provoked it: debate upon the bill was a catalyst for a much broader political and ideological struggle over the desired relationship between the state and private enterprise with respect to the development of nuclear power. Rather than a conflict over 'means' the bill drew opposition from within both the Republican and Democratic parties, to the stated 'ends' which underlay it. Congressional debate, particularly that in the JCAE, was thus fierce, extensive and protracted; one section of the bill actually gave rise to a filibuster,

which was then the longest in Congressional history.[95] Passage of the 1954 act therefore proved to be every bit as controversial as that of the 1946 act. Amendments to the bill were continually proposed: minority reports frequently appeared on specific provisions; and at each stage in its passage through Congress, confusion reigned over what the continuously amended bill actually said. Consequently, its enactment was never assumed despite the Republican majority in Congress.[96] It was only the administration's careful manipulation of that majority which ensured passage of the Bill by the end of the congressional session.[97]

The fundamental issues in the Congressional debate were three fold: the form of the bill; international cooperation; and public versus private development of atomic power. To some extent the debate over these matters mirrored that which had taken place only eight years previously on the McMahon bill. But it was also signficantly different in tone and emphasis, since, in the meantime, the Soviets had acquired the bomb, (as had the British), and civil nuclear power was much more of an engineering reality than it had been in 1946. Congressional debate reflected this new situation.

With respect to the form of the bill what was at issue was its amalgamation of two separate matters: domestic liberalization and international cooperation. Some members of the JCAE perceived this as a tactical move, on behalf of its drafters and the administration, to prevent Congress from voting down its more controversial domestic provisions. As Representative Chet Holifield (Democrat, California) stated at the opening of hearings on the bill:

> Some legislative changes are needed to facilitate the exchange of atomic information with our allies and to encourage pooled development for peaceful purposes. It is not essential that electric utilities and industrial companies be accorded private ownership rights in atomic energy at this time.

> Defense and peaceful requirements in atomic energy which involve our allies should be first on the agenda. Then the Congress should take a long, hard look at the pending proposals to confer private ownership and patent rights in the atomic field.(98)

In essence Holifield, and other Democrats on the JCAE desired separate consideration of the domestic and international provisions in the bill, as the AEC too had originally proposed. This was not unrelated to the fact that they were proponents of public development of atomic power and thus extremely critical of the bills alleged 'give-away' to private industry of all the public investment so far expended in atomic technology. Their position was reinforced by both the AEC's and the administration's acknowledgement that even they regarded the proposals for international cooperation as a more immediately priority than those concerning domestic development.(99) From the opening of hearings, right up until House consideration of the bill in late July 1954, Holifield and others attempted unsuccessfully, through minority reports, amendments and resolutions, to disentangle the domestic and international provisions contained in the bill. What defeated them was a Republican majority in Congress whose unity on this issue arose from the deep ideological commitment, which they shared with the Eisenhower administration, to greater private involvement in the atomic sector; an involvement which could only come through the liberalization of domestic controls. Along with many corporate interests they refused to see such liberalization postponed.(100) Straightforward partisan voting thus ensured that the bill, although quite significantly amended in many other respects, remained intact.(101)

Whilst the unity of the Republican party was strongly apparent on the issue of the bill's form, it was less in evidence with respect to its provisions for international cooperation.(102) Three interrelated concerns complicated the politics of this issue. Firstly, many perceived that the powers devolved to the President and the AEC in respect of international

cooperation were too extensive. Senator Bricker expressed these sentiments explicitly in his attempt to make the bill more restrictive in this regard; he argued that the international section of the bill gave:

> carte blanche authority to the President of the United States to enter into international cooperation with a group of nations, which at the present time ... includes, by invitation, the Soviet Union.
>
> As a Senator of the United States I do not want ... to give away the responsibility that I assumed as a Senator under the Constitution to have the Senate ratify a treaty or the power of Congress to look at an executive agreement that one man enters into with a group of nations.(103)

This was reinforced by a second factor arising out of more innate concerns, that cooperation might lead to the US giving away both military and industrial atomic secrets. To most Republicans this was clearly unacceptable since US security and its industrial monopoly in this field would be threatened. Thirdly the bill's implicit avoidance of any reference to the atomic pool, which the President had proposed in his Atoms for Peace address, stimulated attempts by Democrats to place in the legislation some means of promoting multilateral cooperation.(104) Nothing could have aggravated Republican sentiments more.

What transpired during the debate was a clear partisan division between the Republicans, who essentially opposed greater cooperation, and the Democrats who were generally supportive of it. Serious lobbying campaigns by the administration, designed to appeal to Republican party loyalty, were sufficient to mollify enough congresional opponents to ensure that the international cooperative measures it contained in the bill did not threaten its overall passage.(105) Moreover, even for Republicans like Senator Bricker, who opposed the bill's international provisions, the ideological commitment to the liberalization of domestic controls took precedence: passage of the bill was considered to be more desirable than failure to enact it which would only delay even further private exploitation of atomic energy.(106) Faced with such a stark choice, political differences over the 'international' clauses in the legislation

were resolved successfully in the first conference committee on the bill in August 1954.(107)

It was conflict over the relationship between public and private sectors with respect to the exploitation of atomic power which proved to be the most intense, intractable, and controversial; indeed it very nearly culminated in the bill failing to gain Congressional approval.(108) Two issues dominated these deliberations: the proposed private ownership of power reactors; and the matter of patents. But what provoked the conflict was a parallel controversy over the Dixon-Yates contract (discussed later) which reinjected the long-standing public versus private power issue back into national politics.(109) This central ideological fissure, separating those who advocated public power and public development of atomic power, from those totally opposed to such 'creeping socialism', became the axis around which revolved the most acrimonious Congressional struggle over the Cole-Hickenloopper bill revolved.

One of the key proposals contained in the Cole-Hickenlooper bill was that permitting private ownership and operation of power reactors.(110) This reflected the consensus which had arisen, during the 1953 hearings on atomic power development, between industry, the AEC, the administration, and the majority of Republicans on the JCAE. This consensus on private ownership was reaffirmed by Francis McKune, General Manager of General Electrics Atomic Products Division who testified during hearings on the bill that:

> The proposed act embodies the most important objectives which we advocated before this committee last July. At that time, General Electric recommended private ownership of production and utilization facilities, subject to government security and safety regulations...(111)

This commitment to private ownership was also thoroughly underscored in the Senate's report on the bill which advocated:

> that the goal of atomic power at competitive rates will be reached more quickly if private enterprise, using private funds, is now encouraged to play a far larger role in the development of atomic power than is permitted under existing legislation. In particular, we do not believe that any developmental programme carried out solely under governmental auspices ... can substitute for the cross-cutting and other incentives of free and competitive enterprise.(112)

However, this conclusion was not shared by the majority of Democrats who consistently challenged private ownership in JCAE and floor deliberations on the bill.

Most persistent amongst the critics were Representatives Holifield and Price who viewed the bill as a 'giveaway' to private industry and as containing various provisions for subsidizing private development of atomic energy. Their position, along with many other Democrats in both the House and Senate, was that development of atomic power should remain a government owned and controlled industry. Holifield made this stridently clear in his opening statement at the hearings on the bill, when he indicated that:

> Congress should be on guard against an atomic giveaway through legislative loopholes which would permit selfish exploitation of atomic resources developed with public funds. I believe that it is essential that such legislation should impose upon the AEC an affirmative duty to pursue atomic power development...(113)

Support for this view came from the Confederation of Industrial Organizations, the National Rural Electric Cooperative Association, the American Public Power Association, the Federal Power Commission, and the Tennessee Valley Authority.(114) But weighed against the public power lobby was a coalition of Republicans, who formed the majority in Congress, backed by the administration, the AEC, private industry, the powerful National Association of Manufacturers, the private utility companies, insurance companies and others who would benefit from private development.(115) This was such a powerful coalition of government and private organizations that proponents of public development could not realistically have expected to obtain any significant change in the bills commitment to private development. In consequence the focus of the

conflict between the opposing forces shifted to the more detailed issues of power production by the AEC, and commercial patents.

During the hearings which preceeded the bill's second reading the matter of AEC authority to produce power from production facilities was the catalyst for a further round of conflict between the public and private power lobbies. The proponents of public power clearly wished to see the AEC gain authorization to produce and to sell electric power from atomic plants since this would enable the de facto continuation of public development of atomic energy. However, the strongest opposition to this came, not from private industry but, from the AEC. In reality private industry was divided on the issue between private utilities, very deeply opposed to it, and private manufacturers who were less staunchly opposed since they would benefit from the construction of such plants. But it was the AEC's vehement opposition to the proposals which underscored the arguments of the private power lobby. The AEC case was put by Commissioner Murray who argued that:

> nuclear power as it becomes economically attractive, should be integrated into the existing power economy of the nation; that nuclear power should be produced and distributed by private and public power systems and not by the AEC.(116)

The caustic nature of the ensuing debate is finely illustrated in an exchange between the Chairman of the AEC, Lewis Strauss, and Chet Holifield.

> Chairman Strauss: My point was simply that I hoped that the AEC would never be in the position of making and selling power as a business of the Commission.
> Mr. Holifield: Well your hopes you are entitled to them and they may be entirely justified but that is a matter of policy which Congress will have to decide... (117)

Congress did decide and at the first conference committee on the bill the private power lobbyists, mainly as a result of the Republican majority on the committee, were successful in excluding those amendments which would have given the AEC authorization to produce and sell electric power from atomic plants. What emerged was a stilted compromise in which the AEC was

given permission to sell excess power from its research and development facilities; and as a further sop to the public power lobby, it was required to give public and community owned utilities preference in the sale of such power.(118) In essence the AEC was categorically excluded, to the relief of private utilities, from power production. But this was an issue which, as later sections discuss, was to re-appear upon the JCAE agenda.(119)

Overshadowing these deliberations on the AEC's role was a parallel and intense, as well as violently ideological, political struggle, between public and private power advocates, which had developed out of the administration's canvassing and approval of the Dixon-Yates contract.(120) This rather inocuously sounding document became a natural 'cause celebre' since it released the ideological passions of the pro-public and pro-private power lobbies and generated a congressional furor reminiscent of the period when the [New Deal] TVA was created.(121) The contract involved the AEC and two southern private utility companies, Middle South Utilities Company and the Southern Company whose directors were a Mr. Dixon and a Mr. Yates. Under political pressure from the President, the AEC had agreed (somewhat reluctantly) in June 1954 to proceed with the [Dixon-Yates] contract. This entailed construction of a new generating plant, to be owned by the private utilities, which would compensate the TVA for the power consumed by the AEC at its Paducah enrichment plant. Intentional or not, construction of this plant ensured that any growth in electricity demand in the area could be met without the TVA's expansion.(122) Immediately this ignited fierce political opposition from public power advocates. Overlaid with complex legal, ideological and constitutional ramifications, as well as allegations of impropriety and corruption, the controversy stimulated extensive Congressional debate.(123) This in turn had a profound impact upon the passage of the Cole-Hickenlooper bill since the contract was perceived by proponents of public power as an attack on the TVA, reinforcing their opposition to

private development of atomic power because they 'feared that the administration would use nuclear power development to aid private power interests.'.(124)

So the contest between the advocates of public and private exploitation of atomic energy became conjoined and suffused with the whole Dixon-Yates controversy to the extent that, as Green and Rosenthal observed 'it largely obscured from both public and Congressional view some of the other extremely important provisions of the Cole-Hickenlooper bill.'(125) Indeed according to Allardice and Trapnell, 'So threatening was the opposition at one point that Chairman Sterling Cole of the Joint Committee sought to have the Commission withdraw from the Dixon-Yates contract lest it cause the bill to be defeated in the Senate.'(126)

Whilst the Dixon-Yates controversy did not by itself seriously endanger the Cole-Hickenlooper bill it nonetheless reinforced the increasing polarization of partisan and political views in Congress: Democrats and public power advocates became increasingly opposed to the bill, whilst Republicans and private power advocates were increasingly supportive of it. On virtually every major amendment to the bill voting was on strict partisan lines such that compromise and consensus were not much in evidence. And in general, since they were in the majority, it was Republican, and private power interests, which were advanced. Only upon the issue of patents was the Republican hegemony seriously and successfully challenged.

The patents issue both reflected and nurtured the deep seated conflict over public versus private development of atomic power. Most Democrats and public power proponents viewed the patent proposals contained in the bill as excessively liberal, and a 'giveaway' to private industry of all the public funds which had been invested to date in the development of the technology.(127) What the bill proposed was to allow normal patent rights for non-military applications of atomic energy so as to encourage private

development.[128] In addition it also proposed a new and more liberal framework for the control of atomic information with the object of providing industry with greater access to AEC technology. Together these proposals amounted to a substantive revolution in the basic terms under which private enterprise participation in the industry was governed; in effect the bill returned the atomic energy industry to virtually the same patent conditions as operated in the rest of US industry. This was seen as a vital step; removing a major roadblock, some said, both in persuading private industry to invest in the development of atomic power and in establishing the basis for a flourishing [private] atomic energy industry. It was therefore given the full backing of the administration, AEC, private industry, the utilities, patent lawyers and Republicans in Congress. Their views on the patent issue were probably best illustrated by the comments of C. Willard Hayes, a representative of the American Patent Law Association, who argued during hearings on the bill that:

> the public interest will best be served by ... eliminating the restrictive patent provisions of the present law, to permit the protection of future inventions in this field and the ownership of patents therin, as in other fields of research and development.(129)

Democratic opponents of the patent provisions vehemently disagreed with this policy. They argued that, combined with the declassification and dissemination of information, such liberal patent provisions would give a massive advantage to those corporations which had priveleged access to AEC technology because of their role as AEC contractors. This, together with their huge resource base, they argued, would be sufficient to create oligopoly or monopoly control of the industry.[130] That would not be in the public interest, nor would it be promoting the free competition which proponents of private enterprise argued was so vital to the successful development of a profitable nuclear industry. In general, the bill's patent provisions were seen by Democrats and public power proponents as a hidden subsidy to the big corporations which would add enormously to

corporate profitability (through the creation of a monopoly) but which would not benefit the public, nor repay the public's investment in the technology. What the bill's opponents therefore proposed was a ten year transition period in which there would be compulsory licensing of patents, managed by the AEC, to discourage monopolistic tendencies in the industry. After this period normal patent rights would commence or if necessary there could be a further extension in the transition period. Proposing this amendment Chet Holifield argued that:

> Ready access of licensed firms to all patents for 10 years is one essential element, as I have indicated, in preventing monopolistic exploitation of atomic enterprises by a few large firms. (131)

Many Republicans, particularly the bill's sponsor Representative Cole, were vehemently opposed to any such amendments which, it was believed, weakened the incentives for private investment in atomic power. Even when, in a compromise to expedite the bill's passage, the transition period was set at five years Cole maintained his opposition to the point of producing a minority report (following JCAE endorsement of the bill) on the patent issue in which he stated:

> My objection to this resort to a system of compulsory licensing is threefold:
>
> 1) it is unconstitutional;
> 2) it is unnecessary in order to adequately protect the public interest and prevent undue enrichment or the preferential position of persons and corporations engaged in the atomic programme; and
> 3) it is wholely foreign and hostile to the American tradition and practice, and the system of private enterprise...
>
> Compulsory licensing is not creeping socialism; it is socialism run rampant. This proposal is the initial lurch in the direction of that rampage. It must not be made. (132)

This is a wonderful illustration of the degree to which the ideological fervour of opposing camps was engaged by the issue of patents. There was, however, little objective, as opposed to rhetorical, support for the Cole 'line' since even the administration and the AEC had originally

desired some form of transition period. Moreover, in reality industry was far from united on the issue of patents. Whilst likely manufacturers such as Westinghouse and General Electric had a vested interest in normal patents, private utility companies and others were unaffected and thus ambivalent; publically the latter oused support although undoubtedly this was for purely ideological reasons.(134) For some companies, like General Electric, a transition period and compulsory licensing were not rejected out of hand.(135) Indeed many companies perhaps recognized that this provision would have little real impact since there was unlikely to be a flood of patent applications or investment in atomic power for a considerable period.(136) Such diffident support for the Cole 'line' clearly weakened considerably the Republican argument for normal patent rights.

Debate on the patent issue staved off passage of the bill through the House and Senate as amendment and counter-amendment were proposed and voted upon. The Senate's defeat of the first conference committee report on the bill arose primarily because of the patent issue and Republican insistence that the bill reflect the Cole 'line'. Many feared that unless a compromise was reached the whole bill would become trapped in a possible deadlock between House and Senate over patents and thus would be lost before the end of the session. As a result, in the deliberations of the second conference committee, Cole and his supporters compromised: they agreed to compulsory licensing and a transition period, but only because the bill's passage was clearly threatened. This forced compromise was reflected in the Conference report which noted that:

> The managers on the part of the House reluctantly agreed to the inclusion of the provisions relating to compulsory licensing ... They thought that there was so much good in the balance of the provisions of the bill that the dispute over the patent provisions should not further delay passage in this session.(137)

Therein the bill was passed by both the House and Senate and was signed into law by the President on August 30th 1954.(138)

2.5 A New Phase in Atomic Power Development

The new act was designed to usher in a new phase in atomic power development through its eradication of the obstacles to private investment in the industry. It authorized private ownership of atomic power plants; the leasing of nuclear fuel to private industry; declassification and dissemination of information and technology; quasi-normal patent rights; the export of nuclear materials and technology; research and development assistance; and AEC buy-back of special nuclear materials (eg plutonium) produced incidental to power generation. (139) All of these authorizations were, of course, subject to AEC licensing or regulation. The act was an historic piece of legislation since it established a wholly new structure for the conduct of the state-private industry relationship in the atomic energy field. But it was a structure which, as Mullenbach suggested, contained many internal contradictions -

> ...Industry won a mandate it could not fulfil. The AEC had to assume multiple and often conflicting roles. The new relationship compelled the AEC to act at the same time as "partner, employer, promoter, rival and policeman..."... The 1954 Act protected the interests of the private utilities, but also maintained the preference long accorded to public power. It called for a return to more normal private patent rights in civilian technology, but hedged this action with compulsory licensing and other constraints. It seemingly forbade subsidies to private commercial plants, yet left the way open for many forms of indirect subsidy and government assistance. (140)

In addition it was without doubt perceived as 'Republican' legislation for, as Dawson notes:

> The Republicans, who controlled both houses and therefore the JCAE, together with a few conservative Democrats, mostly Southerners,provided a sufficient vote margin for the Republicans to defeat nearly all of the amendments proposed by the liberal Democrats. (141)

Thus some Democrats were disconcerted by the bill's passage and for sometime after remained hostile to it. (142) This, combined with its internal contradictions, contributed to the re-awakening of the conflict over the whole state-private industry relationship in the late 1950s. Despite some

compromises, the act in no sense resolved the fundamental conflict over the role of the state and that of private industry, in the development of atomic energy.

Paradoxically, although the legislation 'opened the door' for private industry there was no rush by industry to gain entrance. Allen describes the situation rather bluntly, but perhaps accurately:

> Implicit in the provisions of the 1954 law was the expectation that private industry would begin to invest in nuclear R & D and power plant construction, thereby reducing the role the federal government might have to play ... ... the AEC waited for some indication of industrial interest after the 1954 act took effect ... None appeared. (143)

Clearly industry's reticence was a product of the still experimental and uneconomic nature of power reactor technology; atomic energy remained a risky investment.(144) Rather than private industry taking the initial steps towards the demonstration of power reactor technology, as many Republican advocates of the Cole-Hickenlooper bill had desired and expected, it was the AEC which by default took the initiative in early 1955 with the inauguration of its Power Demonstration Reactor Programme (PDRP). Some of the opponents of private development saw this as a vindication of their arguments. So despite the common belief that:

> The passage of the 1954 Act truly represented the birth of a new era in atomic energy development ... (145).

it was the AEC, not private industry as many had expected, which adopted the parental role. For as Dawson perceptively recognized, in spite of the act:

> it soon became clear that the AEC would have to maintain an active role to assure that progress in this new technology would be rapidly and adequately expedited. (146)

FOOTNOTES

(1) For the 'official' history of the MED see R.G.Hewlett and O.E.Anderson The New World 1939-1946 VI A History of the United States Atomic Energy Commission. Pennsylvania State University Press, Pennsylvania 1962. Other unofficial histories exist such as R.Clark Birth of the Bomb, Phoenix House, London 1961, and L.R.Groves Now it can be told: The Story of the Manhattan Project, Harper, New York 1962.

A.McKay The Making of the Atomic Age, Oxford University Press, Oxford 1984, Chs. 7-10.

(2) Although the reports were independently commissioned by the Military Policy Committee and by Richard Tolman, who was scientic adviser to General Groves, it is not clear what role Vannevar Bush played in facilitating their commissioning. Bush and Conant were at this point very much concerned about postwar control and with placating the developing consciousness amongst scientists on the MED about the direction of postwar policy. See Hewlett and Anderson, ibid, p.323-4.

(3) For a discussion of the Jeffries committee report see ibid, p.324-5.

(4) Bush and Conant had begun their 'campaign' for international control of the atom as early as September 1944 and had convinced Secretary of War Henry Stimson of their plans by early 1945.

See 'The Quest for Security: American Foreign Policy and International Control of Atomic Energy 1942-46'. Barton J.Bernstein, The Journal of American History, V60, March 1974, pp. 1003-1044, and ibid, p.329-331.

(5) See Bernstein ibid; Hewlett and Anderson, ibid, Ch. 13, and for an analysis the broader diplomatic context and the nature of US diplomacy at the time - Strategies of Containment - A Critical

Appraisal of Post War American National Security Policy, J.L.Gaddis, Oxford University Press, London, 1982. Ch. 1.

Force and Statecraft, G.A.Craig, A.L.George, Oxford University Press, London, 1983, Ch. 8.

(6) On the establishment of the committee see, Hewlett and Anderson, op.cit. p.345.

On its work and policy role see, Bernstein, op.cit. Hewlett and Anderson, op. cit. Chs. 11,12,13.

(7) In their history of the Atomic Energy Commission Allardice and Trapnell note that "US democracy was confronted with a critical test in trying to reap the benefits of nuclear energy without distorting the political and economic structure that had served the country since its beginnings." The Atomic Energy Commission, C. Allardice and E.R.Trapnell, Praeger, New York, 1974, p.25.

(8) The Smyth report was published as A General Account of the Development of Methods of Using Atomic Energy for Military Purposes under the Auspices of the United States government 1940-45, Washington D.C. 1945.

(9) Hewlett and Anderson, op. cit. p.407.

(10) See ibid, p.412-415 and loc cit.

(11) See ibid, p.424-427.

(12) ibid.

(13) On the legislative history of 1946 Act from the inception of Special Committee to passage of the McMahon bill see - Background Paper - Legislation and Congressional Reports on International Atomic Energy Programs and Policies, 1945-60, by D.R.Toll Staff Counsel, JCAE in V3 pp.922-932 of International Atomic Policies of the United States, A study prepared for the JCAE, R.McKinney. US GPO Washington D.C. 1960, (hereinafter referred to as the McKinney report).

McMahon's resolution, Senate Resolution 179 was passed on 29th October 1945.

(14) Hewlett and Anderson, op.cit, p.430.

(15) Allardice and Trapnell, op.cit. p.29.

(16) See Nuclear Power - Development and Management of a Technology, F.G. Dawson, University of Washington Press, Seattle, 1976, pp.17-8, also Hewlett and Anderson, op.cit. pp.431-33.

(17) Statement of Major General L.R.Groves, US Army, November 28th 1945, p.32 in Hearings before the Special Committee on Atomic Energy US Senate, 79th Congress, 1st Session Pursuant to Senate Resolution 179 - Resolution Creating a Special Committee to Investigate Problems Related to the Development, Use and Control of Atomic Energy, Part 1, November-December 1945, US GPO, Washington D.C. 1945.

(18) On the legislative history of the bill, see Toll op. cit. For the actual hearings consult - Hearings before the Special Committee on Atomic Energy on S1717 A Bill for the Development and Control of Atomic Energy, Parts 1-4. US GPO, Washington D.C. 1946. See also Hewlett and Anderson, op. cit. Ch. 14.

(19) These concerned military vs civilian control of the Commission;international vs domestic control; and the exchange of information. See Toll, op. cit. pp.924-5

(20) See Hewlett and Anderson, op. cit. p.501.

(21) Moreover there was no substantive a agreement on what the real prospects were for the peaceful exploitation of the atom. Whilst the Acheson-Lilienthal, Jeffries, and Tolman reports had all emphasized the value of civil nuclear power, it was recognized that its utility lay very much in the distant, as opposed to the near, future. Others had emphatically denounced even its medium term significance. As Dr.Irving Langmuir (Associate Director the Research Laboratory of General Electric Co.) stated in testimony to the Special Committee -

"... much of the discussion of the human value of atomic energy is based on the thought such energy may displace coal and oil as sources of industrial power. This I think is a relatively trivial matter ..."

and then went on to note that it would not be relevant for at least a century. (See statement of Dr.Irving Langmuir in US Senate Resolution Creating a Special Committee to Investigate the problems Related to the Development, Use and Control of Atomic Energy, part 1. Hearings November-December 1945, US GPO, Washington D.C. 1945, p.110. Such uncertainty weakened the case of those pushing for greater private access to information since it was counterbalanced by the 'certain' knowledge of the obvious security implications.

(22) Newman J.R. and Miller B.S. The Control of Atomic Energy, McGraw Hill, London, 1948, p.64. Newman as Counsel to the Special Committee was responsible for much of the drafting of the McMahan bill.

(23) The Acheson-Lilienthal Report was commissioned by Secretary of State Byrnes to examine the issue of international control. Byrnes had created a Committee on Atomic Energy, chaired by Dean Acheson (then Under Secretary of State) which had then appointed a Board of Consultants on January 23rd 1946 to exmaine the matter of international control. On that Board were David Lilienthal, Chairman of the TVA and Robert Oppenheimer amongst others. The report of the Board, which became known as the Acheson-Lilienthal Report, put forward proposals for the international control of atomic energy which in turn became the basis for the Barruch Plan presented by the US to the UN.

On the work and functioning of the Board see Hewlett and Anderson, pp.534-554.

For the final report see A Report on the International Control of Atomic Energy, Dept. of State Publication 2498, March 16th 1946.

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US GPO, Washington D.C. 1946, reprinted in US Congress Senate Peaceful Nuclear Exports and Weapons Proliferation, A Compendium, Committee on Government Operations, April 1975, 94th Congress, 1st Session, US GPO Washington D.C. 1975, pp. 127-198.

(24) US Congress Senate Report No. 1211, On. S1717, 79th Congress, 2nd Session, pp.21-22, US GPO Washington D.C. 1946.

(25) PL 79-585, The Atomic Energy Act of 1946, Section 1 (a).

(26) On these aspects consult Sections 3,4,5,6,7,8,10,11 and 12 of PL 79-585 ibid.

(27) The president also designated one of them to be Chairman of the Commission, See Section 2 (a) 1 and 2, ibid.

(28) In effect the President had to authorize annually the level of military production of nuclear materials and weapons, Section 6 (a) 1 and 2,ibid.

(29) Initially appointed by the President but in 1950 the act was amended giving the Commission authority to appoint the General Manager. See Dawson op.cit. p.23.

(30) Section 2 (c) PL 79-585, op.cit.

(31) Dawson makes this point following an examination of AEC expenditures in the period 1947-1952. Dawson op. cit. pp.21-22.

(32) PL 79-585 Section 2(b).

(33) On the GAC and the H bomb decision see Hewlett R G and Duncan F. A History of the United States Atomic Energy Commission v2 Atomic Shield 1947-1952. Pennsylvania State University Press, Pennsylvania, 1969, pp. 383-395.

H.York, The Advisors:Oppenheimer, Teller and the Superbomb, W.H.Freeman San Francisco, 1976, pp. 41-65.

(34) See Green H. P. and Rosenthal, A., Government of the Atom, Atherton New York, 1963, p.4.

(35) Allardice and Trapnell op. cit. pp. 39-40.

(36) Green and Rosenthal op. cit. p.25.

(37) PL 79-585 Section 15 (b).

(38) In 1957 in an amendment to the 1954 Atomic Energy Act the JCAE obtained some authoritzation powers, with respect to reactor developments, which were further extended in 1963.
PL 85-79, 1957. PL 88-72, 1963.
See Green and Rosenthal op. cit. Chapter 5.

(39) See Green and Rosenthal ibid, pp. 12-17.

(40) ibid, p.266.

(41) For a more substantive examination of the period 1946 to 1950, and the concept of the national security state, see Yergin, D. Shattered Peace - the Origins of the Cold War and the National Security State, Pelican, London, 1980.

(42) On the plans of the military, see Rosenberg, D. 'The Origins of Overkill - Nuclear Weapons and American Strategy 1945-60', International Security, 1983, v7, No.4, pp.3-71.
Rosenberg, D. 'A Smoking Radiating Ruin at the End of Two Hours',International Security, 1981, v6, No.3. pp. 3-38.
On the interrelations between the military's plans and the AEC's activities see, Simpson, J. The Independent Nuclear State, Macmillan, London, 1983,
pp. 48-54.

(43) Northrop R.M. 'The Changing Role of the Atomic Energy Commission in Atomic Power Development' Law and Contemporary Problems, v, 1956, p.16.

(44) On the question of the stockpile see -
Rosenberg, D. 'US Nuclear Stockpile 1945-50', Bulletin of the Atomic Scientists, May 1982, p.25.
Also Lilienthal stated -

"What we of the new AEC had just discovered, in taking our inventory of nuclear materials and devices inherited from the Army, was that this defense did not exist. There was no stockpile." Lilienthal D.E. Atomic Energy: a New Start, Harper and Row, 1980, new York, p.1.

With respect to military plans and superpower relations see Rosenberg, 1983, op. cit. Yergin, op. cit. Chs. 8,13.

(45) The plan originally derived from a report to the GAC by Walter Zinn, Director of ANL, in January 1947. For background to the programme see -

Dawson, op.cit, pp.36-38.

(46) Atomic Energy and American Industry, Address by the Honourable David E Lilienthal, Chairman AEC, October 6th 1947.

Reprinted in pp. 194-198, US Congress JCAE, Atomic Power and Private Enterprise,Joint Committee Print, US GPO, Washington D.C. 1952 (hereafter referred to as Atomic Power and Private Enterprise).

(47) According to Northrop it was established in late 1948 but not activated until 1949. See Northrop, op.cit, p. 17, Dawson op. cit. p. 39.

(48) The GAC played a significant role in moving the AEC to accept the project, on which it was not very keen.

On the STR project see Hewlett R.G. and Duncan, F. Nuclear Navy 1946-1962, University of Chicago Press, 1974, Chicago.

Allen, W. Nuclear Reactors for Generating Electricity: US Development from 1946 to 1963, Rand Corp. June 1977, Santa Monica, R-2116-NSF,Ch.2.

Pringle P and Spigelman, J. The Nuclear Barons, Avon Books, 1981, New York, Ch. 10.

(49) On the Shippingport project see Allen, ibid, pp. 28-34.

(50) The strong relationship between the two was evident in the fact that R & D was spent on reactors for either military related propulsion systems or breeding purposes to alleviate the shortage of weapons material and uranium. See Northrop, op.cit. pp.15-18.

(51) For more details on the actual project consult Tybout R.A. 'The Public Investment in Atomic Power Development', Law and Contemporary Problems 1956. The AEC was expected to bear around 57% of the total costs of the project.

(52) An incisive analysis of the Truman administration's national security policy in this period can be found in Gaddis, J.L. op.cit. Chapter 4.

(53) For a discussion of NSC-68 see ibid.

(54) On the expansion see Simpson, op.cit. Ch. 3. On its implications for civil power see Dawson, op.cit. p.39-40.

(55) Monsanto's proposal is reprinted in pp.279-80. US Congress JCAE Atomic Power and Private Enterprise, op.cit.

(56) Allen op.cit p.20 discusses the AEC's goals. See also 'AEC Decision to Institute Industrial Particpation Studies' in ibid. pp.297-8.

(57) See Proposal for Atomic Power Study, December 11th 1950 from Detroit Edison and Dow Chemical, reprinted in Atomic Power, ibid. pp.296-7.

(58) Discussion of the programmes origins can be found in ibid. pp.1-9, Northrop, op. cit.

(59) The four groups were -

(1) Dow Chemical and Detroit Edison.

(2) Commonwealth Edison and Public Service Company of Northern Illinois

(3) Pacific Gas and Electric Company and Bechtel Corporation.

(4) Monsanto Chemical and Union Electric Company of Missourii.

For details of the work of these groups consult Allen, op.cit. pp.20-23

(60) By 1955 some 15 groups had produced reports.

See Northrop, op.cit. Dawson, op.cit. pp.51-2.

Dawson notes that something like $3m was spent by the companies in the period 1951-53.

(61) Allen, op.cit. p.24.

(62) See Northrop, op.cit. Allen, op.cit pp.23-24.

(63) In fact the AEC had never wholeheartedly supported the concept since it they had recognized the contradictions between the two objectives in relation to the generating experience of the Hanford plutonium producing reactors. This is noted in Dean, G. Report on the Atom, Eyre and Spottiswoode, London, 1954, p.138. Allen, ibid. p.12.

(64) Allen, ibid. p.28.

(65) For details of the work of these later groups consult Dawson, op.cit. pp.51-52. Also see USAEC Major Activities in the Atomic Energy Programs July to December 1954 (USAEC Washington, 1955) hereinafter USAEC Semi-Annual Report, pp.25-26, USAEC Semi-Annual Report, January to July 1954.

(66) Allen, op.cit. p.28.

(67) In his book Dean notes that -

"All agreed, however, that if private capital is to enter the atomic energy field and thus introduce real competition, the government must be prepared to create an atmosphere conducive to its entry on a 'risk' basis". Dean, op.cit. pp.151-152.

(68) On the actual programme see -

Allen, op. cit. pp.34-36. Dawson, op.cit. pp.43-45.

Regarding industry's welcoming response of the programme see -

AIF Nuclear Reactor Development - a Forum Report, AIF, July 1954, Washington D.C.

(69) Pressure for amendment of the McMahon Act had been stimulated by the Industrial Participation Programme and the AEC's internal studies of what restrained private involvement in reactor development.

See Dean, op.cit. pp.152-156. Allen, ibid. pp.24-27.

(70) For a discussion of the early relationship see Thomas, M. Atomic Energy and Congress, University of Michigan Press, Ann Arbor 1956, Ch. 1.

(71) See Green and Rosenthal op.cit. pp. 252-254.

(72) On the letter, see Thomas, op.cit. p. 144.

(73) Discussion of the hearings can be found in Dawson, op.cit. pp.53-58. For the actual hearings consult, US Congress JCAE Hearings Atomic Power Development and Private Enterprise, 83rd Congress, 1st Session, June-July 1953, US GPO, Washington D.C. 1953. Hereinafter cited as Hearings, Atomic Power Development.

(74) Hearings, Atomic Power Development, ibid. p.6.

(75) Clause 4 of the statement noted -

"We recognise the need for reasonable incentives to encourage wider participation in power reactor development and propose the following moves to attain this end.

(a) Interim legislation to permit ownership and operation of nuclear power facilities by groups other than the Commission

(b) Interim legislation to permit lease or sale of fissionable material under safe-guards adequate to assure natioanl security

(c) Interim legislation which would permit owners of reactors to use and transfer fissionable and byproduct materials not purchased by the Commission, subject to regulation by the Commission in the interest of security and public safety

(d) The performance of such research and development work in Commission laboratories, relevant to specific power projects, as the Commission deems warranted in the national interest

(e) More liberal patent rights than are presently granted to outside groups as may seem appropriate to the Commission and consistent with existing law

(f) Consideration of a progressively adjusted code for safety and exclusion area requirements as may appear reasonable in the light of operational experience with reactors. Competent state authorities will be encouraged to assume increasing responsibility for safety aspects of reactor operation. Financial responsibility associated with reactor operation will be assigned to the owners, in keeping with normal industrial practice

(g) Giving full recognition to the importance of reactor technology to our national security, a progressively liberalized information policy in the power reactor field as increasing activity justified.

On the full statement see 'Statement of Policy on Nuclear Power Development' pp.5-6 in ibid.

(76) 'Statements of Gwiyn A. Price, President and O.H.Weaver, Manager, Atomic Power Division, Westinghouse Electric Corporatiobn' in ibid. p.285.

(77) Green and Rosenthal, op.cit. p.253.

(78) On the programme and the JCAE's evaluation of it see US Congress JCAE Five Year Power Reactor Development Program Proposed by the AEC. Report of the Subcommittee on Research and Development, 83rd Congress 2nd Session, March 1954.

(79) For details of the Shippingport plant and it's independent 'nature' as a project consult Tybout, op.cit.

(80) This is discussed by Green and Rosenthal, op.cit. pp.253-4 and Thomas, op.cit. pp.144-5.

(81) On these broader changes in US foreign policy and its impact see, Gaddis, op.cit. Ch.5.

(82) The origins and debate on the proposal will be discussed in more detail in the following chapter.

(83) Allen, op.cit. p.30.

(84) For the full text consult US Congress House, Message from the President of the United States transmitting Recommendations Relative to the Atomic Energy Act 1946. February 17th 1954, 83rd Congress, 2nd Session, Doc. No. 328.

(85) ibid.

(86) ibid.

(87) On the New Look foreign policy and its broader ideological dimension see, Ambrose, S.E. Rise to Globalism, (3rd ed.) Penguin, London, 1983, Ch.8. Gaddis, op.cit. Ch.5.

(88) In his opening statement to the hearings on the 1954 Bill Rep.Holefield indicated that the AEC had forwarded draft legislation to the JCAE in 1953 upon which it had commented. This is also confirmed by Green and Rosenthal, see US Congress JCAE Hearings, S3325 and HR8862 to Amend The Atomic Energy Act of 1946, Part 1, May 1954 (US GPO Washington D.C.1954), pp.18-19. Hereinafter referred to as Hearings 1954, Green and Rosenthal, op.cit. p.123.

(89) Strauss was Chairman of the AEC but also Special Adviser to the President. This dual role, partly because of its constitutional implications (the AEC was established as an atonomous agency) but also partly because of personalities, created a tense relationship between the JCAE and Strauss. See Green and Rosenthal, ibid. pp.14-15.

More than likely the AEC role in drafting the international co-operation bill was limited since it had not been formally consulted over the Atoms for Peace proposal, and since much of the pressure for co-operation was related to military matters. Thomas, op.cit.notes "the fact was that policy on the international aspects of atomic energy was formulated at the Presidential level." p.164. But also see pp.158-164.

(90) See Green and Rosenthal, ibid. p.25.

(91) ibid.

(92) On the drafting process see ibid, pl25-6.

(93) Important changes from the AEC proposal were that:

(1) private ownership of nuclear fuel was dropped;

(2) it added new procedural requirements for international co-operation and

(3) differed in its approach to patent rights

See Dawson ibid p61-2

(94) The Stennis amendment, if carried, would have eliminated all but the international aspects of the bill.

A recommended motion was defeated. And the first conference report was rejected by the Senate.

See Toll op.cit The Atomic Energy Act of 1954 - Legislative History

Dawson, ibid, p70-2.

Green and Rosenthal op.cit, pp159-163.

(95) It delayed passage of the bill by 18 days. See Allardice and Trapnell op.cit, p43.

(96) Dawson makes the point about confusion.

Dawson op.cit p62-3. See also Toll op.cit.

(97) It was only strict partisan voting which ensured the hills passage; Republican unity had been generated by considerable White House lobbying, even to the extent of Vice President Nixon visiting the House. See Green and Rosenthal op.cit, p.pl158-9, 160-3.

(98) Hearings 1954, part 1, op.cit, p.16.

(99) Green and Rosenthal op.cit, p.12

(100) Uppermost in many Republican minds was the forthcoming mid-term congressional elections. Undoubtedly this was also instrumental in Decmocratic opposition to the bill.

(101) Many like Senator Bricker were suspicious of international co-operation and still retained a belief in the atomic secret. See the history of the international sections of the bill in Toll op.cit.

(103) US AEC Legislative History of the Atomic Energy Act of 1954 (Public Law 703 83rd Congress) USGPO Washington DC 1955
Hereinafter cited as Legislative History 1954, v3 p.3438.

(104) Such measures were proposed by Holifield and others. See Toll op.cit.

(105) In essence these amendments required that co-operation agreements came before the House for 30 days, and restricted the amount of information which the military could exchange. The AEC, DOD, and State Department opposed these amendments.
See Hearings 1954, p.603, pp.930-2.

(106) Those controls being finally enacted in Sections 123 and 144 of the act. See PL83-703 The Atomic Energy Act of 1954.

(107) See Toll, op.cit.

(108) Quite unusually the bill had to go to a second conference committee sessions because of its failure to pass the Senate. See Dawson, pp.71-2, Toll, op.cit. Green and Rosenthal, pp.165-7.

(109) On the details of the general ideological and political significance of the Dixon-Yates controversy consult Pendergrass, B. Public Power, Politics and Technology in the Eisenhower and Kennedy Years, Arno Press, 1979, New York.

(110) This was eventually enacted as Section 41 of the Act. See PL83-703,Section 41, op.cit.

(111) See Statement of Francis McKune in Hearings 1954, op.cit. p.685.

(112) US Congress Senate Report No. 1699, June 30th 1954, p.4.

(113) See Hearings 1954, Part 1, p.16.

(114) See Dawson, pp.64-66.

(115) In Green and Rosental's study they note that "By June and July 1954, private - power lobbyists were swarming through the corridors of the House and Senate ...". p.158, fn 104.

(116) Hearings 1954, Part 2, June 1954, p.575.

(117) ibid. p.907.

(118) The detail on this is covered in Dawson, op.cit. p.71.

(119) In particular it re-appeared in the guise of the Gore-Holefield Bill (1956) which sought a massive government development programme for nuclear power.

(120) The background to the contract was that in December 1953 the Acting Budget Director requested the AEC to explore the possibilities of obtaining private power for its Paducah facility expansion. Discussions were completed and the AEC informed the Bureau of Budget of its views. In June 1954 the Bureau, under a Presidential directive, instructed the AEC to commence negotiation with the authorities for a contract which would supply the TVA with privately generated power to compensate it for that which was consumed by the AEC. The object clearly was to restrict the expansion of the TVA. What heightened the controversy was that the AEC was divided on the issue, with the Eisenhower appointees, including Strauss in favour of it. The contract went ahead under Presidential direction. On the details see, Thomas op.cit. pp.165-7, Pendergrass, op.cit. pp.59-62, Wildavsky, A. Dixon-Yates: A Study in Power Politics, Yale University Press 1962, Yale.

(121) On this see Strauss, Lewis, L. Men and Decisions, Doubleday 1962, New York, Ch.15. Pendergrass, ibid. pp.33-37.

(122) Thomas, op. cit. p.165. Strauss,ibid. pp.301-2.

(123) Legally there was the issue of whether the President had the authority to order the AEC to act and thus to make policy for it.

This led on to the constitutional matter of the broader relationship between Presidency and independent agencies; was the executive getting too powerful? Ideologically there was the conflict betrween public versus private enterprise. Allegations of corruption arose out of conflict of interests between the administrations advisors, in the matter, and the utility companies. For a description of these issues see Strauss, Lewis. L. Men and Decisions, Doubleday 1962, new York, pp.303-4, p.309. Thomas, ibid. Pendergrass, op.cit.

(124) Mullenbach, P. Civilian Nuclear Power, Twentieth Century Fund, 1963, New York, p.103.

(125) Green and Rosenthal op.cit. p.159.

(126) Allardice and Trapnell, op.cit. pp.43-44.

(127) Of course it was not just normalizing patents rights that was seen as a subsidy but also the AEC's continued support of basic research and development activities; its proposed buy back of plutonium from civil plants which thereby made them more economic; its support of reactor development etc. See Dawson, op.cit. pp.64-69 and Hearings 1954, Part 1, pp.647-683.

(128) This was not as originally proposed by the administration or the AEC both of which wanted some protection against a monopoly emerging. The original bill had contained some protective measures which had been excised by Cole-Hickenlooper in the initial stages of drafting the new bill. See Dawson, ibid. p.64.

(129) Hearings 1954, Part 1, p.170.

(130) This was a problem which also concerned the AEC; it was not a spurious argument deployed by Democrats to further their cause. Allen notes that "It was also apparent to the AEC that if reactor technology were opened to commercial development, experienced contractors ... would have an advantage over those who had not been supported by the AEC. Not only had AEC contractors had access to

classified information on nuclear technology and experience in various facets of reactor engineering, they also had had the opportunity to become familiar with AEC operating and contracting procedures, and with AEC personnel. This disparity, commonly known as the 'preference' problem, warned the Commissioners." Allen ibid.

(131) Hearings 1954, Part 1, p.23.

(132) Legislative History - 1954, pp.3488-3489.

(133) In fact the AEC was also divided over the issue and had compromised on a 5 year transition period. See Hearings, 1954, part 1, p.648.

(134) Holifield perceptively commented upon this during the hearings "there is no utility company that I know of that specializes in patents. But they are working hand-in-glove with the machinery people and the chemical people, who do want the patents, and they are acquiescing in going along with their demands that there be exclusive patenting." quoted in Dawson, op.cit. p.66.

(135) ibid.

(136) This was recognized by all but the staunchest supporters of private development.

(137) US Congress, Conference Report No. 2639 in Legislative History 1954, p.3538.

(138) Voting on the bill in the Senate was 59-17. Green and Rosenthal, op.cit. p.167.

(139) See PL 83-709, Sections 41, 52, 53, 63, 142, 153, 54, 123, 32, 55, 56 ...

(140) Mullenbach, op.cit. p. 147.

(141) Dawson, op.cit. p.72. See also Green and Rosenthal, op.cit p.760-3.

(142) See the comments of Holifield and Price in Dawson ibid, p.73.

(143) Allen, op.cit., p.37-8.

(144) For industry's reaction to the bill consult AIF A Forum Report - The

New Atomic Energy Law - What it Means to Industry, AIF Washington, D.C., November 1954.

(145) Dawson, op.cit, p.75.

(146) Ibid, p.76.

Chapter 3: From Development to Commercialization: The Changing Balance of State-Industry Relations

Between 1954 and 1974 the nuclear energy industry in the United States underwent a dramatic transformation. Whereas in the mid-1950s civil nuclear power remained a largely technical dream by the early 1970s it had become one of the fastest expanding high technology industrial sectors in the whole US economy. Moreover, the technology with which American corporations were experimenting in those early days of nuclear power development had come to dominate the world market for commercial nuclear power. In seeking to discover what factors precipitated and facilitated this remarkable industrial transformation, this chapter will concentrate upon three specific themes. Firstly, the objectives and the role of state institutions, in particular the Atomic Energy Commission, in promoting the development of a civil nuclear industry will be explored. Secondly, the nature of the relationship between private industry and the AEC in the drive to commercialize nuclear technology will be examined. And, thirdly the politics of civil nuclear power development will be analysed, with particular emphasis upon the conflicts over public versus private development of atomic energy. By concentrating upon these three themes it is hoped that a simple picture may be sketched of the complex domestic forces which underwrote the US nuclear industry's international commercial and technological hegemony.

3.1 Partnership in Development 1955-1962

Under the 1954 Atomic Energy Act the AEC's functions and responsibilities were dramatically expanded such that its role in atomic energy development was significantly redefined. It was now expected formally to:

> encourage widespread participation in the development and utilization of atomic energy for peaceful purposes to the maximum extent consistent with the common defense and security and with the health and safety of the public. (1)

Initially the AEC had been primarily an operational agency; now it was to be primarily a promotional agency, with certain regulatory functions. Along with its redefined role went the acquisition of extended powers; it became a quasi-executive, quasi-legislative, and quasi-judicial body. It was given the authority to: formulate and execute policy; determine regulations; and assess individual regulatory cases.(2) Despite these significant powers it faced an enormous hurdle in promoting nuclear power, atomic power reactors remained in the purely experimental stage and they were also disasterously uncompetitive with other energy sources.(3) To establish commercial nuclear power as a reality the AEC, together with industry and the JCAE, recognized that major technical and economic obstacles would have to be surmounted.

During the 1956 annual hearings on the state of the nuclear industry the AEC restated and clarified its policy on power reactor development. Basic to that policy was a developmental strategy which involved several phases, starting with basic R & D, the construction of experimental and then demonstration power reactors, and culminating in the commercial exploitation of power reactor technology.(4) This was in many respects a post-hoc rationalisation of AEC policies and programmes for there was in practice no neat distinction between these development 'phases'. Construction of demonstration reactors, which were designed both to produce power and to establish which reactor technologies would be commercially viable, sometimes went ahead well before the operation of experimental reactors had been comprehensively assessed.(5) Moreover, the experimental reactor phase, which in theory was designed to establish the technological feasibility of a particular reactor design or concept, was confused with the demonstration reactor phase. Thus far from being the phased and progressive developmental programme, which the AEC claimed, not having:

> ... a comparable past effort nor any model of research, development and administration to refer to ... the AEC was forced to devise programs and to evaluate program outcomes on an ad hoc basis ... .(6)

An examination of power reactor development throughout the latter part of the 1950's confirms this assertion.

3.1.1 The Power Demonstration Reactor Program

Prior to the passage of the 1954 Act the AEC had proposed the Five Year Power Reactor Development Programme to assuage JCAE criticism, voiced in the 1953 hearings, of the pedestrian pace in reactor development. That programme, as noted earlier, involved the construction of five different experimental reactor types, with the object of assessing the technical feasibility of various reactor designs. Yet curiously when the AEC announced the first round in its follow-on Power Demonstration Reactor Programme (PDRP) on January 10 1955, none of the 5 experimental reactors in the five year programme had been completed. (7)

According to the AEC the PDRP was:

> ...designed to open the way for American Industry to develop, fabricate, construct and operate experimental nuclear power reactors.(8)

Like the Industrial Participation Programme the PDRP had the primary aim of engaging private industry in power reactor development but a major difference was that industry was required to build, own and operate the plants. Since private industry appeared reluctant to do this the AEC had devised the PDRP as a means of persuading it that the financial risks involved in early power reactor development could be partly offset through AEC assistance and cooperation. Although the AEC was strictly forbidden by the 1954 Act from subsidizing private industry the Act had provided it with sufficient autonomy and discretion to be able to offer, under certain conditions, assistance to private companies.(9) Basically that assistance involved:

> ... a. Waiving the established Commission charges for loan of source and special nuclear materials up to an agreed upon amount for a period of up to seven years from July 1, 1955...
> b. Performing in AEC laboratories without charge to the licensees certain mutually agreed upon research and development work;
> c. Entering into research and development contracts under

> Section 31a, for the technical and economic information resulting from development, construction, and operation of power demonstration reactors by contractors. The amounts to be paid by AEC under the contracts will be fixed in advanced and may be used for development, fabrication, and experimental operation.(10)

In effect such assistance was a subsidy to those willing to engage in private power reactor construction under the programme. It reflected the longer term objective of the PDRP: 'To advance the time when nuclear power will become economically competitive.'(11)

This long-term objective somewhat contradicted the AEC's projected image of the PDRP as a programme for the construction and operation of 'experimental nuclear reactors.'(12) In theory the demonstration programme should have been geared to making nuclear power economically competitive with other sources of electricity generation. It therefore should have involved the construction of fairly large-scale plants to evaluate and demonstrate their economic potential as opposed to their technical feasibility. The problem was that the AEC confused experimental and demonstration reactors so that the PDRP combined both; a point underlined by a Rand study of reactor development which concluded that

> Ideally, a demonstration program is begun after as many technical problems as possible have been identified and solved. Demonstration projects yield the most useful information when the technology can be tried in a setting very like its ultimate commercial environment. Until the early 1960s, the AEC often expected demonstration projects to provide solutions to some kinds of technical problems that would better have been addressed in experimental R & D programs.(13)

One crucial implication of this confusion was, as Allen notes, that it:

> ... in a number of cases not only guaranteed that some of the projects would fail, particularly those having high technical uncertainty - but also that the sources of failure would be difficult to determine. The AEC was unable to separate strictly technical problems from those stemming from a combination of technical and non-technical constraints.(14)

Thus far from the PDRP being a programme which involved an evaluation of technically proven reactor technologies, in order to assess which had the best commercial prospects, it combined proven and experimental technologies

making any such rational assessment extremely difficult. Partly responsible for this confusion was the inherent tension between the two objectives which the AEC set for the whole programme, in that it:

> ... was supposed to solve technical problems and to convince industry that reactors were mature enough to warrant investment in both R & D and commercial construction.(15)

As the history of the PDRP illustrates these were not necessarily mutually compatible goals.

In announcing the PDRP the AEC set a deadline of April 1st 1955 for submission of construction proposals. These proposals were to be evaluated by a Selection Board staffed from the AEC's Reactor Development Division, according to certain criteria such as:

> a. Probable contribution of the proposed project toward achieving economically competitive power;
> b. Cost to AEC in funds and materials; ...(16)

as well as factors to do with risks and the competence of the proposer. In all some four proposals were submitted and assessed. Yankee Atomic Electricity Company,a combine of 12 New England utilities, proposed a 175 Mwe PWR; the Nuclear Power Group, headed by Commonwealth Edison, proposed a 185 Mwe BWR; Consumers Public Power District proposed a 76 Mwe SGR; and finally the Power Reactor Development Company, consisting of a number of utility companies, wished to construct a 60.9 Mwe FBR.[17] None of these reactors, apart perhaps from the PWR, was of a proven technology; a fact which was recognized by the Selection Board.[18] But this was a secondary issue since what most influenced the Board's deliberations was the more pressing need to engage industry in reactor development and construction. According to Allen this fact alone accounts for the AEC's decisions on these first PDRP proposals:

> The Board argued that proceeding with all four projects as demonstration projects would provide incentive (sic) for potential supply and service firms to enter the market, thereby establishing a broad industrial base for future reactor development. The advent of competitive nuclear power would be accelerated faster than if only one or two proposals - to build reactors that were deemed truly ready for demonstration - were accepted. (19)

However for a number of different reasons all of the projects, were delayed for some time. (See Table 3-1) In the case of the Yankee Atomic project complications arose over its precise relationship to the Shippingport project, (then under construction), resulting in the signing of a revised contract in June 1956. An even longer delay, due to financial and technical matters, meant that the AEC and Consumer's Public Power District did not enter into a fixed contract until September 1957. Safety issues delayed construction of the Power Reactor Development Company's FBR project until January 1957. In fact by 1956 only the Nuclear Power Group had begun reactor construction and ironically this was partly due to the fact that it had withdrawn its request for AEC assistance shortly after the April 1st deadline. Negotiations between Commonwealth Edison, the largest of the utilities involved, and General Electric had resulted in agreement not to seek AEC assistance but to construct the first privately owned and operated reactor.(20) This inevitably sealed General Electric's commitment to BWR technology in the same way as the Shippingport project wedded Westinghouse to the PWR.(21)

Private industry's response to the PDRP was regarded as disappointing particularly by those Democrats on the JCAE who had pressed hard for public development of nuclear power. But even staunch Republicans too were dismayed by the response. What reinforced the political significance of this Democratic disgruntlement, however, was the fact that they were now the majority party in Congress, and on the powerful JCAE. Relying on this majority Senator Gore, (Democrat Tennessee) introduced a bill into the Senate, in July 1955, requiring the AEC to construct six nuclear power plants for electricity generation.(22) For various reasons the bill was not acted upon by the JCAE until the following session; nonetheless it had a significant political impact for in late 1955 the AEC announced a second round of its PDRP.

Table 3 - 1

POWER DEMONSTRATION REACTOR PROGRAM

Plant	Location	Reactor Type	Reactor Owner/Operator	Reactor Contractor	Start of Project	Initial Operation
Round One						
Yankee Nuclear Power Station	Rowe, MA	Pressurized water	Yankee Atomic Electric Co.	Westinghouse Electric Corp.	CP 1957	1960
Hallam Nuclear Power Facility	Hallam, NB	Sodium graphite	AEC/Consumers Public Power District of Nebraska	Atomics International	A 1960	1962
Enrico Fermi Atomic Power Plant	Lagoona Beach, MI	Sodium-cooled fast breeder	Power Reactor Development Corporation	Atomic Power Development Association	CP 1957	1963
Round Two						
Elk River Reactor	Elk River, MN	Boiling water	AEC/Elk River Rural Co-op Power Assn.	Allis-Chalmers Manufacturing Co.	A 1959	1962
Piqua Nuclear Power Facility	Piqua, OH	Organic cooled	AEC/City of Piqua, Ohio	Atomics International	A 1960	1962
La Crosse Boiling Water Reactor	La Crosse, WI	Boiling water	AEC/Dairyland Power Co-operative	Allis-Chalmers Manufacturing Co.	A 1963	1967
Boiling Nuclear Superheat Reactor (BONUS)	Punta Higuera, PR	Boiling water, nuclear superheat	AEC/Puerto Rico Water Resources Authority	General Nuclear Engineering Corporation	A 1960	1964
Round Three						
Big Rock Nuclear Power Plant	Big Rock Point, MI	Boiling water	Consumers Power Co.	General Electric Co.	CP 1960	1962
San Onofre Nuclear Generating Station	San Clemente, CA	Pressurized water	Southern Cal. Edison and San Diego Gas and Electric Cos.	Westinghouse Electric Co.	CP 1964	1967
Malibu Nuclear Plant	Corral Canyon, CA	Pressurized water	Dept. of Water and Power of City of Los Angeles	Westinghouse Electric Corporation	(CP) 1964	cancelled
Connecticut Yankee Atomic Power Station	Haddam Neck, CT	Pressurized water	Conn. Yankee Atomic Power Company	Westinghouse Electric Corp.	(CP) 1963	1967
Carolinas-Virginia Tube Reactor	Parr, SC	Heavy-water pressure tube	Carolinas-Virginia Nuclear Power Association	Westinghouse Electric Corp.	CP 1960	1963
Pathfinder Atomic Power Plant	Sioux Falls, SD	Boiling water, nuclear superheat	Northern States Power Company	Allis-Chalmers Manufacturing	CP 1960	?
Peach Bottom Atomic Power Station	Peach Bottom, PA	Gas cooled	Philadelphia Electric Co.	General Atomic	CP 1962	1966
Fort St. Vrain	Platteville, CO	Gas cooled	Public Service Co. of Colorado	General Atomic	CP 1968	?

A = Project authorization

CP = Construction permit granted

(CP) = Construction permit application filed

Source: Walter Zinn, Frank K. Pittman, and John F. Hogerton, Nuclear Power USA (New York: McGraw-Hill, 1964).

Although there is no direct evidence to prove definitively that the AEC announcement of a second round, in the PDRP, was intimately connected with Congressional rumblings about delay in the nuclear programme it is curious that it was sanctioned before any of the first round contracts had been agreed, and before any of the experimental reactors in the five year programme had become operational. This latter point is echoed by Allen who confirms that:

> the AEC did not have the information necessary for a rational structuring of the second round, which had been announced well before any first round plants got started.(23)

In addition the conditions attached to participation were made far more attractive financially than those in the first round. There was also a degree of positive discrimination in favour of small publically owned utilities.(24) As Green noted, AEC financial assistance in the second round was taken:

> to the extreme, even beyond subsidy. Indeed ... there is only slight resemblance and relationship between the concepts of the first and second rounds. Under the first round ... the costs and risks will be borne primarily by the private interests sponsoring the proposals ... Under the ... second round ... the projects are essentially Government projects, with the Government paying most of the costs and consuming most of the risks with only nominal participation by the private interests.(25)

This new round demonstrated the AEC's commitment to the successful implementation of its policy to promote power reactor technology. As for its timing it would not be inaccurate to conclude that it was dictated mostly by the AEC's desire to neutralize further JCAE intervention in the reactor programme. Such a conclusion is buttressed further by the AEC's 'campaign', throughout late 1955 and early 1956, to convince Congress as well as the press and the public, of the effectiveness of the PDRP and the rationale for private enterprise development of power reactors.(26)

Seven proposals for the construction of reactors under the second round of the PDRP were received by the AEC, all but two of which were purely experimental. Thus the same confusion between experimental and

demonstration reactors was inherited from round one, excepting that round 2 was in fact explicitly more experimental in character. This did not go unchallenged for the AEC's Selection Board 'questioned the wisdom of proceeding with experimental reactors in the framework of a demonstration program.'[27] Partly as a result of this two proposals were rejected, three progressed to contract negotiation stage but no further; leaving only two which after protracted negotiations were eventually built. (See Table 3-1).[28]

By mid 1956 contract negotiations between the AEC and the utilities with respect to the successful round two proposals had failed to progress since both parties were engaged in an exercise aimed at minimizing their potential financial commitments to the projects. This proved a major stumbling block to the rapid implementation of round two because all of the proposed reactors were experimental, so making it impossible to specify in advance any fixed total financial commitment since the slightest unforeseen technical problem, could vastly increase construction costs.[29] Clearly the AEC could not offer the utilities involved a series of blank cheques nor could the utilities enter into such an open-ended financial commitment. Thus round two of the PDRP appeared in mid 1956 to guarantee very little prospect of advancing power reactor development nor of enticing private industry into the construction (or utilization) of nuclear plants. Combined with the 'failure' of round one, which at that point had led to the signing of only one contract, this further set back precipitated a crisis of confidence in the AEC amongst members of the JCAE disturbed by the lack of progress in reactor development. This surfaced with the introduction of proposed legislation to expand the civil reactor programme.

3.1.2 The JAEC Intervenes

The Gore-Holifield bill was introduced into the Senate in early 1956 with the incipient backing of the Democratic majority. The bill threatened to wrest control over civil power reactor development from the AEC since it

sought to direct the Commission to:

> construct six nuclear power facilities designed to demonstrate the practical value of utilization facilities for industrial or commercial purposes ... (30)

Not surprisingly the AEC (along with private utilities and industry), vehemently opposed the proposal and throughout hearings on the bill emphasized the success of the PDRP. A 'Status Report on the Civilian Power Reactor Programme' was presented to the JCAE reiterating the need to maintain current policy with its stress upon private enterprise development.(31) But the AEC's arguments did not persuade the full JCAE, particularly the Democrats. Three factors in particular underlay Congressional unrest over the AEC's policy: the new scientific edge to the Cold War competition; the question of US technological superiority; and forthcoming Congressional elections.

With the Eisenhower administration came a 'New Look' to US foreign policy which had at its core, amongst other things, a conviction to demonstrate the moral and material superiority of the US (capitalist) system over that of the Soviet Union. (32) Science and technology therefore became a new arena for superpower competition. In this context rapid development of nuclear power was viewed by the administration not only as a means of advertising US technological supremacy, but also as a real practical solution to the energy problems of US allies, particularly Japan, and emerging Third World states. US technological hegemony in the nuclear field was perceived as a means of extending US political influence in the world, underpinning the vital energy security needs of both the 'old' and 'newly' emerging capitalist economies, thereby affirming the superiority of the Western way of life. Civil nuclear power technology thus became another medium through which the global struggle between competing socio-economic orders was fought. Politically, it was vitally important for the AEC to be able to convince Congress and the US public that the US was ahead of the Soviets in the civil nuclear power field.

This they found difficult to achieve since at the first UN Conference on Nuclear Power, in Geneva in 1955, the Soviets had surprised the western delegation by the advanced state of their programme.(33) As a result both Republican's and Democrats in Congress were concerned that the US might be (or even might just be perceived to be) trailing the Soviets in atomic energy development. Measures to redress this perceived 'technological gap' were thus sought.

Closely related to this cold war competition was the knowledge that the British had achieved considerable advances in civil reactor technology. In 1956 they were nearing completion of Calder Hall, a commercial sized dual purpose station. This prompted many on the JCAE to conclude that the US was losing its technological advantage to the British. Such a situation was unacceptable to both Democrats and Republicans alike. It was believed that, if successful, this challenge to US technological leadership would severely damage US prestige abroad, undermine the Atoms for Peace plan, and destroy potential export opportunities for the nascent US nuclear industry. For supporters of the Gore-Holifield bill these considerations strongly reinforced their commitment to a state backed programme to confirm US leadership in atomic technology.

Finally there were forthcoming Congressional elections. Democrats were aware that support for the bill would improve their public image, as the party committed to US technological supremacy. In this context they also recognized that Republican opposition to the bill would appear to the public at best as ambivalent, or at worst willing to place the interests of private industry, above that of the national interest. In opposing the bill the Republicans, as proponents of the private development of atomic energy, had to wrestle with an uncomfortable dilemma: too aggressive an opposition to Gore-Holifield might give the appearance of their favouring sectional private interests at the expense of the national interest whilst failure to oppose the bill would amount to tacit acceptance of public

development of atomic energy and the potential displacement of the private sector's role in the industry. The old conflict between public and private power advocates had reasserted itself.

Hearings on the Gore-Holifield bill were held in May 1956 and testimony was provided by a wide selection of public and private organizations.(34) The administation opposed the legislation because it would have expanded the public sphere; a move which it resisted in any sector for ideological reasons. Strong opposition from the AEC arose out of its natural bureaucratic instincts since the bill threatened both its autonomy and its executive powers over policy making and implementation. Representatives of the nuclear industry (the Atomic Industrial Forum), the utilities, (Edison Electric Institute) and the Coal industry (NCA) too considered the bill 'dangerous' since the proposed construction of publically owned and subsidized nuclear power plants could only harm private industry's vital interests. Indeed Green suggests that opponents:

> saw in the Gore Bill a mechanism to put the government into the nuclear power business and to impede private utility investment in this new area.(35)

Ranged against this powerful and united opposition were public power advocates, (American Public Power Association), the unions, (AFL-CIO) and a majority of Democrats in Congress. What strengthened the political credibility of their case was the general belief that private industry had failed so far to advance power reactor development. Exploiting this they argued that, as a result, the US now appeared to be losing its technolgical edge, and so it was vital to safeguard the national interest by initiating immediately a public programme of reactor development. Earlier in the year this view had been substantiated by the report of the independent McKinney panel, established to advise the JCAE, which had:

> recommended that the government should promptly take the initiative in power reactor development if private industry failed to act.(36)

Deliberations on the bill were dominated by this public-private power cleavage with its strong ideological overtones. In some respects it was

reminiscent of the controversy over the patent clauses in the 1954 act but the political context was now dramatically different. For despite the AEC's generous policy, private industry still remained reticent about investing in the technology; few plants had actually been constructed by 1956. Yet for the bill's proponents the urgency in demonstrating US technological supremacy in this field, because of the Cold War competition and the British technological challenge, had never been so acute. Advocates of public power and public development of atomic energy were therefore in a much stronger political position than in 1954 particularly so since Congress was now controlled by the Democrats.

This public-private power cleavage gave the controversy over the bill a highly partisan flavour although Republican opposition (because of the difficulty on this ocassion of reconciling private power interests with the national interest), was somewhat muted. In the JCAE the Republicans abstained so that the bill was carried by a Democratic majority 14-0.(37) In the Senate vote several Republicans either voted for it or abstained with the result that the bill was carried 49-40.(38) Nonetheless, voting was highly partisan reflecting the opposing ideological and political interests of both parties. Despite a Democratic majority the bill very narrowly failed to pass the House (191-203) since lobbying by coal industry and union interests had depleted the bill's natural support.(39) As a result the Gore-Holifield bill was lost. What was not defeated, however, was the political will of the public power constitutency which desired to see the redrawing of the boundaries between the public and private sphere so as to expedite power reactor development and utilization.

The failure of the Gore-Holifield bill led to renewed attempts by the JCAE both to influence the pace and the direction of the civil nuclear programme and to gain greater control over AEC policy. Again in an effort to forestall JCAE intervention the AEC announced a third round of its PDRP on January 7th 1957.(40) This third round was to be quite different from

the previous two since the AEC required proposals to make 'a significant contribution toward achieving commercial utilization of nuclear power.'(41) Moreover, the financial assistance offered by the AEC was significantly less than under the second round since support for reactor construction was withdrawn. On the other hand the AEC indicated that it was:

> willing to modify its position that all financial assistance under the Power Demonstration Reactor Programs must be fixed, closed-end, and agreed upon in advance.(42)

One consequence of this was that, as Green recognized:

> The organizations which assume financial risk by participation in the Power Demonstration Reactor Programs are now given some hope that the AEC may bail them out through additional ad hoc subsidy ... (43)

Clearly the AEC was attempting desperately to persuade private industry to participate much more intensively in power reactor development so as to accelerate the civil programme. This was partly a response to the legitimate JCAE criticisms about the slow pace of civil development, but also partly a means of fending off further political intervention against its strategy of promoting the private development and exploitation of atomic energy. But in addition to offering incentives the AEC threatened:

> ... construction of six specified reactor types which are regarded as "ready for full scale construction" if private industry does not submit acceptable proposals... (44)

This was designed as a warning 'shot' to the private sector of the consequences which would result from its continued unwillingness to engage itself more deeply with civil nuclear power development.

Since the deadline for the third round projects were set for 1962 there was no immediate rush of proposals. But by 1961, four had been accepted and were at various different stages of construction. (See Table 3-1) In addition, a further project was agreed in September 1962 bringing the total projects being supported by the AEC in the third round to five. By 1960, the third round appeared to be relatively successful. What was also significant was that of the five proposed reactors, three were light water reactors. And for the first time, General Electric and Westinghouse,

committed to the BWR and PWR respectively, were both participating in the programme.

BWR and PWR technology appeared to be advancing towards technical and commercial maturity. This was partly confirmed by the construction and operation of a number of privately financed BWR and PWR plants (see Table 3-2), namely Dresden 1 which came on line in 1959, the Saxton experimental PWR, and the partially privately financed Shippingport PWR, which began producing electricity in 1957. Of course, these privately or mainly privately financed projects still depended on a range of AEC assistance. Nonetheless, they became a significant political weapon in the AEC's battles against its critics in the JCAE. As Strauss, Chairman of the AEC, remarked in November 1957, at the dedication of the completely privately financed General Electric Vallecitos experimental BWR, such ventures provided:

> ... an irrefutable answer to those who contend that American industry cannot be entrusted with major responsibility in the development of nuclear power, that industry cannot be relied upon to shoulder the financial risks associated with the present stage of the nuclear art, and therefore that this new but fast growing industry should be dominated by the government - and fostered - entirely upon taxpayers money. (45)

This was an unabashed reply to the AEC's critics on the JCAE who following the failure of the Gore-Holifield bill had been heavily engaged throughout 1957 in attempts to expand public control over power reactor development by extending the JCAE's legislative authority over the AEC.

Despite the establishment of a third round in the PDRP the JCAE continued to pressure the AEC for an accelerated and expanded civil power reactor programme. But it turned to procedural mechanisms as a means to exert greater influence on the AEC's policy. Firstly it sought to extend its legal control over AEC expenditure by obtaining authorization power over that part of AEC finances spent on civil reactor development. This had been denied the JCAE in the original 1954 act but members of the JCAE realized that if it were to acquire such power it would be able to direct,

Table 3 - 2

—PRIVATELY FINANCED POWER REACTORS

Name	Location	Principal contractor [a]	Owner	Type	Power (kilowatts)		Start-up	Status
					Electrical (net)	Thermal		
Vallecitos Boiling Water Reactor.	Pleasanton, Calif.	GE	GE and PG&E.	Boiling water	5,000	20,000	1957	Operated satisfactorily during 1958. Primary function was testing Dresden fuel elements.
Consolidated Edison Thorium Reactor.	Indian Point, N. Y.	B&W	Con. Ed.	Press. water	255,000	500,000	1960	Construction began Jan. 28, 1958 and continued throughout the year.
Dresden Nuclear Power Station.	Morris, Ill.	GE	Com. Ed.	Boiling water	180,000	626,000	1959	Construction was 60 percent complete on Dec. 31, 1958; on schedule.
Humboldt Bay Project	Humboldt Bay, Calif.	GE	PG&E	Boiling water	50,000	180,000	1962	Preliminary design was essentially complete at year-end.

[a] GE—General Electric Co.
B&W—Babcock & Wilcox Co.
Con. Ed.—Consolidated Edison Co. of New York.
Com. Ed.—Commonwealth Edison Co.
PG&E—Pacific Gas & Electric Co.

Source: 23rd Semiannual Report of the Atomic Energy Commission
January 1958 Washington DC

or at least 'shape' the nature, size, pace and direction of the civil power programme since the AEC would thereby be required to obtain its approval to expend funds on any major projects.(46) Secondly, once it obtained authorization powers the JCAE would be able to insert into annual authorization legislation any projects which it regarded as necessary to the successful achievement of the nation's atomic energy policies. Quite clearly this would impose on the JCAE considerable responsibility since in effect it would give it a de facto executive function in determining, with the AEC, the nation's atomic energy policy. Moreover, since no President was likely to veto an authorization bill (because the AEC then would not be able legally to expend any funds) acquiring authorization powers was naturally viewed as a most effective route to influencing the content and direction of the civil power reactor programme given that ordinary legislation could be vetoed easily. Of course this depended in the first instance upon obtaining authorization powers.

Following the failure of the Gore-Holifield bill the JCAE, and in particular Chet Holifield, had pressed the AEC to include in the 3rd round of the PDRP four projects, based on GCR technology, in a bid to insure against the apparent British lead in commercial reactor technology.(47) By 1957 the British had opened Calder Hall, were in the process of constructing the Chapelcross station, and had published a White Paper setting out an expanded nuclear programme. Holifield's response to these British advances was not the expected one of reaching for legislative action; rather, it was decided to invoke the JCAE's newly acquired authorization powers to expand the AEC's reactor development programme.

Congress had amended the 1954 Act in early 1957, to give the JCAE greater control over the AEC's budget for civil nuclear development.(48) The necessary legislation only took just over a month to gain Congressional approval since it was unanimously adopted by the JCAE and attracted negligible opposition on the floor of the Senate or House. (49) The new

law gave the JCAE wide powers over the civil reactor programme, requiring the AEC to obtain approval for the expenditure of public funds on individual reactor projects and programmes such as the PDRP.[50] On the basis of this newly acquired authority the JCAE was able to force the AEC to consider its demands more sympathetically. [51] In doing so the locus of conflict between the the two bodies shifted as the JCAE

> chose to effect their civilian reactor policy through authorization legislation. They made it clear that such issues would henceforth be resolved in authorization bills, rather than by substantive legislation. (52)

The first test of its powers came with Holifield's attempt to include in the bill to authorize the AEC's 1958 expenditure an expanded nuclear programme. Although scaled down from his original request, Holifield's proposed programme included a study of a dual purpose reactor, $40m for a GCR, and $15m for a plutonium fueled reactor. Opposition arose over both the unprecendented detailed interference in the AEC's policy and the implicit extension of public development of atomic energy. [53] Consequently the final authorization legislation was considerably altered in Congress and the original Holifield programme was reduced to a $3m GCR design study. [54] Nonetheless its significance should not be underestimated: for it was an initial statement of the JCAE's potential ability to manipulate the AEC's reactor development programme.

Following hard upon this relative success the JCAE maintained pressure on the AEC, throughout 1958, to expand the civil programme by including GCR technology. The first opportunity came during hearings covering, amongst other things, the GCR study report authorized in the previous year. As expected Holifield and other Democrats castigated the AEC in the light of British advances, for its lack of commitment to GCR technology. [55] To remedy this the Democrats on the JCAE inserted into the authorization bill for 1959 expenditures a number of projects, including a GCR and a dual-purpose reactor for the AEC's Hanford facility. [56] The AEC's response was encouraging even though it was deeply opposed to such detailed

intervention by the JCAE in its policy making. (57) A compromise was therefore reached and the GCR was included in the 3rd PDRP round. However, the Hanford project stirred up a furious debate between the JCAE, the AEC, and the Pentagon.

As early as 1956 Senator Henry Jackson (Democrat, Washington) had urged the AEC to construct a dual-purpose reactor at its Hanford facility in Washington. (58) His argument was based upon the belief that such a project would accelerate the civil programme, by demonstrating power reactor technology in operation, whilst simultaneously meeting the military's plutonium needs. (59) Nor could he have been unaware of the political cudos such a project would bring him in his home state. Despite frequent failures to approve the project, the JCAE nevertheless assimilated it into the AEC's 1959 authorization bill.(60) At the hearings on the Bill the AEC sided with the Pentagon making it transparently obvious that it opposed the project on the grounds that it was unnecessary, since the US did not require any further plutonium production facilities. Moreover, the possibility of a publically funded power producing atomic plant inflamed the private power lobby so that Congressional discussion of the project became enmeshed yet again in the familiar public-private controversy. Despite this the Democrats on the JCAE were able to establish a strong case for the project and in so doing thoroughly undermined their opponents arguments. Their case was also assisted by the departure of Strauss, AEC Chairman, who for some time had been strongly opposed to the JCAE's 'interventionary' stance. (61)

Essentially the success of the 'Hanford project' lobby can be ascribed to three factors. Firstly the Pentagon's assertions that additional plutonium production capacity was not required was found to contradict the military's own recent statements before the JCAE subcommittee on agreements for co-operation (62) At issue was the fact that in requesting approval from the JCAE for amendments to the 1954 act to allow for a military

co-operation agreement, between the US and the UK, the military had repeatedly stressed how vital such an agreement was since it would enable the US to exchange enriched uranium for much needed British plutonium. (63) This appeared an explicit contradiction of the Pentagon's evidence to the JCAE that the Hanford project was superflous since the US could meet all its plutonium requirements from existing facilities. Divisions within the Pentagon and within the administration, over US plutonium requirements became increasingly apparent. Exploiting these divisions, as well as the Pentagon's desires to expedite the military co-operation agreement with the UK, the JCAE was able to obtain the reluctant acquiescence, of both the administration and the AEC, to the Hanford project. (64)

A further factor in resolving the issue was that an expansion of electrical generating capacity in the Pacific North West region was required if the local (publically owned) Bonneville Power Administration was to maintain a steady rate of growth. Operation of the Hanford reactor would generate surplus electricity so that:

> ... additional firm power previously sold to the AEC would become available for sale elsewhere.(65)

Although this was unlikely to entice Republican's to support the Hanford project it nonetheless added further cement to the unity of the Democratic majority.

Finally, a recent survey of industrial opinion by the AEC had highlighted increasing dis-satisfaction with its 'glacial'approach to reactor development. In a further survey this was reinforced by the majority view which favoured:

> ... acceleration of the civilian power program and stepped-up AEC expenditures on power reactor construction. (66)

Combined with the unrelenting pressure from the JCAE for expansion, the AEC and the administration, despite their misgivings, felt it politically unwise to sustain their opposition to the Hanford project.

The 1959 authorization bill, which included both the Hanford project and the GCR project, was passed by Congress and signed into law by the President in August 1958. Despite the President's staunch opposition to the Hanford project, he did not attempt to veto the bill recognizing that to have done so might have jeopardized funding of the whole civil programme. What this episode so clearly demonstrates is the JCAE's accretion of virtual executive power in relation to the civil programme; it had finally established itself as a joint partner with the AEC in the determination of civil nuclear power policy. (67) From 1958 onwards it consolidated its powerful position in the policy making structure. Construction of the Hanford reactor began in 1959 but private industry failed to respond to AEC invitations to construct a GCR under the PDRP third round so that the GCR project was adopted and financed by the AEC itself. This did not deter the Commission from continuing to sound optimistic about the PDRP. However there was still little real evidence to indicate that it was generating the kind of private industry commitment that the AEC had hoped for. Indeed the situation in 1958 was disappointing for whilst planned reactor construction was fairly impressive the number of operational reactors of any significant size was negligible. Moreover, apart from Westinghouse and General Electric, both of which had by this stage become totally committed to commercialization of the PWR and BWR respectively, few other major corporations appeared willing to invest in the technology. (68) As for private utilities since nuclear generating costs were still some 25-35% above those of coal fired stations there was little economic incentive for them to invest in what, after all, still remained a developing technology. (69) One consequence of this was that General Electric and Westinghouse developed greater commercial interest in demonstrating their LWR technology in foreign markets, like Europe and Japan, where both the economics of electricity generation and high dependence on imported energy sources favoured nuclear power. By 1959

General Electric and Westinghouse together had obtained foreign contracts for some six reactors which actually put them in a dominant position as regards the world reactor market. Yet as far as the domestic market was concerned private industry maintained that major economic and legal constraints still restricted the rapid exploitation of atomic energy.

3.1.3 Removing the Obstacles to Commercialization

In an attempt to remove one of the major obstacles to private development of atomic energy, namely industry's liability for nuclear related accidents, the AEC had introduced legislation into Congress in mid 1956. The essence of the problem was that both private utilities and manufacturers were concerned that without some clarification of their liability, in the case of a reactor accident, few could afford to invest in the technology since insurance premiums, if available, would be enormous. This was a situation which called for state action to determine the boundary between public and private (financial and legal) responsibility where such potentially catastrophic risks and financial burdens were involved. It was also a situation in which the fundamental contradiction between the AEC's roles as licensor, regulator, and promoter of atomic energy attracted initial public concern. (70) The liability issue therefore had to be managed delicately in order not to generate serious public disquiet and controversy.

Private industry's concern at the lack of any AEC policy on the matter first surfaced during the annual state of the industry hearings in 1956. Prominent amongst the critics of the AEC's neglect of the liability problem was Francis McKune of General Electric. Reflecting opinion within the industry he emphasised to the JCAE that the:

> ... gravest problem now facing the Atomic Energy business is that of liability for the consequences of an atomic incident.(71)

What he proposed, with the concurrence of many in the industry, was legislation to limit industry's liability to a maximum figure beyond which

the government would accept responsibility. (72) Both the Atomic Industrial Forum (the newly formed nuclear industry pressure group) and the AEC, following their own studies of the problem, broadly agreed with this strategy. (73)

Legislation was introduced quickly and hearings held in May to June 1956. (74) Although various approaches were considered the JCAE settled on indemnification as the most acceptable solution. This in effect meant that up to a certain level, utilities and others would have to obtain private insurance, but beyond that level the government would 'indemnify the reactor operator for sums up to $500m.'(75) If that sum proved inadequate then legislation provided for '...Federal contributions through additional congressional action ...'.(76)

Deliberations on the legislation ran into two constraints: time and expert knowledge of the likelihood and implications of a reactor accident. As a result legislation had to be reintroduced into Congress in early 1957.

At the JCAE's request, the AEC had undertaken to contract a study of the probability and consequences of various types of reactor accidents. The report from the study, forwarded to the JCAE in March 1957, became a central ingredient of Congressional deliberations on the indemnity legislation. 'Washington 740', as it was referred to, was the first comprehensive study of reactor safety.(77) What it highlighted was the fact that estimates of both probabilities and consequences of reactor accidents were extremely vague, uncertain and unreliable. This reinforced private industry's case that the indemnity approach, as proposed in the legislation, was the only viable solution to the liability problem. As industry argued, without a government indemnity the pace of power reactor development would be halted dramatically since the risks involved were so clearly incalculable that private insurance companies were unlikely to enter into insurance contracts with open ended liabilities. If the AEC and

the JCAE wished to persue commercial nuclear power development then this liability 'roadblock', as Dawson refers to it, had to be removed.

Hearings on the indemnity legislation, or the Price-Anderson bill as it was nick-named, proceeded through 1957. Reactor manufacturers, private utilities, the AIF, the EEI, the insurance companies, alongside a majority on the JCAE, all unanimously supported the bill. But the AEC, although staunchly supportive of the indemnity approach, disliked the bill's institutional and procedural requirements for the licensing of power reactors. The two issues (liability and licensing), were clearly substantively related since the licensing process existed to guarantee safety standards. What the AEC objected to, however, was the requirement that a statutory licensing process,which was also open to public scrutiny, be established. (78) This had been inserted in the bill in response to public and Congressional concern over the conflict between the AEC's promotional and regulatory functions which had come to the fore in its management of the PDRP. (79) In the case of the experimental fast breeder reactor - 2, which was part of the PDRP-round 2, the AEC had executed a contract with the proposer, the Power Reactor Development Company, even before the design had been formally licensed. Allen notes that:

> by executing the contract, the AEC in effect presumed that the reactor as designed could be operated safely ... (80)

Yet only in June 1955, the EBR-1 had suffered a core meltdown. (81) This case highlighted the dangers entailed in the fusion of regulatory and promotional functions in the one agency. One consequence of this was that the AEC underwent internal reorganization in early 1958 to separate its promotional and licensing responsibilities. (82)

Opposition to the Price-Anderson bill thus arose in part from the feeling that indemnification, combined with an AEC which was more interested in promoting than regulating the industry, would erode existing safety standards. However, the insertion of statutory licensing

requirements into the bill largely appeased those concerned about safety standards. The only other significant opposition to the bill came from the American Public Power Association, some Democrats, and coal interests. What united them was the intense dislike of yet another indirect public subsidy to the [private] nuclear industry. Regardless of any arguments to the contrary, the legislation was a clear subsidy; for as Dawson argues:

> By stating that it would not require full insurance, the JCAE indicated that an indirect subsidy to the reactor development program was intended (83).

However, without it private industry:

> were adamant that they would not proceed with substantial investments... (84)

Since the primary objective of the AEC's civil nuclear policy, was to create the conditions for private sector development and utilization of atomic energy, the Price-Anderson bill was crucial to its success. It thus gained overwhelming Congressional approval. Even the staunch cost-conscious Republicans voted in favour of what was essentially a clear subsidy and state intervention in the operation of the 'free enterprise system'. However, this was justified on the grounds that the measure was supposedly temporary, the object being to remove it once the industry was commercially viable. It was also perceived as vital to ensure the maintenance of US technological and commercial leadership in the nuclear field. (85) On September 2nd 1957, the Price Anderson bill was signed into law by the President (86) and with it:

> ... Congress took another step toward accomplishing one of the fundamental purposes of the 1954 Atomic Energy Act; namely "to encourage widespread participation in the development and utilization of atomic energy" ... (87)

In its continuing battle to assist ... 'private enterprise groups to overcome the obstacles created by Federal domination of the field ...' the AEC also attempted to 'liberalise' controls over atomic energy (88). Faced with criticisms from private industry, concerning restrictions on access to

atomic information, the AEC reacted with a concerted declassification exercise and relaxation of controls. Everyone recognized that further private development of nuclear power was:

> ... dependent, to a large extent,upon access to classified technology controlled by the AEC in the interests of the common defense and security... (89)

During hearings on the state of the industry in 1955, many representatives of private industry had complained about the rigidity of the existing system. Frances McKune of General Electric expressed:

> ... the need for more adequate information in order to operate effectively in the atomic field ...

suggesting that:

> ... to achieve the goal of widespread and effective private industry participation, a re-examination of the atomic information and security system is required. (90)

The AEC responded by quickening the pace of its declassification programme so that by 1958 it had declassified the bulk of all existing data on nuclear reactors. To effect further declassification it had to obtain the tacit consent of the UK and Canadian governments with whom long-standing agreements had been reached, for national security purposes, concerning the harmonization of classification policy. (91) Thus significant changes in declassification procedures were discussed and agreed at the 9th Tripartite Declassification Conference in September 1958.

Whilst the AEC's much more 'liberal' attitude towards declassification encouraged more widespread commercial availability of atomic energy related information the problem of access still remained. Data which still remained 'restricted' was available only to those with security clearances. In effect this meant those corporations and individuals with a long involvement in the nuclear field; the system discriminated against and was a barrier to new entrants. The result was that the established access programme encouraged the development of an oligopoly with the large corporations like Westinghouse and General Electric, effectively coming to

dominate the exploitation of the technology. (92) But the AEC countered any criticisms with the view that as declassification accelerated then access would become less of an issue. (93) Although access to information did widen throughout the late 1950s nonetheless it was too late to alter radically the tendencies towards an oligopolistic industrial structure which had been encouraged by the AEC's earlier information control policy. (94)

Besides 'liberalization' of information controls the AEC also initiated attempts to engage private industry in the construction and operation of fuel reprocessing plants. This was a radical development since not only was the technology classified, because of its intimate connections to weapons production, but also there would be no effective demand for such services until the commercialization of power reactors was attained in the distant future. Nevertheless in early 1956 the AEC announced:

> ... a programme to encourage private industry to build and operate plants for the chemical processing of irradiated fuel elements from research and power reactors, as a further step towards private ownership of atomic energy facilities .(95)

This was initiated with a series of classified seminars on reprocessing.(96) Private industry remained reticent, however, about investment in the nuclear fuel business because of the financial, technical, and legal risks involved. Moreover, as long as nuclear fuel remained a government owned monopoly there was little incentive for private involvement since corporations would be commercially dependent upon the AEC. Such dependence was already proving to be disastrous for the long term future of the uranium mining and milling industry as the AEC significantly reduced its demands for uranium for the weapons programme.(97) The AEC's reprocessing initiative thus failed to attract enough private support, despite offers of considerable subsidies and was forced into abeyance only to be reactivated in the early 1960s. One

consequence of these efforts, however, was to engender interest in the possibilities for private ownership of nuclear fuel.

3.1.4 The Remaining Barriers to Commercial Nuclear Power

By 1960, it was becoming obvious that technologically speaking PWR and BWRs were at the forefront of the power reactor development programme. Several PWRs and BWRs, both publically and privately financed, were either in operation or nearing completion. And, as noted previously, LWR's had already broken into the international market. If nuclear power was to be commercialized it appeared that LWR technology was likely to provide the initial economic breakthrough. But it still remained far from obvious when that might occur.

As far as potential demand for nuclear generating capacity was concerned, the prosperous economic environment of the late 1950s, solicited predictions of continued economic growth throughout the 1960s and 1970s which, in turn, suggested a significant market for nuclear plants. (98) Electricity consumption was expected to at least double in the decade 1960-1970 and annual growth rates, according to a range of studies, were put at a low of 4.3% and high 7.4%. (99) The Federal Power Commission's own estimates confirmed this phenomenal growth indicating a virtual tripling in steam generating plant capacity in the years 1960-1980. Opinion amongst utility companies, reactor manufacturers, the AEC, the FPC, and independent analysts converged on the expectation that the market for electrical generating plant would expand dramatically over the decade 1960-70.(100) Estimates of how far nuclear power plants might penetrate that market varied enormously, however. (101) The reason was simply that it depended crucially on the competitiveness of nuclear generating costs and the utilities expectations about the future availability and costs of fossil fuels. On the former comparison nuclear still remained distinctly uncompetitive whilst on the latter utilities, in general, believed that:

> ... no urgent demand for nuclear power exists in the United States ...

because

> ... ample reserves of low-cost fuels are available for many years of steadily expanding energy consumption. (102)

Confirmation for this came, not surprisingly, from coal producers and the domestic oil industry. Reactor manufacturers, the AEC, the JCAE, the AIF, the Edison Electric Institute, the uranium industry, and the administration held a contrary view arguing that the expansion of nuclear power, so long as it was economically competitive with other fuel sources, was preferable to continued reliance on fossil fuels. But even so there remained an intense conflict of interests between the utilities, on the one hand, whose interests lay in minimizing the costs of electricity production,and the nuclear reactor industry, backed by the AEC, whose interests lay in selling reactors which were not yet economically competitive but which had the potential to be so. Since the utilities remained to be convinced of the economic and other advantages of nuclear power, the AEC announced a modified third round in its PDRP on August 23rd 1962 in the hope of finally convincing them. (103)

This modified third round differed quite considerably from the previous rounds. As Allen notes its objective was to:

> ... support the construction of 'large ... base load, electrical generating facilities' to demonstrate proven reactors as reliable sources of electric power. (104)

What the AEC sought was to demonstrate to the utilities that reactor technology was now mature, as well as reliable, and that its generating costs could be keenly competitive with fossil fuel plants. It aimed therefore to select the projects for this modified round purely on the basis of:

> ... the lowest total assistance requested ... in terms of dollars per kilowatt of gross electrical capacity. (105)

One consequence of this, together with the emphasis upon large and proven reactor types, was to exclude anything other than LWR designs. (106) This was historically significant since it confirmed the technological maturity of the PWR and BWR and guaranteed their manufacturers a predominant position in the emerging domestic market. Of the projects accepted for AEC support, in this modified third round, both were PWRs. (107)

Shortly after the announcement of the modified third round the AEC published a seminal report on the status of nuclear power development. (108) As part of its larger review of future energy needs and available resources the Kennedy administration had requested the AEC in March 1962 to:

> ... take a new and hard look at the role of nuclear power in our economy. (109)

In November, after exhaustive study, it produced what became an historic report since it was the first major review of:

> ... where the nuclear electric power program should be headed, at what rate and with what amount of government participation. (110)

The report confirmed that the nations growing energy requirements would lead to a significant demand for new electrical generating capacity. Estimates of the market for new plant were put at approximately $6.5 billion by 1980 and $20 billion by the year 2000.(111) This was a huge market representing something approaching 1.5% and 4.5% respectively of total GNP in 1962. Moreover, the report made a cogent case for meeting this expanding electricity demand through nuclear power. It emphasized the importance of conservation, and the nations long term energy security noting that:

> ... the development and explotation of nuclear electric power is clearly in the near-and-long-term national interest and should be vigorously pursued. (112)

Thus it predicted that approximately 50% of electrical generating capacity would be nuclear by the year 2000 and that annual savings accruing from

what would then be a very much cheaper means of power production would amount to some $2-2.5 billion by 1990 and $4 - $5 billion by 2000. (113) In addition it also emphasized that even despite this projected massive growth in nuclear generating plant, energy requirements were so buoyant that there would still remain a significant demand for fossil fuel stations; a fact which it hoped would assuage the strong opposition to nuclear power from the coal and oil lobbies.

Fervently optimistic in its projections of nuclear power growth the report was nonetheless well aware that:

> Before commiting a substantial fraction of their installations to nuclear technology, utility executives will want to be convinced, themselves, that nuclear power is economical, reliable and safe. (114)

On these issues the AEC could offer some concrete evidence. Based upon its experience with different reactor technologies in the PDRP the AEC concluded both that LWRs were the:

> ... most highly developed reactors for electric power generation

and significantly that

> ... Although there is still room for improvement ... They are reliable and safe. (115)

On their competitiveness with fossil fuel generating plants the report, although optimistic, was realistically guarded carefully avoiding any unequivocal statements.

In 1962 nuclear generating costs still remained the primary barrier to the commercial acceptance and exploitation of nuclear technology. What made nuclear systems so relatively expensive was their high initial capital costs. According to Hogerton total generating costs of comparable sized nuclear and oil fired generating plant constructed in 1962, operating at 80% design capacity, were broken down in the following way: capital costs of 58% and 44% respectively of total generating costs whilst fuel costs accounted for 31% and 52% respectively. (116) Moreover, as plant

utilization or capacity decreased the ratio of capital to fuel costs would increase significantly for the nuclear plant. (117) If nuclear was to become competitive with fossil fueled plants major increases in design capacity (size), optimization of fuel use (via increased power densities and fuel burn up), and design improvements to ensure maximum utilization of plant were all required. By increasing plant size capital costs would be spread across a larger output which, combined with more efficient fuel use and plant utilization, would lead to very significant reductions in nuclear generating costs. (118)

The prospects for significant cost reductions through technological improvements were given great emphasis in the AEC's 1962 report. It argued that because of technical progress generating costs had been signficantly reduced:

> from the first actual experience of 50 mills per kwh at the Shippingport prototype reactor in 1958 to less than 10 mills per kwh for full-scale plants now in existence.(119)

Moreover, it was expected that the existing trend towards larger generating stations would give nuclear a competitive commercial advantage over conventional plants. Combined with advances in reactor technology the AEC estimated that a large LWR constructed in 1962 could generate power at less than 6 mills per kwh as compared with a range of between 4.1 to 6.2 mills per kwh for conventional plants. (120) Where conventional generating costs were at the higher end of the range nuclear was now, according to the AEC, just as economically attractive as fossil fuelled stations. (121) In their own estimation that covered:

> ... areas which now account for approximately one-third of the electrical energy consumption in the country. (122)

This was an extremely optimistic forecast, open to considerable criticism, but it was nonetheless authoritative and therefore had a significant influence on the utility industry's expectations about the prospects for commercial nuclear power.(123) The AEC fully recognized the tremendous

importance which such expectations played in the industry's investment decisions. It therefore sought to tap that general ideological commitment to technological progress which was already responsible for the widespread optimism surrounding nuclear power exploitation in the early sixties, to ease nuclear power into its commercial phase. (124) As the report indicated:

> In our opinion the above facts [competitive nuclear costs through technological progress] will, when demonstrated to their satisfaction, give to an appreciable fraction of the utility industry sufficient economic incentive to bring about extensive installation of nuclear electric power. (125)

All that was necessary was some:

> ... relatively modest assistance by the AEC ... (126)

By 1962 the AEC had expended some $1.275 billion of public funds for the development of civil nuclear power and continued to spend some $200 million annually. (127) Private industry had invested considerably less, in the region of $487 million, during the same period. (Table 3-3) And throughout the years of reactor development AEC expenditure had consistently outstripped that of private industry. This is not surprising since the AEC's promotional role required enormous expenditures; firstly to establish the necessary technological base; and then to subsidize, through the PDRP and other means, initial private development of power reactors. Moreover, as generating costs remained the only barrier to commercialization the AEC provided further assistance, through the 'Ten Year Programme', to help industry achieve competitive nuclear power costs by 1968.

The 'Ten Year Programme' had developed in reaction to the convergent pressures from industry and the JCAE, for the AEC to take a more determined leadership role in civil nuclear power development. (128) In June 1958 following the acrimonious debates of 1957, the AEC produced a statement on reactor development policy which in turn stimulated the JCAE to publish a

Table 3 - 3

Privately Owned and Financed Nuclear Power Projects, February 1962

Owner and location	Net capacity (ekw.)	Date essentially complete	Estimated costs[a] (millions)
Total	809,750		$298.9
Consolidated Edison Co. of New York, Inc., Indian Point, N.Y.	255,000	Apr. 1962	129.5
Saxton Nuclear Experimental Corp., Saxton, Pa.	3,250	Sept. 1961	6.8
General Electric Co. and others,			
Pleasanton, Calif. (boiling water reactor)	5,000	1957	3.0
Pleasanton, Calif. (superheat reactor)	—	Sept. 1962	9.9
Commonwealth Edison Co., Morris, Ill.	185,000	Sept. 1959	60.9
Pacific Gas & Electric Co.,			
Humboldt Bay, Calif.	48,500	July 1962	22.4
Bodega Bay, Calif.	313,000	Fall 1965	66.4

a. Research and development costs plus construction, as reported by the companies; in one instance, the Dresden plant (Morris, Ill.), full costs are understood not to have been reported by the manufacturer (General Electric Co.).

Sources: AEC, *Major Activities in the Atomic Energy Programs, January-December 1961* (Annual Report), Washington, January 1962, pp. 437 ff.; and Section 202 Hearings, 1962, pp. 589, 605-07.

Source: Mullenbach P. Civilian Nuclear Power Twentieth Century Fund N.Y. 1964.

report outlining an expanded civil nuclear programme. As a result the AEC established an advisory committe to investigate and evaluate its basic policy towards nuclear power as well as nuclear R and D. Following publication of this committee's report the AEC announced a 'Ten Year Programme', in early 1960, which aimed to bring about commercial nuclear power by 1968. It combined certain recommendations of the earlier JCAE report, particularly those concerning the construction of further demonstration plants, with a commitment to a revamped R and D programme designed to support the achievement of commercia nuclear power by 1968.

3.1.5 Approaching the Threshold of Competitive Nuclear Power

There can be little doubt about the crucial role played by the AEC, continuously prodded by the JCAE, in the development of civil nuclear power technology and in the creation of a private 'nuclear industry'. By institutional, financial, and legislative means the AEC, along with the JCAE, ensured that the state assumed the responsibility for the major risks entailed by the private exploitation of nuclear power. However as nuclear power, according to the AEC's report to the President, was nearly competitive and thus edging towards commercial exploitation, the Commission recognized the need to review its own role in civil nuclear development.

In reviewing its civil nuclear power policy the AEC indicated that its future role would not necessarily be less interventionary than in the past. Indeed it argued that a critical role for the AEC still remained.In the short term it would act as the catalyst for commercialization of power reactors and in the longer-term it would promote the construction and development of advanced breeder reactors. (129) For the immediate future the 1962 report stated that the AEC's efforts would be focussed primarily upon establishing a propitious environment for the rapid commercialization of nuclear power. As the report commented:

> In our opinion, economic nuclear power is so near at hand that only a modest additional incentive is required to initiative its appreciable early use by the utilities.

> Should this occur the normal economic processes would, we feel, result in expansion at a rapid rate. (130)

By continued support for private industry, through the R and D programme to achieve lower costs; through AEC fuel pricing policies; by the streamlining of regulatory procedures; and by promoting private ownership of nuclear fuels, the AEC sought to provide that necessary 'additional incentive'. In so doing it also sought to achieve its major policy objectives which were,

> ... 1. The demonstration of economic power ...
> 2. The early establishment of a self-sufficient and growing nuclear power industry that will assume an increasing share of development costs ... (131)

and

> ... 4. The maintenance of US technological leadership in the world by means of a rigorous domestic nuclear power program ... (132)

Having attained these it would then be able to concentrate upon its much longer-term goal of:

> 3. The development of improved converter and, later, breeder reactors to convert the fertile isotopes to fissionable cones, thus making available the full potential of the nuclear fuels. (133)

In summarizing the essential ingredients of its changing role the AEC strongly asserted its continuing vital contribution towards ensuring the full exploitation of nuclear energy by private enterprise -

> The role of the Commission ... must be one of positive and vigorous leadership both to achieve the technical goals and to assure growing participation by the equipment and utility industry as nuclear power becomes economic ... (134)

The AEC's Report to the President confirmed the general mood of optimism, predicated upon the belief that the technology was rapidly maturing, which had captured the nuclear 'establishment' and the wider public; a mood which Dawson attributes, in part, to the fact that:

> By the end of 1962, seven more of the civilian power reactors became operable ... Also, by the end of that year, three reactors - Dresden, Yankee and Shippingport - had each generated over one billion kilowatt hours of electricity ... Transition of the technology to industry was proceeding at a rapid pace. (135)

Relations between the AEC and the JCAE had also improved significantly as the civil programme appeared to be accelerating. Demands for a large

publically financed AEC reactor programme were no longer so vigorously pursued. Nonetheless, the JCAE retained a critical attitude towards what it viewed as the AEC's reticent approach to atomic power development. A fierce battle, over federal funding for the conversion of the Hanford reactor to allow power production, raged for over a year until finally, in late 1962, Congress authorized the necessary expenditure. (136) During this debate the JCAE demonstrated that it had not lost its fundamental enthusiasm for an expanded reactor programme. Moreover, the Hanford controversy spilled over into the annual authorization hearing with the consequences that additional projects were inserted, by the JCAE, into the AEC's programme in order, so it was argued, to guarantee fulfilment of the Ten Year Programme's objectives. Yet despite these interventions, one of the AEC's staunchest critics on the JCAE, Chet Holifield, reflecting upon the state of the industry in 1962, commented that:

> I believe it can be said that nuclear power is on the move. (137)

The AEC's report confirmed this:

> ... nuclear power is on the threshold of economic competitiveness and can soon be made competitive in areas consuming a significant fraction of the nation's electrical energy; relatively modest assistance by the AEC will assure the crossing of that threshold and bring about widespread acceptance by the untility industry. (138)

However, the AEC's confidence did not necessarily reflect the utility industry's opinions and even less so its actual investment policies. Indeed, one contemporary study noted that:

> ... the fact is that private utilities, eight years after passage of the 1954 act, had constructed only two full-scale plants without heavy government assistance ... The evidence raises the qustion whether the private utilities are prepared, even at this late date, to make the large investments called for by full-scale nuclear power.(139)

But with reactor manufacturers eager to effect sales, and the AEC willing to assist industry in crossing the 'threshold', the breakthrough to commercial nuclear power was zealously anticipated by all concerned.

3.2 Commercialization, Privatization and Regulation: 1963 to 1974

Although it provoked and inspired widespread optimism about the future of nuclear energy, the AEC's report to the President did not signal the commercial debut of nuclear power. (140) Indeed, it was over four years before the exploitation of nuclear power became a truly commercial, as opposed to developmental, endeavour. But within less than a decade, and ironically in the midst of the 1973 oil crisis, the industry was enveloped by its own structural crisis as orders collapsed and the market dissolved.(141) Throughout these years, from commercialization to stagnation, four major factors conditioned the politics of the state-industry relationship which had by then developed: the massive commercial expansion of the industry; the organized political pressure to extend private ownership to the whole nuclear fuel cycle; the changing role and functions of the AEC; and the ramifications of increasing organized opposition to nuclear power. The remainder of this chapter will examine the dynamic inter-relationships between these factors by focussing upon the commercialization process and the consequent form of the AEC-industry 'partnership'.

3.2.1 Commercialization 1963 to 1974

From 1954 through until the early 1960s the AEC had expended its financial, technical, and administrative resources in engaging private industry in the development of power reactors. That investment had proven relatively successful in that by 1963 LWR technology had been validated technically and a private reactor manufacturing industry, led by two of the largest US corporations, Westinghouse and General Electric, had been established. (142) What would determine the commercial success of this industry, was investment by domestic or foreign public or private utility companies in nuclear power stations.(143) Both Westinghouse and General Electric fully recognized that their own considerable investment in power reactor

technology could only be transformed into income and profit through a considerable sales effort. That required demonstrating to a reluctant utility industry that their concerns about the costs and uncertainties of nuclear, as opposed to conventionally generated, power were unfounded.(144) Both the AEC, and particularly the reactor manufacturers, faced the acute challenge of persuading a cost conscious, relatively conservative, but profit-motivated utility industry, to enter the nuclear age.

Apart from providing favourable conditions conducive to investment in nuclear plant, such as absorbing liability risks, guaranteeing competitive fuel prices, and maintaining an acquiescent regulatory environment, the AEC could do little more materially to assist the reactor manufacturers. Everyone agreed that the potential domestic market was massive: in 1961 the utility industry had invested $2,114 million in new generating plant;(145) and future investment was predicted to expand enormously as the economy continued to grow.(146) But, no private orders for nuclear plant had been received by any of the manufacturers since 1961 when General Electric had obtained the Bodega Bay contract; but even that was later cancelled.(147) Thus the major vendors, but particularly General Electric, recognized that if market resistance was to be breached then very positive incentives would have to be offered to the utility companies.

Both major reactor vendors, Westinghouse and General Electric, underwent significant corporate restructuring and management changes in 1963. Driven by the need to expand corporate profitability and their respective market position both had begun to diversify into new ventures, mostly in high technology products.(148) Nuclear power thus became a critical arena for competition between the two giants. For Westinghouse it was perceived partly as a means through which to attain considerable corporate expansion, in order then to challenge General Electric's dominant position in the world electrical industry.(149) Conversely, nuclear sales offered General Electric a new 'product' through which to consolidate and

reinforce its domestic and international competitive position. It was General Electric, which captured the first 'commercial' sale but only by subsidizing the original purchase.

Until the Three Mile Island accident in 1979, Oyster Creek was the most famous nuclear plant in the US since, according to the industry's folklore, it was the 'prince' which finally awoke the utility 'princess' to the commercial viability of nuclear power. Purchased by Jersey Central Power and Light company in late 1963, the Oyster Creek plant was a 560 Mwe BWR.(150) According to its own economic analysis, what had persuaded the utility company to invest in a nuclear, as opposed to a conventional station, was that the plant promised competitive generating costs, of between 3.42 to 3.97 mills/kwh.(151) This made it economically attractive since generating costs for fossil fuel plants, even with relatively cheap US coal, were somewhat higher at 4.3-6.4 ills/kwh.(152) Additionally General Electric (GE) offered Jersey Power and Light a 'turn-key' contract at a fixed price of $66m; GE would oversee everything from site construction to reactor engineering, installation, and initial operation so that all that the utility company had to do was to 'turn the key' following delivery.(153) This turn-key contract, at a fixed price, made GE's BWR not only cheaper than any comparable fossil fuelled station or PWR, but also cheaper than other reactor types.(154) It was therefore acclaimed as evidence that the breakthrough to commercially viable nuclear power had arrived. But if anything it had been prematurely induced for it did not occasion a 'flood' of nuclear sales.

Much mythology surrounds the Oyster Creek sale, but in particular the claim that it signalled the crossing of the competitive threshold is only partially accurate. In fact some five months earlier GE had been contracted by the Niagara Mohawk utility company to construct a 500 Mwe BWR (Nine-Mile Point -1) also on a turn-key basis.(155) Thus Oyster Creek was not the industry's 'commercial watershed'. Moreover, GE was engaged in

a strategy of 'loss-leading': it did not expect to make a profit on initial turn-key sales but rather planned to recoup its losses over at least three plants.(156) GE was desperate to attract business for as Gandara comments:

> ...if something was not done to attract the utilities to the LWR, the technologies for heavy-water and gas-cooled reactors, sold by competitors, might catch up. GE was locked into the BWR and stood to lose its investment if that happened. But more important, GE wanted quick market penetration to secure a market share for the boiling-water reactor.(157)

On this basis Oyster Creek, like its predecessors Nine-Mile Point-1 and Dresden 1, was subsidized by GE in order to establish a market share for the BWR. As such it was under-priced and in consequence not truly economically competitive with a comparable fossil-fuelled plant.(158) Therefore in reality commercial nuclear power did not begin with Oyster Creek although, given the intense publicity, the general public at the time could be forgiven for believing the contrary.

Certainly those in the utility industry responsible for investment in new generating plant were not totally convinced that commercial nuclear power had arrived, even with generous fixed price turn-key contracts. Following Oyster Creek there were no additional nuclear sales until early 1965; nearly 18 months elapsed from the two initial GE turn-key sales until further orders were forthcoming. In that time Westinghouse, in response to GE's initiative, had also begun to market turn-key plants, again in order to establish a market share for its PWR. But it was not until 1965 that it obtained its first 'commercial' order for the R.E. Ginna 490 Mwe PWR turn-key contract with Rochester Gas and Electric Corporation. Turn-key contracts, despite their generous nature, did not encourage a rush of new order's, for the utility industry remained cautious in its investment policy. This suggests that, contrary to the general opinion of many commentators on the history of US LWR development, the turn-key strategy and the Oyster Creek sale:

> ...were not as influential in commercialization as is often suggested.(159)

Reactor sales only began to increase dramatically in 1966, foreshadowing the first 'wave' of nuclear sales which reached its peak in 1967. With a new generation of larger and more technically advanced reactors a second sales 'wave' developed in the years 1969 to 1974. True commercialization of the LWR therefore effectively only began in 1966 and, in comparison with other technologies, had an unexpectedly brief existence. However, in the decade 1965-1974, domestic reactor sales totalled a staggering 188 units, equivalent to some 193 Gwe; operational and planned nuclear capacity approached over 40% of the then existing operational generating plant.(160) By September 1974 reactor sales (in dollar terms) alone had netted the four major reactor vendors some $102 billion; over 156,000 were employed in the industry with employment growth rates averaging 8.5% in the years 1968-1975.(161) Moreover, in terms of generating capacity, nuclear reactor orders began to outstrip those for fossil fuelled plants in the early 1970s.(162) But this 'Great Bandwagon Market' for the LWR, as Bupp and Derian refer to it, violently collapsed as the economic recession gathered momentum in the wake of the oil crisis. Orders declined from a peak of 35 in 1973 to 4 in 1975.(163) The 'Bandwagon' had ceased to roll forward and was perilously close to engaging reverse gear. How did this collapse come about?

3.2.2 The First Phase of Reactor Commercialization

The first 'wave' of reactor sales from 1966 - 1968 was a period of intensely rapid commercialization of the LWR. In 1966 alone a quarter more orders were placed for nuclear plants than in the whole decade 1955-1965. (See Table 3-4); potential nuclear capacity more than doubled. By 1968 investment in nuclear plant was absorbing over 68% of total utility capital investment in new generating capacity.(164) Such a huge domestic market offered to support more than 2 reactor vendors and thus Combustion Engineering, and Babcock and Wilcox, penetrated the Westinghouse, General

Electric, duopoly in 1967. With domestic sales in this period approaching $21 billion, employment expanded rapidly, and given a flourishing export market, the efficacy of the AEC's policy of relying upon private enterprise to develop and commercialize power reactor technology appeared proven beyond a doubt. Moreover, the expanding nuclear industry epitomized for many the technological supremacy of American capitalism and the inevitable progression towards a prosperous post-industrial society. (165) But the first phase in reactor commercialization ended inauspiciously as construction delays and cost escalation blunted 'the utilities enthusiasm' for the nuclear option.

Initially several factors had combined to overcome the utilities natural reluctance to invest in nuclear power. The one given most prominence, by many critics and proponents of nuclear power alike, is the loss-leading turn-key contract strategy by the major vendors.(166) Without doubt both GE and Westinghouse subsidized their turn-key sales, of which there were 13 between 1965 - 1967, to an estimated value of between $875 m and $1 billion dollars.(167); an average of between $73 to $78 m per plant and in terms of generating costs a subsidy of 1.7 mills/Kwh from the manufacturer to the utility.(168). Vendors also bore the escalating costs of plant construction thereby absorbing a significant unknown risk which it was believed acted as a disincentive to utility investment.(169) Yet, whilst turn-key contracting existed it attracted only 13 reactor sales; many more sales, some 27 in all, were effected through normal contractual arrangements in which the purchaser bore the risks.(170) Gandara, Perry and others claim this demonstrates that the turn-key strategy was nowhere near as effective or significant in LWR commercialization as has been suggested.(171) Nonetheless in 1965 all GE and Westinghouse's nuclear sales were turn-key contracts, as were most GE sales in 1966 prior to its abandonment of turn-key contracting in June 1966.(172) Therefore the significance of turn-key contracting in the initial phase of reactor

commercialization can not be totally dismissed, although it seems that other factors did intervene to persuade utilities that nuclear power was commercially viable.

If turn-key contracting was not the catalyst for rapid commercialization the events of Autumn 1965, when much of the Northeast suffered a complete electrical blackout, focussed utility attention on the advantages of both a 'national grid' and nuclear power.(173) Indeed the blackout reinforced the Federal Power Commission's (FPC) attempts to encourage greater regional inter-connection amongst utilities in order to meet the expanding demand for electricity. An inter-connected grid, so the FPC maintained, would allow utilities to maximize the efficient use of available investment capital, by exploiting economies of scale reaped through the joint purchase and operation of very large capacity plants.(174) Regional inter-connections, it was argued,would also provide greater security of supply. Under FPC guidance a number of utilities cooperated in the establishment of regional councils aimed at encouraging an integrated approach to investment in new generating capacity. One consequence of this regional cooperation was that it encouraged greater interest in nuclear plants. In part this arose from the assertion that:

> ...nuclear plants became more competitive as their size increased

combined with the certain knowledge that:

> ...utilities acting together could build larger and more economic power plants than they could manage singly.(175)

But this growing interest in nuclear power was also partly a product of the belief that the combination of regional cooperation and investment in nuclear plants would increase the reliability and security of supply for the utility's customers. Greater cooperation amongst utilities therefore hastened the erosion of individual utility resistance to investment in nuclear plant since it offered a mechanism for minimizing the costs and the risks involved whilst maximizing the predicted benefits.

Combined with the unintended consequences of regional cooperation the nuclear industry also benefitted from the utility industry's reappraisal of future fossil fuel costs. Until 1964 coal, which because of its relative cheapness accounted for nearly 66% of total generating capacity, had declined continuously in price.(176) And, in order to safeguard their future market share coal producers had even offered coal at below market rates in the hope of dissuading utilities from investing in nuclear plant. By 1965 this situation began to alter as coal producers recognized that nuclear was unlikely either to steal a significant slice of their largest markets, nor to arrest their potential massive growth; coal prices therefore stabilized. Naturally, this had an immediate impact on utilities since:

> ...unable to count on continued declining coal prices, the utilities turned their attention to nuclear power in late 1965.(177)

Nuclear plants also offered the utilities a partial solution to the increasing cost burden of regulatory constraints upon the operation of fossil fuelled, but particularly coal burning, generating plants. As the environmental lobby gained momentum, at both the local and federal levels, coal producers and users came under increasing pressure to minimize the ecological damage and environmental pollution resulting from their activities. Raising pollution standards meant increased costs, particularly for those utilities burning high-sulphur content fuels, forcing the industry to consider an appropriate, but simultaneously profitable, response to the changing regulatory climate. It is somewhat paradoxical, given later environmental opposition to nuclear plants, that in the mid-1960s many utilities viewed nuclear technology as the solution to their environmental problems. For, as Gandara acknowledges:

> ...Nuclear plants were seen as clean sources of power compared with dirty fossil-fuelled plants ... particularly for utilities that operated coal-fired or oil-fired plants in urban or highly industrialized areas.(178)

Added to which, environmental opposition to nuclear plants had not yet been effectively mobilized.

Growing interest in nuclear power was rapidly translated into real orders, throughout 1966 and 1967, as utilities re-appraised their investment policies. Besides deteriorating fossil fuel prices, the emergence of regional cooperation, and environmental pressures, by the mid 60's the operating experience of a number of demonstration LWR's provided utilities with firmer evidence upon which to base their investment decisions. This early construction and operating experience was quite favourable and so strengthened the case for nuclear power. With utilities committed to massive increases in capital spending to meet projected electricity demand, together with the easy availability of external financing, the rapid acceleration in nuclear orders throughout 1966 and 1967 was virtually guaranteed.(179) For many utilities joining the 'great nuclear bandwagon' was crucial in the struggle to maintain a comparative advantage over their competitors; the new technology, with its expected greater reliability and economies of scale, promised just such an advantage to those who could afford to invest in it. (180)

A mixture of incentives, constraints, and motivations determined the first phase of reactor commercialization, culminating in a record 30 plant orders in 1967.(See Table 3-4) In that year alone more nuclear capacity was ordered than in the preceeding twenty-three years combined (1955-1967 24.07 Gwe; 1967 25.63 Gwe). Yet by 1969 nuclear orders had slumped dramatically, as construction costs escalated alarmingly, rising well above originally quoted purchase prices.(181) Since the majority of utilities had to bear these unanticipated cost increases there was a very sudden deceleration in the rate of nuclear ordering. Cost increases were further compounded by the lengthening delays in reactor construction and licensing.(182) Even the famous Oyster Creek plant encountered more than a year's construction delay.(183) Rather than experiencing (as vendors had

Table 3.4

US Domestic Nuclear Reactor Market

Year of Sale	Babcock & Wilcox			Combustion Engineering			General Electric			Westinghouse			Total	
	A	B	C	A	B	C	A	B	C	A	B	C	A	B
1955-1965							10	5,401	72	4	1,690	23	16[1]	7,471[1]
1966	3	2,564	15	2	1,278	8	9	7,746	47	6	5,015	30	20	16,603
1967	5	4,380	17	5	4,118	16	7	6,223	24	13	10,912	43	30	25,633
1968	3	2,177	17	0	--	0	7	6,194	48	4	4,532	35	14	12,903
1969	0	--	0	1	1,070	15	3	2,944	41	3	3,189	44	7	7,203
1970	2	2,426	17	4	4,225	29	3	3,951	21	5	4,664	33	14	14,266
1971	2	1,814	19	0	--	0	4	4,603	28	9	8,705	53	15	15,122
1972	5	5,336	15	2	1,990	6	13	15,450	45	10	11,546	34	30	34,322
1973	3	3,072	8	11	13,554	34	7	7,527	19	14	15,709	39	35	39,862
1974	6	7,119	26	4	4,730	17	6	7,213	27	7	7,996	30	23	27,058
1975	0	--	0	0	--	0	0	--	0	4	4,100	100	4	4,100
1976	3	3,440	100	0	--	0	0	--	0	0	--	0	3	3,440
1977	0	--	0	4[3]	5,100[3]	100	0	--	0	0	--	0	4	5,100
Totals	32	32,328	15	33	36,065	17	69	66,252	31	79	78,058[2]	37	215	213,063

Legend: A=Number of units sold; B=Net capacity sold (MWe); C=Percent of total market(%)
Notes:
1 Includes 50-MWe LaCrosse sold by Allis-Chalmers in 1962, and 330-MWe Fort St. Vrain sold by General Atomic in 1965.
2 Includes four 1,150-MWe units sold by Offshore Power Systems.
3 Limited to preliminary engineering & licensing work done for 1,250-MWe nuclear steam supply systems (NSSS) for New York State E&G Corp. and preliminary planning & licensing work for two 1,300-MWe nuclear units, designated Palo Verde 4 & 5 for Arizona Public Service Co.

Source: *Electrical World*, January 15, 1978, p. 39.
Data is uncorrected for cancellations in 1978.

Source: Duffy G. et al Power Politics Council on Foreign Relations 1978

promised) declining costs, arising from a construction learning curve and greater plant standardization, utilities had to bear cost increases of some $100 to $150 per kilowatt which in some cases approximated 90-100% of the original estimated cost.(184). Vendors recognized the inevitability of cost escalation and increased their contract prices to reflect the new reality.(185) Caught between rising costs and construction delays, utilities reduced their commitment to nuclear power and began directing new investment into the construction of fossil fuelled stations.(186) This was most strikingly reflected in the changing balance between nuclear and fossil fuel plant orders; whereas in 1966 53% of new orders (in terms of capacity) were for nuclear and 47% for fossil fuelled plants by 1968 this had altered to 37% and 63% respectively.(187) Orders continued to decline and in 1969 only 7 new nuclear plants were contracted for. The initial phase of reactor commercialization had all but expired.

3.2.3 The Second Phase of Commercialization

Signs of a revival in the reactor market began to emerge in 1970. Indeed by the end of the year orders had doubled over those of the previous year. A second phase or wave of commercialization had arrived but one which arose from quite different circumstances than the first. Between 1969 and the end of 1974 some 124 nuclear units were purchased totalling a staggering 137 Gwe.(See Table 3-4) In value terms the domestic market was now enormous: the AEC's annual report on the state of the industry in 1974 noted that:

> ...The magnitude of American investment in nuclear power can be best illustrated by the fact that over $102 billion are presently committed to the nuclear power program.(188)

Total employment also expanded rapidly from some 141,727 in 1968 to 162,599 by 1975; in the private sector this growth was even more marked with a phenomenal 77% increase over the same period.(See Table 3-5) This second phase of reactor commercialization involved an unprecedented

Table 3 - 5

APPENDIX C: EMPLOYMENT IN THE US NUCLEAR INDUSTRY

Employment in the Atomic Energy Field, 1968-1975

	1968	1969	1970	1971	1973		1975		1968-1975 Growth Rate (%)	
					Adj.	Unadj.	Adj.	Unadj.	Adj.	Unadj.
Private	42,728	49,794	55,515	61,464	73,126	85,756	75,650	108,092	8.5	14.2
Scientists	2,393	2,524	2,507	2,657	2,927	3,819	2,889	5,281	2.7	12.0
Engineers	9,802	11,690	12,966	14,781	18,430	21,098	21,597	30,177	11.9	17.4
Technicians	9,007	10,939	13,049	14,332	15,638	17,928	16,714	22,915	9.2	14.3
Other	21,526	24,641	26,993	29,694	36,131	42,911	34,450	49,719	6.9	12.7
GOCO	98,999	99,626	98,609	95,470	83,204	85,109	86,949	89,374	-1.8	-1.4
Scientists	10,631	10,468	10,154	9,782	9,622	9,746	9,729	9,871	-1.2	-1.0
Engineers	12,833	13,205	13,065	12,818	11,726	11,943	12,705	13,056	-0.1	0.2
Technicians	16,386	16,138	16,415	15,383	13,450	13,905	13,496	14,142	-2.7	-2.1
Other	59,149	59,815	58,975	57,487	48,406	49,515	51,019	52,305	-2.1	-1.7
Total	141,727	149,430	154,124	156,934	156,330	170,865	162,599	197,466	2.0	4.9

Source: Duff op.cit.

expansion of the industry making it one of the fastest growing, and potentially most highly profitable, industrial sectors in the US. Nuclear power had not just penetrated the electric utility market but had begun to dominate it; from 1972 onwards annual orders (in terms of capacity) for nuclear plant exceeded those for conventional generating plant, until the slump in orders in 1975.

Several factors contributed to this revival and expansion of the industry, amongst the most salient being the events in the coal and oil markets. Coal prices had increased steadily from 1969 onwards. This was compounded by much stricter environmental legislation and controls which, following the National Environmental Policy Act of 1970, had also led to increased generating costs.(189) As the competitiveness of coal declined that of oil and nuclear power was enhanced. But domestic oil prices too were increasing. Following the 1971 Teheran and Tripoli agreements amongst OPEC producers, world oil prices began to rise considerably; utilities fully recognized that domestic fossil fuel prices could not be insulated from movements in world prices.(190) Numerous contemporary studies also confirmed that indigenous oil production would be unable to meet domestic demand, necessitating an increased dependence upon foreign oil.(191) Combined with this was the emerging fear of an energy crisis, following a number of studies, such as the Club of Rome and Ford Energy Project, which predicted, amongst other things, growing energy and resource shortages.(192) Such fears had been instrumental in the Nixon administration's establishment of Project Independence in November 1973, following the Arab oil embargo of the US. (193) Motivated by both the increasing costs of fossil fuels and the desire to diversify their generating plant mix, utilities rapidly expanded investment in nuclear plants in order to ensure future reliability and security of supply for their customers. (194) For utilities the nuclear option offered competitive generating costs (at least according to official estimates) as

well as a fuel which, with predicted future plutonium recycling and the FBR, was regarded as virtually inexhaustable. (195) Nuclear power therefore appeared to provide a technological solution to the economic and strategic problems which weighed upon the utility industry in the early 1970s.

As investment in nuclear power increased throughout this second phase it coincided with changes in the structure of the utility industry. Orders for nuclear plants were concentrated amongst the largest utility companies since only they could afford to finance the necessary capital investment. Thus by 1975 the top third of utilities accounted for over fifty per cent of planned, operating, or nuclear plants under construction.(196) But as the costs of nuclear plants escalated, smaller utilities (revenue less than $100m) were increasingly disadvantaged being unable to afford the necessary investment capital, whilst even many larger ones (revenues greater than $100m) wishing to embark on nuclear programmes faced enormous financial burdens in doing so. One consequence of this was a very marked increase in the number of joint ventures entered into by utility companies in order to diffuse the risks of nuclear investments. During the period 1970 to 1974, thirty-nine joint venture plants were ordered compared with twenty-three during the first phase of commercialization. (197) More significantly was the fact that, as inflation and the general financial climate for utilities worsened, throughout 1973 and 1974, joint ventures accounted for a remarkable proportion of new orders: in 1973 41% and 40% in 1974. (198) Joint ventures provided a mechanism by which many small and medium sized utilities could maintain both their 'independent' corporate existence and technological parity with the major utility companies. Greater co-operation and integration, amongst utilities, with the consequential pressures for further concentration of ownership, was both a cause and a consequence of the rapid investment in nuclear power during this second phase of commercialization.

Technological innovation and advances in reactor design and operation also contributed to this rapid investment since they promised utilities greater economies of scale than with most conventional plant. Vendors had continuously upgraded the size and efficiency of their reactor models such that by 1974 very few sales were for plants below 1100Mwe. Moreover, with the exception of Westinghouse, all the vendors were offering plants of up to 1300Mwe which was the maximum permitted size. (199) Technical and operational improvements had further enhanced the theoretical efficiency, and thus the economics of nuclear plants. For instance, GE's most advanced BWR (the BWR 6) had nearly double the burn up rate, a third greater power density, and higher efficiency, than the path breaking Oyster Creek (BWR-2) design. (See Table 3-6) Such technical advances were replicated by other major vendors. (See Table 3-7)

Alongside these technical improvements the major vendors, Westinghouse and GE, initiated procedures to obtain AEC approval of standardized reactor designs. Standardization was aimed at reducing construction costs and delays, as well as expediting the lengthening, and increasingly fraught, plant licensing process. (200) Whilst its origins lay in the initial phase of reactor commercialization, when both the major vendors (Westinghouse and GE) had initiated their standardization programmes mainly with the object of minimizing production costs and delays, it became singularly important in this second phase since it offered both vendors and purchasers a partial solution to some of their most urgent problems. In particular, it held out for the major vendors a mechanism for maintaining continued dominance of the reactor market, through a combination of: the containment of manufacturing costs resulting from greater economies of scale in production; more efficient plant construction; and, as a marketing advantage, a less burdensome and time-consuming licensing process. For utilities the potential gains, although far less immediate than for the vendors, revolved around the containment of escalating construction costs,

Table 3 - 6

GENERAL ELECTRIC PLANTS--BWR

Plant	Start Year	Operating Year	Elec. Power	Thermal Power	Efficiency	Height	Core Diameter	Volume	Fuel Inventory	Power Density		Burn-up	No. of Loops
			MWe	MWth	%	m	m	m^3	tonnes	kw/l	kw/kg	MWd/te	
Dresden 1 (BR-1)	2/57	6/60	210	690	30.4	2.7	3.3	23.1	57,600	33	12.0	12,000	4
Oyster Creek (BR-2)	3/64	12/69	670	1930	34.7	3.66	4.07	47.6	125,000	40	15.5	15,000	5
Quad Cities (BR-3)	3/66	1/73	850	2510	33.8	3.66	4.82	67.0	155,000	39	16.2	19,000	2
Brown's Ferry 1 (BR-4)	2/67	7/74	1100	3290	33.4	3.66	4.82	67.0	169,000	49	19.5	19,000	2
La Salle 1 (BR-5)	2/71	1979	1120	3290	33.8	3.66	4.78	65.5	149,000	50	22.1	27,600	2
Perry 2 (BR-6)	10/74	1980	1250	3580	35.0	3.76	4.65	62.5	138,000	57	26.0	28,000	2

MWe = Megawatts electric
MWth = Megawatts thermal
m = meters
m^3 = cubic meters
tonnes = metric tons (1000 kg)
kw/l = kilowatts/liter
kw/kg = kilowatts/kilogram
MWd/te = Megawatt days/metric ton

Source: Perry R. et al Development and Commercialization of the LWR 1946-1976 Rand Corp. Santa Monica June 1977 R2180-NFF

Table 3 - 7

WESTINGHOUSE PLANTS--PWR

Plant	Start Year	Operating Year	Elec. Power	Thermal Power	Efficiency	Height	Core Diameter	Volume	Fuel Inventory	Power Density		Burn-up	No. of Loops
			MWe	MWth	%	m	m	m^3	tonnes	kw/l	kw/kg	MWd/te	
Shippingport	1955	1958											
Yankee (Rowe)	1957	1/61	185	600	30.8	2.4	1.9	6.5	20,700	92	28.9	25,000	4
Haddam Neck	1/64	1/68	600	1825	32.7	3.07	3.03	22.3	75,000	82	24.3	30,000	4
San Onofre	5/64	2/68	450	1350	33.4	3.07	2.82	19.0	57,000	71	23.6	30,000	3
R. E. Ginna	2/64	5/70	470	1520	30.9	3.66	2.44	17.2	52,000	88	27.0	29,000	2
H. B. Robinson 2	4/67	1/71	730	2200	33.1	3.66	3.04	26.6	71,400	83	30.8	31,000	3
Surry 1	4/68	10/72	820	2440	33.6	3.66	3.04	26.6	70,000	92	34.8	31,000	3
Zion 1	2/68	8/73	1050	3250	32.2	3.66	3.55	35.6	99,000	91	32.8	22,000	4
Trojan	10/69	9/75	1130	3425	33.0	3.66	3.45	34.2	101,000	100	33.8	24,000	4
Callaway City 1 (SNUPPS)	1976	1982	1150	3425	33.6	3.66	3.45	34.2	95,000	100	36.0	25,000	4
South Texas	1976	1982	1250	3800	32.9	4.27	3.45	39.9	110,000	100	34.5	25,000	4

MWe = Megawatts electric
MWth = Megawatts thermal
m = meters
m^3 = cubic meters
tonnes = metric tons (1000 kg)
kw/l = kilowatts/liter
kw/kg = kilowatts/kilogram
MWd/te = Megawatt days/metric ton

Source: Perry op.cit.

resulting from lengthy construction delays which were usually the product of either construction problems or the complexity of the licensing process. Although undoubtedly significant in financial terms, such potential savings were, in 1973, when the AEC announced the criteria for licensing of standardized designs, very much in the distant future. Nonetheless, standardization was welcomed by most utilities as confirming the maturity of the technology and substantiating the hoped for trend towards cost containment. It helped to ameliorate some of the utilities worries about continued investment in nuclear generating plant. Far more immediately significant for individual utility company decisions about nuclear investment was the availability, by the early 1970s, of considerable operating experience combined with a collective euphoria about the nuclear option.

According to the AEC there were forty power plants operating in the US in 1973, generating some 24 Gwe of power. (201) This amounted to approximately 5.5% of total electrical generating capacity. There was thus a considerable fund of construction and operating experience from which to extrapolate. What is interesting, however, is that despite that experience demonstrating a progressive increase in the capital costs of nuclear plants (see Table 3-8) and generating costs which rarely reflected initial expectations, nuclear plant orders continued to rise throughout the early 1970s. The explanation, according to Burn, lies in the fact that not only had the capital costs of fossil fuelled plant increased dramatically too, but also as noted earlier:

> ... the prospect of steeply rising coal prices was favouring the nuclear choice. (202)

Moreover, the experience already gained in nuclear construction and operation had not dissuaded utilities that their original decisions to invest in nuclear power plants had been unwise. Indeed regardless of how adverse that experience was, it had not dislodged their commitment to

Table 3-8

Capital Cost Estiamtes of Nuclear Plants 1967-1974

year[1]	$/Kw 1000 Mwe	% increase on previous
1967	135	-
1970	240	77.7%
1971	265 - 330[2]	10 - 37.5%
1972	350	4.2 - 6.1%
1973	411 - 472[3]	17.4 - 34.8%
1974	433 - 520[4]	5.4 - 10.1%

1 Excludes escalation during construction

2 Wash 1174-71

3 " 1174-73

4 " 1174-74

Source: Perry op.cit p42

nuclear power, which most utilities singly and collectively continued to effuse, nor had it undermined the economic calculations upon which their investment decisions were partly based. Rather than positively motivating expanded investment in nuclear plant, as intimated by Gandara, the utilities accumulated experience with the nuclear option had a far less decisive, but nonetheless significant, influence on their investment decisions: it either confirmed or failed to discredit the prevailing utility 'ideology' with respect to nuclear power.(203)

It was the juxtaposition of favourable economic, technological, and ideological conditions which accelerated the pace of reactor commercialization in this second phase, making the nuclear industry one of the most vibrant and rapidly expanding sectors in the whole US economy. Indeed its growth was spectacular: in just over a decade from the initial Oyster Creek contract, domestic sales had exceeded over 180 units.(204) During 1973 alone over twice as many nuclear plants were sold as in the whole decade 1955-65, with more than five times the total generating capacity. Corporate growth and sales were unprecedented: GE's domestic nuclear sales accounted for nearly 21% of its total corporate sales in 1973 (205) and just over a third of its total corporate profitability. (206) For many the industry's successful development epitomized the technological and commercial supremacy of American capitalism and confirmed the validity of the AEC's determined strategy to promote and encourage the private exploitation of nuclear energy. However, the market for nuclear power began to contract rapidly in late 1974 under the combined pressures of reduced electricity consumption and financial stringencies arising from escalating interest rates.

3.2.4 The Collapse of Nuclear Plant Orders

Underlying the optimism of the early 1970's was the increasing turbulence in the fossil fuel markets which, together with the Nixon administration's

attempts to establish a national energy policy based upon energy independence and security of supply, necessarily reinforced the case for greater reliance on nuclear power. (207) But as the ramifications of the 1973 Arab oil embargo, together with the four-fold rise in oil prices, reverberated throughout the economy, it became increasingly apparent that the nuclear industry was entering a crisis phase in which optimism, cautious or otherwise, was severely misplaced. New orders declined alarmingly (see Table 3-4) but much more serious was the catastrophic increase in the cancellation and deferment of nuclear plant orders: by the close of 1975 the situation was bleak with:

> ... 125 nuclear units delayed, 23 units cancelled (since June 1974), with schedules for 55 others unchanged. (208)

Cancellations and deferrals rose dramatically as utilities attempted to adapt to a harsher commercial environment. The oil crisis had imposed contradictory pressures on utilities: on the one hand the combined effects of a fall in electricity consumption and continuous rises in interest rates (due to worsening inflation) pushed many utilities into a serious financial crisis; but on the other hand the perceived need for nuclear power, to replace expensive and volatile supplies of fossil fuels, had never been so obvious nor so urgent. Nonetheless utilities immediate responsibilities were to their shareholders; a discipline which focused their efforts upon resolving their own financial crises rather than entertaining new ventures, which, however desirable, they could not possibly afford.

Essentially utilities were faced with a loss of income at a time when all their operational and capital costs were increasing. Electricity consumption, according to official figures, actually declined in 1974 by -.14% following a period of unbroken exponential growth since the war. Utility income therefore fell but costs continued to rise whilst rate increases (electricity charges) were delayed by the FPC. For many utilities the resulting financial crisis was decidely serious since they had been operating in a deteriorating financial climate for a number of

years. (209) Particularly worst affected were those which had invested heavily in nuclear plant since the enormous capital costs involved placed them under considerable financial strain as interest rates and construction costs continued to rise. (210) Capital costs increased alarmingly: one contemporary study concluded that annual cost escalation was in the region of $47kw (1973 dollars) and a later report noted that:

> Most utilities experienced at least 100% construction cost overruns. (211)

Even the AEC's 'optimistic' figures did not conceal the quantum annual leaps in capital costs. (212). This situation was compounded by lengthening delays in nuclear power plant construction, which reached unprecedented levels, further contributing to costs and imposing an additional financial burden upon utilities (213). Lengthening construction times, whatever their cause (and this was hotly debated at the time), combined with a proliferation of regulatory controls, general price inflation and rising interest rates, forced up the combined contribution of interest charges and expected construction cost escalation, during nuclear power plant construction, from:

> ... 20 per cent of the total forecast cost in 1967 to 45 per cent in 1974. (214)

A bitter debate raged, in which the AEC, the utility industry, reactor vendors, and opponents of nuclear power, attempted to apportion responsibility for the underlying causes of this cost escalation, upon each others deliberate policies or shortcomings. (215) Regardless of causes the disastrous consequences were swiftly realized. Financing nuclear power plant construction, in a worsening financial climate, became increasingly formidable. Postponements and cancellations therefore offered the only solution to the financial crisis amongst utility companies for, as Gandara's study affirms:

> ... more capital could be saved per kilowatt of capacity lost by cancelling nuclear than by cancelling fossil fuel plants. (216)

In consequence the AEC's 1974 annual report on the nuclear industry bleakly recorded that:

> By the end of September 1974 electric utilities had deferred construction of nearly 70 previously-ordered power reactors, and had cancelled plans for nine nuclear units previously ordered.(217)

The major vendors were not immediately enveloped in crisis since there remained, despite the cancellation of plants, a considerable backlog of orders. Sufficient orders existed to maintain the industry intact in the short-term but without at least 4-5 orders per year the long-term future was decidedly grim. Eventually growing over-capacity would force a restructuring. To safeguard their future market position GE and Westinghouse, together with the AIF, expanded their lobbying efforts to persuade the administration and the utility industry that, in the wake of the oil crisis, America's future energy security depended upon nuclear power.(218)

In the aftermath of President Nixon inauguration of 'Project Independence', on November 6th 1973, a programme which aimed to establish energy self-sufficiency for the US by 1985, the nuclear industry responded by promoting nuclear power as the vital ingredient in the national energy mix which would guarantee dependable, cheap and safe electrical energy.(219) Partly responding to industry pressures, partly wishing to re-assert its own authoritative role in civil nuclear policy-making (because of fears that the Nixon administration's plans to abolish the AEC might lead to an erosion of its position) the JCAE announced in January 1974 the reconvening of annual ('202') hearings on the state of the nuclear industry. As the JCAE Chairman Melvin Price explained:

> Major developments have occurred since the Committee last held '202' hearings in 1965 ... I believe it is time for the Committee to examine the state of the nuclear industry, and to obtain a progress report on what has been achieved in introducing this badly needed new energy source into our economy at a time when our supplies of fossil fuels ... are diminishing at an increasing rate. (220)

Throughout the 1974 '202' hearings industry and AEC witnesses reiterated the central importance of a viable nuclear industry, and the maintenance of a large nuclear programme, in meeting national energy goals. A common, if not the dominant, theme in the evidence provided by utility organizations, such as the EEI (the utility's pressure group) the major reactor vendors, the AIF, and other industry representatives was the vital supportive role which the AEC was expected to play in this period of turmoil to ensure that nuclear power's contribution to the energy crisis was fully exploited. In concluding his statement to the JCAE the President of the Edison Electric Institute noted that:

> Full utilization of nuclear power's potential is a crucial ingredient in assuring our Nation has a reliable and adequate domestic source of energy. Problems connected with its increased use are susceptible of solution and all segments of government and industry should work toward that end.(221)

The President of Westinghouse's Power Systems division reinforced this emerging consensus, on the AEC's role, but in a more direct manner -

> I believe we have in our company and throughout the United States the broad industrial base necessary to meet the challenge of providing an all-electric economy based on nuclear power; however, there are a number of obstacles which we must overcome through joint government industry efforts.(222)

Essentially what industry required of the AEC was a much more aggressive promotional role combined with a more circumspect regulatory process. With heightened opposition to nuclear power, the industry demanded that the AEC respond positively and authoritatively to legitimize, in the public mind, the crucial contribution of nuclear power in ensuring future national energy requirements.(223) In addition the industry considered rationalization of the AEC's regulatory process to be of equal priority since such action would help moderate the increasingly successful intervention of anti-nuclear groups in the licensing process and contain the costly proliferation of rules, regulations and standards.(224)

Industry's appeals for a renewed partnership with the AEC were reminiscent of earlier stages in the history of power reactor development,

except that in 1974 it was the contraction, rather than the expansion, of the industry which had acted as the catalyst. The AEC's response was both predictable and unambiguous: Chairman Dixie Lee Ray notified the JCAE of its intentions with the warning that:-

> If nuclear power is to be one of the prime movers for 'Project Independence', and I believe that it must be, we must begin now to expend every effort to build new capacities, remove construction delays, and undertake initiatives, including advanced technical development for its promotion. There is no time left for delay.(225)

However, with the passage of the Energy Reorganization Act in October 1974, the AEC's attentive fostering of the nuclear industry became a legacy bequeathed to the newly established Energy Research and Development Administration. An examination of how these agencies managed that legacy and the unfolding crisis in the industry is unfortunately beyond the time frame of this study. Much more pertnent to this chapter's concerns is precisely how the AEC interpreted its role and functions throughout the period of reactor commercialization.

3.3 The AEC and Commercialization

In early 1967 the AEC was compelled, mainly because of the rapid pace of reactor commercialization, to issue a revised version of its 1962 Report to the President.(226) This report marked the end of an era in the development of nuclear power for it noted that:

> ... further government assistance to the development of light-water reactors under the demonstration program was not planned.(227)

In effect this was an official declaration that commercial nuclear power had been firmly established. By 1974 just prior to its abolition, the AEC publically congratulated itself and the JCAE for their tremendous foresight and leadership which had been instrumental in developing and commercializing nuclear power technology; as AEC Chairman Dixy Lee Ray commented:

> It is a source of tremendous satisfaction to all of us involved with nuclear power that, with the help and foresight of the Joint Committee on Atomic Energy, the atom is truly beginning to make a significant contribution to the generation of electricity.(228)

Indeed that contribution, in the aftermath of the oil crisis, became much more strategically important than ever could have been imagined in the earliest period of civil nuclear development when fossil fuels were so comparatively cheap and readily available.

However, the self-congratulation was not simply because nuclear power was generating nearly 6% of US electricity but rather because the AEC and JCAE had been so remarkably successful in helping to create, what in 1974 was, a vast commercial nuclear power infrastructure. Compared with the years of the PDRP, when private investment was minimal, the years of commercialization witnessed an industrial metamorphasis of startling magnitude and rapidity. From virtual industrial obscurity, in the 1950's, the nuclear business had been transformed , by the early 1970s, into a vast commercial 'technostructure' dominated by a few major corporations whose domestic nuclear sales in 1972 alone amounted to between $5.13 to $8.8 billion.(229) Added to which was nearly $1 billion of exports, approximately 1% of the US total, which flowed from the US industry's domination of the world market in reactors and nuclear services.(230) Moreover, private industry accounted directly for in excess of 179,000 jobs with nearly as many again indirectly employed in related and supplier industries.(231) Projected growth in nuclear capacity also underpinned official and industry predictions in the early 1970's that sales, revenue, employment and exports would continue to grow well into the 1980's.(232) Furthermore, contemporary fears about the costs and availability of fossil fuels reinforced recognition of the nuclear industry's increasing strategic importance to the whole US economy in guaranteeing, a source of relatively cheap and reliable energy which would enable manufacturing industry to contain costs and maintain its competitive position in domestic and world

markets.[233] Obviously this transformation both in the industry's scale of operations and its strategic significance had a direct impact upon the form and character of the state-industry 'partnership'.

Although the AEC's 1967 supplemental report promised to abolish public financial support for the LWR this was far from the radical gesture which it appeared. On the contrary the AEC's assistance to industry was not significantly reduced; rather it took new forms. Even its acquisition of new and additional responsibilities, such as that for general energy R & D (which it obtained in 1971), did not prejudice its ideological or material commitment to nuclear power. Assistance to industry continued, albeit in a variety of different forms, throughout the period of reactor commercialization. Several crucial functions were performed by the AEC throughout this period: through direct and indirect subsidies it secured the industry's expansion; and it acted to promote public acceptance of nuclear power.

3.3.1 Subsidies and Services

As discussed earlier in the chapter, direct subsidies to industry were outlawed by the 1954 Atomic Energy Act so that AEC assistance had to be framed within this legal constraint. However, in practice it was not a major obstacle to AEC initiatives: it had not prohibited, for instance, subsidies to utilities under the PDRP. Throughout the period of commercialization industry benefitted from two distinct subsidy arrangements: firstly a state controlled, but later only state regulated, nuclear fuel cycle; and secondly, the AEC's absorption of the social and external costs resulting from the commercial exploitation of nuclear power.

Through its direct and indirect controls over the price of uranium, enrichment services, and buy back prices for plutonium produced in power reactors the AEC was able to provide the utility industry, at least in the initial phase of reactor commercialization, with favourable fuel price

arrangements.[234] This undoubtedly assisted them in their investment planning for new capacity and directly benefitted the nuclear option. Moreover, since inflation from 1966 onwards gathered pace stable nuclear fuel prices meant, according to Burn's, a fall in real terms of some 11% between 1967-70.[235] Combined with steep increases attached to the buy back price of plutonium, which continued well into 1970, this amounted to a not insignificant subsidy to nuclear fuel costs.[236] Much more difficult to establish, however, is the extent to which AEC ownership of enrichment plants kept the price of enriched uranium below a 'realistic' or 'market' level.

On this issue there remains considerable debate since vital data remains classified and there has been no independent analysis of AEC enriching costs and pricing criteria throughout the period 1966-74.[237] But according to Berger, Patterson, and the National Coal Association the full costs of enriching uranium at the AEC's Paducah, Portsmouth, and Oak Ridge facilities were never truly reflected in enriched uranium prices.[238] The effect of this was therefore to subsidize nuclear fuel costs, and thus generating costs, making nuclear power 'unrealistically' competitive with other energy sources. But whilst the evidence is convincing it is far from complete. Official AEC pronouncements always strenuously rejected such allegations pointing to an early AIF study of all the relevant official data which concluded that:

> ...the published prices for U-235 do not include any government subsidy.(239)

However, the suspicion that enriched uranium prices were never set at a realistic market level throughout this period is confirmed partly by the rapid increase in prices in the early 1970's, as the AEC changed the basis of its pricing policy to recover 'the Government's costs over a reasonable period of time.'[240] Additionally, the 1973 Congressional debate on private ownership of enrichment facilities implicitly endorsed the claim that the AEC's charges for enriched uranium never reflected the real costs

of production. Indeed it was tacitly admitted by the Chairman of the AEC in 1974 in pointing out to the JCAE that:

> ... under the Atomic Energy Act, AEC's enriching charges must be limited to recovery of Government costs; such costs, of course do not reflect the full range of cost elements associated with a commercial activity.(242)

Just as significant to industry as the absolute price of enriched uranium was its relative price together with the trend in AEC pricing policy. Earlier it was noted that, in the first phase of reactor commercialization, enriched uranium prices remained stable thereby 'guiding' utility investment planning decisions towards the nuclear option. This was not the case throughout the second phase when prices were increased annually in excess of the inflation rate. However falling fuel fabrication costs, together with increases in the value attached to by-product plutonium(243), mitigated the rise in U-235 prices thereby containing the increase in nuclear fuel costs just at the time when fossil fuel costs were rapidly increasing. Through its fuel charging policy, in respect of both the phasing and magnitude of increases, the AEC was thus able to ensure that nuclear fuel costs remained competitive. In 1973 Commissioner Larson surprised the JCAE when in testimony concerning the future of the enrichment industry he explained that:

> New AEC customers paying $36 for enriching services are still enjoying a lower unit charge than that prevailing in 1961 ... Enriching services, even at twice their current level ... are a bargain relative to the likely lost levels of their alternatives. (244)

Of course nuclear fuel costs were not a decisive factor in determining utility investment in nuclear power since they only amounted to 30% of generating costs. (245) But they were undoubtedly significant, and by providing favourable fuel market conditions the AEC assisted reactor commercialization.

Fuel subsidies were supplemented by the AEC's direct provision of vital programmes, covering such important fields as reactor fuels and materials, plutonium recycle and nuclear physics, all of which contributed to

improving LWR efficiency, and economics, as well as the industry's technological infrastructure.[246] Access programmes too were established to provide industry with classified technical information where this was deemed vital to its commercial operations.[247] Considerable financial and technical support was also channelled into development of breeder reactor technology which the AEC promoted as the answer to both the nation's future energy needs and the industry's long term viability. All these programmes were instrumental in buttressing the industry's technological infrastructure and, alongside the fuel subsidies noted above, provided sturdy foundations for an expanding industry. But equally as crucial in this respect was the AECs absorption of the external costs generated by that expansion.

Without the government indemnity provided by the Price-Anderson Act, (discussed earlier in the chapter), the pace of reactor commercialization would have been very much attenuated. In providing utilities with an indemnity of up to $465m, in the case of a nuclear 'incident', the government was accused by the representatives of the coal industry, and critics of nuclear power, of subsidizing the nuclear power. [248] Of course the AEC preferred to think of indemnification as removing a constraint or, as Dawson refers to it, a 'roadblock' to the industry's expansion. However, no other sector of the energy industry, or any other industry for that matter, benefitted from such a privileged arrangement. But the real impact of the Price Anderson legislation on the industry's fortunes was not so much that it indirectly subsidized nuclear power [costs], therefore making it a more financially attractive option than it might otherwise have been, but rather that it 'socialized' the potentially enormous costs of the major risk involved in such an investment: namely a catastrophic reactor accident which could bankrupt even the largest utility.[249] Indemnity legislation therefore 'neutralized' what would have been the major disincentive to utility investment in nuclear power.

Although the Price-Anderson legislation was amended in 1965 and 1973 the basic principle of government indemnification remained steadfastly intact.(250) Even though, as a result of these amendments, utilities were required to increase their own private nuclear insurance cover, giving the appearance of absorbing a greater share of the risk (from $74m in 1965 to $95m in 1973) because of inflation over the same period the real increase was negligible.(251) Thus the major burden of the risk continued to be born by government.

Acceptance of this burden imposed related costs upon the AEC since, besides its legal responsibility to protect the public's health and safety, it had a direct material interest in minimizing both the potential risks and the potential consequences of reactor accidents. Of course, as a promotional agency too, the AEC had to:

> balance its health and safety regulatory responsibilities ... against the necessity for producing a level of private technological effort adequate to meet national objectives.(252)

It thus had to maintain an awareness of the commercial implications of its regulatory activities. But, as power reactor technology was commercialized, it was forced to focus its efforts upon regulatory matters. Safety R & D therefore became an increasing proportion of general nuclear R & D expenditure. Major studies were financed, such as the Rasmussen study on the probability and consequences of reactor accidents, and vital safety research programmes, like the Loss-of-Fluid-Test facility (designed to assess the adequacy of LWR emergency core cooling systems), were established.(253) In addition the AEC sponsored research into the environmental and health effects of nuclear power, the problems of reactor de-commissioning, nuclear waste disposal, nuclear waste management, nuclear fuel transportation and radiation.(254) Industry too established and sponsored its own research on safety related matters. But what distinguished the AEC's role in this regard was not only the size and scope of its activities but their generic nature. For unlike the private sector,

where corporate research activity was geared, in the main, to enhancing and improving its own specific products, the AEC concentrated upon generic research which was vital in guaranteeing public health and safety and thereby implicitly enhancing public acceptance of nuclear power.

Besides these research activities, the AEC also provided or organized the provision of such essential services as: reprocessing, nuclear waste disposal,transportation, radiation protection, and training in key aspects of safety related management.(255) These were all services which, in both the medium and the longer term were vital both to the efficient functioning of the industry and in maintaining public confidence in nuclear power. For instance without an adequate safe waste disposal policy the industry would be vulnerable to criticism from environmentalists and, under environmental legislation, possibly susceptible to legal action. Only the AEC, however, had the institutional capacity to organize a coordinated national response to such problems as waste disposal.

Through both its provision of essential services and its support of vital research the AEC bore a very significant proportion of the external costs resulting from the commercial exploitation of nuclear power. Combined with its acceptance of indemnification responsibilities the AEC therefore absorbed many of the risks and social costs which would otherwise have retarded very seriously the expansion of the commercial nuclear power industry. Public confidence in nuclear power partly depended upon the AEC being seen to ameliorate these risks and social costs but equally it was dependent upon effective promotion and 'impartial' regulation of the technology.

3.3.2 Promotion and regulation

As commercialization accelerated in the early 1970s so did the need to assure the public that nuclear power was both safe and harmless to the environment. The success of the environmentalists in mobilizing Congress to enact the National Environmental Protection Act in 1969 sensitized the

public to the safety and environmental hazards of industrial processes, and in particular to the dangers of nuclear power. Local opposition to the siting of nuclear power plants combined, with more highly organized national environmentalist groups, to pose a significant hindrance to the nuclear plant licensing process. Licensing delays became commonplace and as the pace of commercialization quickened the regulatory system became overloaded, resulting in a temporary 17 month moratorium on reactor licensing in 1971.(256) It was partly this crisis in the regulatory process which encouraged the Nixon administration's plans to abolish the AEC in 1974.

Industry depended upon the AEC to reinforce public confidence in nuclear power since this was not a function which sectional bodies, like the AIF, could successfully perform. By establishing national safety and environmental standards and regulations, based upon rigorous scientific and technical evidence, and by presiding over an open and accessible regulatory system it was believed that the AEC, through rational and technical argument, would encourage greater public acceptance of nuclear power. In effect the AEC was expected to function as a legitimating agency providing an objective and independent framework, the procedures and regulations necessary to guarantee the public's health and safety and thereby public confidence in nuclear power. But the AEC suffered from a contradiction between its promotional and its regulatory roles; a contradiction which had produced regular demands for the dissolution of the AEC into separate functional agencies.(257) Even though following commercialization it no longer directly promoted LWRs, the AEC continued to be regarded by the public very much as a promotional agency. This too despite the fact that its most publicly visible activities, particularly throughout the 1970s, were primarily regulatory in nature. However, the manner in which it conducted these activities, its public statements, its Congressional

testimony, its general activities, and its raison d'etre were suffused with an unambiguous commitment to nuclear power.

Critics of nuclear power made much of the AEC's ambivalent regulatory role suggesting that its commitment to nuclear power undermined both its regulatory independence and its objectivity. As Berger suggests, the AEC was regarded by many as the pivotal institution in the "Atomic 'Industrial' Complex" that interlocking set of relations between the nuclear industry, nuclear scientists pro-nuclear industry groups, the military, and the JCAE which single-mindedly promoted the expansion of nuclear power.(258) Such criticism undermined the Commission's independent image and provoked frequent rumours of its abolition, reorganizations of its regulatory division, and the Nixon administration's decision in 1973 finally to abolish it (259). But it was its disastorous handling of the Calvert Cliffs case, which eventually was resolved by a US Court of Appeals (District of Columbia) judgement indicting the Commission for its failure to abide by the National Environmental Protection Act, that did much to confirm public scepticism about its dual, but contradictory roles (260). That scepticism was further encouraged by growing scientific criticism of the AEC's radiation standards and the engineering safety of LWRs (261).

By 1973 the AEC's public credibility was under severe strain from a substantive barrage of technical and scientific criticism issuing from organized groups of environmentalists, scientists, and engineers, amongst the most prominent being the Friends of the Earth, the Union of Concerned Scientists, the Sierra Club, and the Natural Resources Defence Council. One effect of this extensive but unco-ordinated 'offensive' was to expose publically, the weaknesses, inefficiencies and incompetence in the (AEC's) regulatory system. A particularly disastorous example of all three combined was the crucial 1972-3 rule making hearings on LWR emergency core cooling systems (ECCS). These hearings demonstrated deep divisions within the AEC over the effectiveness of ECCS; its suppression of damaging safety

evidence; and significant inconsistencies between official public statements on LWR safety and serious internal doubts. (262) Public confidence in the regulatary system was shattered since the technical credibility of the AEC was significantly compromised (263). According to Bupp and Derian 'In the wake of the dramatic and nationally publicized Emergency Core Cooling System hearings, opposition to nuclear power ... entered its third phase by appearing to assume some of the characteristics of a national movement' (264).

Precipitated partly by the mounting crisis of public confidence which beset it in the early seventies, the AEC attempted reforms of the regulatory system in order to restore credibility and to limit the damage that nuclear power's opponents were inflicting on the industry. (265) Internal reorganization within the AEC's regulatory branch did little to enhance its public image, however. And attempts to reform the nuclear power plant licensing process, in the light of the seventeen month licensing moratorium, increasingly appeared, particularly to the 'intervenors' (those using the public licensing process to oppose plant construction or operation), as being designed to marginalize or displace opposition to nuclear power. (266) Far from enhancing its credibility, proposed licensing reforms undermined it further since to the public the unambiguous object of reform was to expedite the licensing process because of its increasing financial burden upon the industry.

In many respects, the AEC faced an impossible task since its regulatory role was expected to resolve the often contradictory requirements of industry and the intervenors. Industry desired an efficient 'procedure' but one which would also facilitate public acceptance of nuclear power based upon purely technical considerations. The intervenors, however, favoured a more open and 'democratic' procedure which would allow them to challenge not just discrete technical issues but also wider concerns arising from the utilization of nuclear power. (268) Clearly, these were

quite conflicting expectations. The AEC was trapped by this fundamental tension, if not contradiction, between the efficiency and the legitimacy of the regulatory process; a tension which reflected much deeper structural constraints on its functioning.(269) Thus in 1971 it was simultaneously promising both '...to be more responsive to the concerns of conservationists and environmental groups as well as other members of the public' (270) and '... the use of available administrative techniques ... in order to minimize delays in the hearing [licensing] process'. (271) In attempting to resolve this contradiction, its objectivity and independence was called further into doubt since its bureaucratic commitment to nuclear power combined with intense pressures from a beleagured and financially fragile utility industry, as well as from a reactor industry concerned about sales and an administration wedded to energy self-sufficiency, forced it to err increasingly in favoure of efficiency (272). Thus measures were introduced to deflect, constrain and mitigate the consequences of growing opposition to nuclear power.

With the assistance of the JCAE legislation was passed in 1972 allowing the AEC to remove its seventeen month licensing moratorium giving, as Dawson notes, '...industry the relief it wanted.' (273) Moreover, procedural changes removed generic issues, such as reactor safety, plutonium recycle, waste disposal and radiation protection standards, from consideration at individual plant licensing hearings, with the object of displaci ng opposition to public hearings at the national level thereby reducing plant licensing times considerably. (274) (The ECCS hearings discussed above were the first of these.) Administrative and procedural decisions too restricted the agenda of regulatory hearings to purely technical issues thereby further disadvantaging an already poorly resourced opposition. (275) And by contesting attempts by environmental groups, and by local state s to devolve significant regulatory powers to the individual state's the AEC maintained intact a national regulatory system with

nationally administered standards. (276) Such national regulation was crucial to the efficiency and viability of the industry since a proliferation of state controls would destroy a unified national market, make vital product standardization programmes impossible, increase costs and would undoubtedly escalate the already horrendous delays in plant construction as the licensing process became ever more complex. What is significant about all these measures is that they reveal the AEC's determination to enhance the efficiency of the regulatory process at the expense of its legitimacy.

In fairness to the AEC, however, it must be stated that it did concede a number of points to its opponents. For instance, it tightened up nuclear plant radioactive emission standards; it changed its ECCS criteria following demonstrable public concern; and it actively encouraged participation in the regulatory process (277). But as Camilleri documents in his comparative study '... there were limits to which the state could accommodate the demands or grievances of the opponents of nuclear power without at the same time threatening the survival of the industry.' (278) Concessions were therefore atypical: in reality, the AEC, with the assistance of other agencies, functioned both to contain and to constrain the impact of growing opposition to nuclear power, as expressed through the regulatory process. In this it performed a vital function for the nuclear industry and its relative success, in this regard, is demonstrated by the fact that, despite intense and widespread organized opposition throughout the second phase of commercialization, orders for nuclear plants (as noted earlier) attained record levels. (279)

Paradoxically, its apparent success was also the source of its demise for its credibility and reputed independence, two essential requirements for maintaining public confidence, had been eroded in the process. This, together with the desire to rationalize federal energy administration, convinced the Nixon administration of the urgent need to abolish the AEC,

replacing it with two separate functional agencies responsible for energy matters and nuclear regulation respectively.(280) On December 31st 1974 the AEC 'expired' leaving its successors to manage, albeit in a political environment in which opposition to nuclear power was intensifying, the unresolved contradiction between the efficiency and the legitimacy of the regulatory process.(281)

3.4 Extending Private Ownership to the Nuclear Fuel Cycle

When the Oyster Creek contract was announced in 1963 the government still directly controlled a major section of the nuclear industry through its ownership of nuclear fuel and its monopoly over nuclear fuel services, such as enrichment and reprocessing. The prospect of commercial nuclear power provided the AEC with an appropriate opportunity to divest itself of its legal monopoly over nuclear fuels; a policy which it had originally desired to effect in 1954. With the long term commercial interests of the industry firmly in mind it actively sought, throughout the 1960s, to facilitate and to encourage the extension of private ownership to all areas of the nuclear fuel cycle. Beginning with private ownership of all nuclear fuels (U-235, Thorium and Plutonium) its policy also encompassed uranium enrichment and reprocessing services.

3.4.1 Private Ownership of Nuclear Fuels

Following internal discussions within the AEC consultations began with industry, in 1961, concerning private ownership of nuclear fuels.(282) This was followed up during hearings before the JCAE, in March 1962, when it became apparent that the AEC's enthusiasm was not totally shared by the industry.(283) Mullenbach describes industry's dilemma:

> ...industry has suggested that private ownership of nuclear fuel is desirable ultimately, but that it is premature at the present stage of nuclear development ...(284

But the AEC continued to promote private ownership and encouraged industrialists to examine the issues and the problems which it raised. Advice and assistance were provided by the AEC to the AIF's study groups, particularly the *Ad Hoc Committee on Private Ownership of Nuclear Fuels*.[285] But the AIF's studies suggested a cautious approach to the implementation of private ownership. This reflected the significant conflict of interests within the industry. Whilst industry was deeply united on the desirability of private ownership this did not translate directly into unambiguous support for the AEC's policy. On the contrary when the AEC introduced its draft legislation to Congress in March 1963 the AIF, and others in the industry, duly criticized it.[286] Ironically this was because it adopted a fairly radical approach based upon purely commercial principles. In effect the AEC was proposing immediate abolition of the current fuel leasing arrangements replacing this with a virtually unregulated market in nuclear fuel, with no restrictions on uranium imports, and immediate toll enrichment of private uranium (supplied by the customer).[287]

This distressed all sectors of the industry. Uranium producers were concerned that imports would depress prices and threaten the industry's viability because of existing surplus capacity whilst fuel fabricators, reactor vendors, and utility companies, desiring as low fuel prices as possible, harboured fears that immediate toll enrichment would lead to a volatile and unstable market which would be detrimental to their commercial prospects. The AIF issued a critical commentary on the draft bill and the JCAE experienced considerable pressure from industry to revise the draft.[288] Changes were made and in July 1963 hearings were held on the revised bill as presented to Congress.[289] Although, it did not meet the demands of all sectors of the industry it assuaged major worries by proposing a comprehensive transition period during which time the AEC would be responsible for ensuring a gradual and orderly transfer from a

government nuclear fuel monopoly to private ownership and free competition.(290)

Congressional deliberations on the bill extended beyond 1963 and into 1964 as each sector of the industry attempted to guarantee that the bill's provisions would not unduly harm their specific interests.(291) These were not strategic engagements between the JCAE, AEC, and industry groups but rather tactical confrontations, the broad approach of the bill having been overwhelmingly accepted. Through expert JCAE mediation several issues of vital importance to different sectors of the industry were resolved without damaging the consensus on the bill's passage. Thus the difficult questions of uranium imports,enrichment of foreign uranium, and arrangements for enriching domestic uranium were decided to the satisfaction of the uranium producers, reactor vendors, and domestic utilities respectively. Consequently uranium imports were banned totally until 1975 to bolster the domestic uranium industry; no restrictions were placed on enriching foreign uranium for use in foreign reactors so as not to harm US nuclear reactor exports;(292) and the transition period for toll enrichment arrangements met the utilities requirements.(293) Only the AFL-CIO, the coal industry organizations, NCA and NCPC, stood opposed to the bill. But with such solid agreement between the industry, the JCAE and the AEC, the bill passed both the Senate and the House with little substantive discussion and became law on August 26th 1964.(294)

Three significant points arise out of the passage of this legislation. Firstly, industry's response to private ownership of nuclear fuels was much more cautious than its rhetoric about competition and private enterprise suggested. It wanted protection from competition and a government managed transition to a commercial nuclear fuel market. Secondly, the AEC's role was crucial in promoting and facilitating the practical extension of private ownership and in providing the necessary administrative framework for ensuring the orderly transition which industry desired. What motivated

the AEC was its commitment 'to strengthen free competition in private enterprise'[295]; its belief, as noted earlier in the chapter, that commercial nuclear power was about to be realized; the desire to reduce the financial burden which ownership of nuclear fuels imposed upon it;[296] and the reduction in military requirements for nuclear materials which created surplus enrichment capacity which could now be put to civilian use.[297] Ultimately private ownership of nuclear fuels was a further stage in the realization of the AEC's secular policy commitment, commencing with the PDRP, to secure the development and expansion of a private nuclear industry. Thirdly, and finally, the JCAE's instrumental role in reconciling the conflicting interests of different sectors of the nuclear industry reinforced its strategic position in the policy making structure. For it was crucial in molding the agenda of debate and determining the compromise's between the conflicting interests of the uranium producers, reactor vendors, and utility companies. What was also distinctive about its deliberations on this particular legislation was the absence of any substantive discussion 'on the broader philosophical question of private versus public ownership of atomic energy resources.'[298] Clearly with the onset of commercial nuclear power the JCAE's fervour for public ownership, which was so markedly evident in the 1950s, had been dissipated. Private ownership of nuclear fuels, like Oyster Creek, ushered in a new era in the development of nuclear power.

The primary features of the private ownership legislation were the abolition of the government's fuel monopoly; a requirement that all nuclear fuel be privately owned by 1st January 1971; toll enrichment of privately owned uranium was to commence on 1st January 1969; and buy-back arrangements for plutonium produced in civil nuclear reactors were to be terminated on December 31st 1970.[299] In effect it created a tightly AEC regulated and managed transition to full private ownership, minimizing the

risks and transitional costs born by the industry. This is evident in its implementation of the legislation.

Following extensive consultation betweem the AIF and the AEC, the contractual arrangements for toll enrichment which were to take effect in 1969 were announced by the AEC in June 1966. (300) These arrangements were crucial to all sectors of the industry from uranium mining to reactor sales and were therefore deliberately formulated to reflect these interests.(301) As a result the AEC shouldered many of the contractural risks involved to facilitate the transition to private ownership of nuclear fuels.(302) This was later to prove both a source of tension between the AEC and the JCAE, who were keen not to subsidize the industry, and a significant factor in provoking a crisis in the AEC's enrichment service.(303)

3.4.2 Private Ownership of Enrichment Plants

One major consequence of the private ownership legislation was that it precipitated widespread interest, within the industry, in the private ownership and operation of enrichment plants. An AIF committee report noted in October 1965 that it was:

> ...discussing with the AEC ... the feasibility of private ownership and/or operation of separation [enrichment] facilities. (304)

Industry's interest in abolishing this last vestige of the government's nuclear monopoly heightened as the first phase of reactor commercialization brought promise of a potentially massive and lucrative future uranium enrichment market. Coinciding with this was a growing recognition within the AEC that, if projected domestic and foreign uranium enrichment requirements were to be met, an expansion in enrichment capacity was necessary.(305) Given the long lead times involved in such complex projects it was assumed that any expansion would have to commence in the mid-1970s.(306) Moreover, even utilizing new enrichment technologies the required capital investment would be enormous: the three existing diffusion

plants had costs $2.4 billion to construct. Thus the substantive question became one of whether government or private industry should provide the finance and accept the risks involved in constructing new enrichment capacity.

Industry's position was stated with perspicacity in an AIF study committee report which, following a thorough examination of all the issues, concluded that:

> ... the growth in the need for enrichment services will require both the expansion of the three existing government owned plants and the addition of new enrichment facilities before many years. The market for enrichment services, therefore, will be sufficiently broad so that there is a reasonable probability that a viable private industry can develop. In the opinion of the Study Committee ... private ownership and operation of facilities for the peaceful use of the atom can now be extended to uranium enrichment, the last remaining area of government ownership...(307)

This fervour for private ownership of enrichment facilities was shared by the incoming Republican administration which was faced with a large balance of payments deficit, the enormous budgetary burden imposed by the Vietnam war and resulting political pressures to contain the budget deficit.(308) Privatization of enrichment facilities would contribute to the latter goal as well as symbolizing the administration's strong ideological commitment to private enterprize. Almost immediately upon assuming office in 1969 President Nixon established a White House Task Force to examine the possibilities for private ownership of enrichment facilities.

Although the Task Force report did not specifically recommend private ownership it did assess the costs and benefits of various ownership strategies.(309) Following this report the President, acting upon increasing pressure from within the administration and from private industry, initiated the first steps towards private ownership by requesting, in November 1969:

> ... the AEC to operate the diffusion plants as a separate organization in a manner which would approach 'more closely a commercial enterprise'.(310)

This request came after JCAE hearings, during which it was made apparent that the political and economic case for private ownership was gathering a powerful momentum. As the second phase of reactor commercialization reached its apotheosis in the early 1970s so too did the organized political pressure for private ownership. Underlying this was the growing political appeal of privatization amongst government agencies, the industry and many politicians on the JCAE. Four factors reinforced the case for private ownership: the growing size of the enrichment market; balance of payments considerations; public expenditure constraints; and foreign competition.

With the tremendous growth of nuclear plant orders in the 1970s increasing concern developed within the industry and the AEC that existing enrichment capacity would be unable to meet projected demand in the 1980s.(311) This potential shortfall in supply had been identified originally, as far back as 1968, and had formed the backdrop to the 1969 JCAE hearings on the enrichment industry. By 1973 continuing fears of a potential supply shortfall became a major political issue for both the industry and the government, since nuclear power was being promoted as a reliable substitute for fossil fuel electricity generation. In a Presidential statement on April 18th 1973 the urgent need for new enrichment capacity was reiterated alongside the administration's:

> policy of looking to US private industry to provide the additional enriching capacity that will be required to meet needs in the 198os and beyond.(312)

This potential supply crisis dominated the first stage of the JCAEs 1973 hearings on the uranium enrichment industry's future. Summarizing these hearings, the JCAE's Chairman, Melvin Price, warned that:

> The most significant piece of information that emerged during the Phase 1 hearings was a reconfirmation of earlier projections which indicated that the demand for nuclear fuel in the 1980s is expected to exceed the supply available from the AEC's improved and uprated gasseous diffusion plants.(313)

An AEC report was more assuredly pessimistic generating fears, within the JCAE, that a nuclear 'fuel crisis' would envelop the nuclear industry by 1983 unless additional enrichment capacity was constructed immediately.(314) As the report authoritatively stated:

> ... it appears that adequate enrichment services will be available to meet the projected needs of the domestic and US suplied foreign nuclear power plants only until fiscal year 1983. Through fiscal year 1978, the annual production ... exceeds the annual requirements. The enriched uranium preproduced during this period will be used to help in meeting product requirements during the fiscal year 1979-1983 period. Near the end of fiscal year 1983 the preproduced inventory will be exhausted and additional enriching capacity will be needed.(315)

But because the lead times for plant construction were calculated at between 8 to 10 years the AEC's report was in effect an ultimatum to private industry that it would have to make a definite decision on investment in new enrichment plant by 1974 or 1975 at the latest.(316) Confirmation of the exigency of the situation was provided both by the AEC's testimony that by 1974 the full capacity of its enrichment plant would be contractually committed (317) and by predictions of a domestic uranium supply shortage in the mid-1980s.(318) And in his April 1973 Energy Message to Congress (noted earlier) Nixon not only reaffirmed the administration's commitment to private ownership of enrichment facilities but also the vital need to construct additional plants immediately to ensure adequate future fuel supplies.(319)

For the major corporations considering involvement in the enrichment sector predictions of supply crises provided favourable conditions for investment. Throughout the JCAE hearings there was unanimous agreement that already a substantial market for enriched uranium existed and that on current projections it would be able to sustain a viable and competitive industry. Indeed during the JACE hearings the possibility of four new enrichment plants being required was mentioned. Moreover, not only was there a substantial market but also it was expected to be extremely lucrative; during 1973, AEC revenues from its enrichment plants were $257m,

in 1974 $542.1m,[320] and revenues overall were expected to exceed $80 billion by 2000.[321] This, together with projections of future demand, was sufficient to guarantee private industry's interest in abolishing the government's monopoly.

Alongside healthy market prospects, balance of payments and export considerations also affirmed the case for private ownership. Following the 1971 international financial crisis, when the dollar was devalued and the administration introduced its New Economic Policy, the balance of payments became a highly salient domestic issue.[322] Since by the year 2000 about $30 billion of the projected $80 billion revenue for enriching services was expected to be from abroad, its contribution to the balance of payments, at over $1 billion per annum could not be ignored.[323] Moreover, for reactor vendors investment in private enrichment facilities would provide them with an enviable commercial advantage over their foreign competitors in that they would be in a position to guarantee enrichment services and supplies to any foreign customer. This would maintain US commercial hegemony in the nuclear field, which was partly a function of the US world monopoly over enriched uranium supplies, and contribute through continued reactor exports, to ameliorating the US balance of payment deficit. Both government and industry therefore recognized that, with respect to international commerce, their mutual interests could be furthered through private ownership.

Of course a continued government monopoly of enrichment services would reap equally significant balance of payments advantages. But the crucial factor was that to meet the expanding demand would require massive government investment in new plant which, in a period of budgetary restraint was unlikely to be forthcoming. Indeed the Office of Management and Budget, the President's body which constructs the federal budget), had placed enormous pressure on the AEC to persuade private industry to provide funding for the already agreed upgrading of capacity at the existing

government owned plants at Oak Ridge, Paducah, and Portsmouth.(324) That upgrading programme (referred to as the CIP and CUP) was estimated to cost over $1 billion; an amount which the OMB fought tenanciously against providing out of public funds. Having failed it was therefore almost certain that with the support of the President, it would block further fudning for additional enrichment capacity. This only underlined the case for private ownership since it provided the opportunity and a justification for substituting private funding for scarce public funds. Therefore on budgetary grounds alone private ownership was exceedingly 'popular' within the administration.

Events in Europe also propelled the administration towards to private ownership. During the early 1970s, several new government-backed enrichment ventures began to form in Europe as a response to the continued US monopoly of this lucrative market. Britain, Germany and the Netherlands established URENCO in 1970; France initiated the Eurodif consortium in 1973; and the Soviets began to offer enrichment services too. (325) International competition threatened to undermine the US commercial enrichment monopoly as well as its dominance in the reactor export market. Hence, part of the urgency in privatizing the enrichment sector, and expanding US capaciaty, was related to the administration's attempts to dissuade customers from either contracting with these new suppliers or investing in indigenous enrichment facilities. As early as 1969 the JCAE had warned prospective competitors that the US, as the monopoly supplier, could make competitive conditions extremely hostile; nor would the JCAE accept for long a situation in which the US was meeting the short term needs of prospective competitors. (326) The administration took much the same view but appreciated that private ownership would act to politize the intense international competition which could emerge in the mid to late 1970s as new government backed enrichment ventures came on stream in Europe.

It was the combination of these factors, namely the existence of a large and potentially lucrative world market , balance of payments considerations, public expenditure constraints, and the need to combat foreign competition which, alongside the administration's avowed ideological fervour for private enterprise, committed it to the rapid privatization of the enrichment business. Whilst, in some respects, the mutual interests of government and industry would be enhanced through privatization, it was nonetheless natural that private industry's commitment should rest purely upon commercial logic. Industry recognized the potentially substantial and lucrative returns on prospective investment despite the large initial capital outlays which plant construction would require. (327) For huge multi-national conglomerates, like Exxon and Union Carbide, privatization offered a further avenue for diversification. Whilst for Westinghouse and General Electric it was a means to achieve further vertical integration in order to provide prospective customers with a complete fuel cycle service thereby retaining a competitive edge in the world reactor market. Thus within industry, the commitment to private ownership was a serious one. It was also reflected in the number of joint ventures established both to study enrichment technology and to lobby Congress and the AEC for decisive legislative action on the enrichment industry's future.

Two major private enrichment ventures were established in 1973: Cengex Associates, a General Electric - Exxon joint venture; and Uranium Enrichment Associates, consisting of Union Carbide - Westinghouse and Bechtel. (328) Each, initially sought to study and to analyse the investment prospects in the enrichment sector. During the 1973 JCAE hearings, it became obvious that their assessments of the mammoth investment requirements of new enrichment plants, together with the many uncertainties involved, had induced a more cautious tone in their public statements. (329) Transitional arrangements were frequently mentioned as

a means to reduce the uncertainties and the risks industry faced in the move to complete private ownership, reflecting experience with the implementation of the private ownership of nuclear fuels legislation. But in fact the AEC was already operating a 'de facto' transitional policy.

In responding to the President's November 1969 address requesting a more commercial approach from the AEC to the management of its enrichment services, a new AEC Directorate was proposed to do just that. Its major function was to facilitate the transition from a government enrichment monopoly to private ownership but opposition from the JCAE blocked its formation. (330) Consequently the AEC was forced to utilize other administrative instruments to achieve the same ends. Through changes in its pricing policy and contractual agreements it sought to eradicate the uncertainties which retarded private investment in the industry.

Charges for enriching uranium were increased steadily over the period 1969-1974 and the atomic energy act was amended to require the AEC to ensure pricing on a virtually commercial basis. (331) Although the JCAE had objected to this new pricing criterion since it was viewed as a further step towards private ownership, the proposed legislation nonetheless gained congressional approval. (332) Arguably, the most radical change was in the AEC's enrichment contracting policy which, in May 1973, was totally revised. A new fixed commitment contract procedure required long-term customer commitments eight years in advance of delivery, unlike the old flexible contracts, which required only one year's advance notice. (333) As a GAO report later commented: 'The principal objective of this revision was to firm up the demand for enrichment services to achieve more realistic and reliable planning.' (334) It was, of course, an essential step towards privatization of the industry since it shifted the risks on to the customers and simultaneously made enrichment a more promising and secure investment for private industry. (335) This was vital to the UEA and Cengex ventures, for the banks which would ultimately provide the major

slice of their investment capital had to be convinced not only that an adequate market existed but also that sufficient returns on that capital would be forthcoming. Fixed commitment contracting, which virtually guaranteed customer reliance on the AEC, for 18 years, provided the necessary assurance and thereby demolished a crucial barrier to private ownership of enrichment plants. This new contracting procedure was fundamental to the AEC's 'de facto' transitional arrangements for private ownership.

A further aspect of these transitional arrangements was the existence of access programmes which provided interested corporations with the necessary technical information to make their investment appraisals. This required sanctioning corporate access to much secret information since key aspects of gaseous diffusion technology remained classified for national security reasons, as did all centrifuge enrichment technology. (336) There was thus an inherent tension between providing adequate and necessary access to this technology whilst simultaneously protecting national security interests. Nevertheless the AEC, with the full agreement of the JCAE, established a domestic access programme in 1971, to furnish approved corporations with security clearances giving them direct access to classified information. (337) These security clearances were extended in 1973 and in 1974. (338) Furthermore, in April 1974, the AEC outlined an additional programme to '...encourage the evolution of a private, competitive centrifuge enriching industry' through the Demonstration Centrifuge Enriching Facilities arrangement. (339) Because centrifuge enrichment technology had been classified in 1967 when, for national security reasons, private work on it had been terminated by the AEC, there was a particularly urgent need to establish arrangements for its effective transfer to the private sector if it was to be seriously considered as an alternative to the more capital-intensive diffusion technology. (340) Through the DCEF, which had similarities with the PDRP concept, the AEC

hoped to demonstrate the commercial attractiveness of centrifuge enrichment technology. So throughout the early 1970s the AEC, under its access programmes and the DCEF, was heavily engaged in transferring to private industry the technology which was vital to the successful creation of a viable, technically advanced, and competitive private enrichment industry.

During the JCAE's 1973 hearings, it became clear that, despite the AEC's considerable encouragement and assistance, private industry's approach to investment in enrichment technology remained decidedly cautious. Whilst the ideological commitment to private ownership was undiminished, there was series concern about the huge capital investment which would be required and the many risks and uncertainties which reamined unresolved. (341) Some members of the JCAE too believed that the urgent need for new enrichment capacity could not be ignored whilst private industry vacillated over its decision to enter the enrichment sector. (342) Reminiscent of the 1950's debates about reactor development, there were latent fears that private ownership would be another 'give away' to monopoly interests. Responding to these legitimate concerns, Representative Hosmer proposed the creation of a public corporation, the United States Enrichment Corporation (USEC), which would provide '...a mechanism to do three things: (i) avoid a nuclear fuel gap; (2) protect the US claim to overseas' markets...; and (3) provide for a quick and orderly transition from public to private enriching.' (343) In effect, the Hosmer plan was for a nuclear TVA excepting that its major purpose was to encourage the transition to a private and competitive enrichment industry. (344) Reactions to the plan from industry and its representatives, such as the AIF, were guarded since they were fervently committed to private ownership and extremely suspicious ideologically of the creation of a government corporation. Commenting upon the plan, the AIF's Chairman firmly warned the JCAE that:

> We are also concerned that the plan as outlined appears to provide a 'permanent' solution for what has been described as an 'interim' problem ... we believe the likelihood of private entry into the enrichment business is realistic and that all reasonable steps towards that end should be taken before resorting to alternative measures. (345)

However, outright opposition to the USEC approach was conspicuously absent.

What was interesting about industry's reaction to the Hosmer plan was its apparent ambivalence. Even the latent conflict of interests between, for instance, the utility companies, which, on the whole, were interested most in stable and cheap enriched uranium supplies, and the large enrichment consortia of UEA and Cengex which had direct interests in immediate privatization, never really surfaced. (346) However, as the JCAE's hearings proceeded it became apparent that the absence of any fundamental corporate opposition to the Hosmer plan was based on the pragmatic assessment of all concerned that some form of transitional regime was vital to ensure the successful privatization of the enrichment sector. (347) General Electric's Mr Sutton was completely unambiguous in his assessment.

> ...we believe that one conclusion is unarguable: the transition from the present Government monopoly to a system of effective private participation cannot be achieved overnight. The problems facing us involve a complex transition which will take years and will almost certainly involve a substantial government role into the indefinite future. (348)

This was a view which was reflected generally in the testimony of virtually all the major private and public organizations appearing before the JCAE. (349) Thus, unlike the JCAE's deliberations in the 1950s, with respect to public versus private development of power reactors, the hearings on the future structure of the enrichment industry lacked any serious ideological confrontations over the principle of private ownership. Indeed, since industry, the administration, the AEC and the JCAE were at one on this strategic issue the dominant focus of debate was purely tactical: how best to secure it.

Nonetheless, on this tactical question some divergence of opinion arose. Whilst many in industry and on the JCAE believed that supportive transitional arrangements (such as Hosmer's USEC plan), which considerably reduced the uncertainties facing private investors, would enhance the prospects for early corporate investment in the enrichment sector, the administration and the AEC continued to argue that maintenance of the existing approach would ensure a smooth and timely transfer from public to private ownership. (350) In a letter to Craig Hosmer OMB Director Roy Ash reiterated the administration's view:

> that there is a high probability that private industry will be both willing and able to provide the next increments of capacity for producing enriched uranium in the early 1980s ... we believe that our plan to have private industry provide the necessary increments of capacity is the correct approach and will provide the additional capacity when it is needed. (351)

Yet, throughout the JCAE hearings, only the testimony of the UEA consortium intimated that private industry was anywhere close to reaching such a critical stage in their planning (352); and even the UEA welcomed the Hosmer plan. (353) Certainly the general impression gained from a reading of the JCAE's hearings is that, except on the strategic question of ownership, the administration's views were far from congruent with those of many in the private sector or the JCAE. This should not be surprising given that the administration desired privatization mainly to reduce its immediate financial commitments whilst private industry required continued long term government assistance for the transition to private ownership. In consequence, the AEC and the JCAE began to promote quite different and conflicting solutions to the privatization problem.

Since no substantive consensus emerged out of the JCAE's hearings, other than that some form of transitional arrangements were necessary, the AEC and the administration continued to argue against any significant alterations in their approach to privatization. Moreover, following the 'contracting gap' crisis, which erupted in July 1974 when the AEC

temporarily suspended signing of its new fixed commitment contracts because of fears that contracted demand exceeded its production capacity, it was announced that the AEC would discontinue long term contracting 'and that industry would be expected to provide the additional capacity required in the future.' (354) This was a deliberate act to exert pressure on private industry to end its vacillation and initiate an investment programme in the enrichment sector. (355) By manipulating the ramifications of the 'contracting gap' crisis the AEC was able to inject added urgency and political momentum into the case for immediate private investment. But, as a GAO report on the crisis noted, it was confronted with the stark reality that in late 1974 there was '...not one firm commitment from the private sector to build and operate a gaseous diffusion [or] uranium enrichment plant.' (356) Equally depressing for the AEC was the news, in late 1974, that both Westinghouse and Union Carbide had withdrawn from the UEA consortium, leaving only Bechtel to continue the research programme, and that General Electric too had withdrawn from Cengex. (357) In both cases it was the overwhelming uncertainties involved, the developing crisis in the reactor market, and the huge investment required which forced their withdrawal. (358) Moreover, there was also a tacit recognition, in their public explanations for the withdrawals, that the enrichment business, because of the long lead times, huge capital investment and massive uncertainties, was best suited to public ownership. As GE stressed '...in the event that private industry is unable to do so, the government, or a government corporation, will build new plants.' (359)

One consequence of these developments was that the AEC, given its continuing predictions of an enriched uranium supply crisis in the mid-eighties, was forced to acknowledge that 'If a private commitment is not forthcoming by about the middle of 1975 ... contingency plans could be comple ted for the Government to build another enrichment facility.'

(360) This unwittingly lent support to the JCAE's consistent 'campaign' for the creation of a public enrichment corporation.

The JCAE remained highly critical of both the AEC and administration's stance over private ownership advocating that '...much more aggressive action should be taken by the Government to encourage commercial enrichment.' (361) Throughout 1974 a third set of hearings was held during which considerable utility and corporate support emerged for a modified version of the Hosmer USEC plan. (362) Undoubtedly, the developments discussed above convinced many in the industry that some form of public commercial undertaking, like the USEC, was necessary to provide the most effective conditions for the orderly transition to private ownership. As a result, in October 1974, Hosmer introduced legislation into Congress to establish the USEC. (363)

The administration opposed the legislation since they regarded it as premature in the light of the continued interest shown by UEA and the formation of a new enrichment consortium CENTAR. (364) Moreover, the administration planned to introduce its own legislation to encourage these consortia to commence construction of commercial enrichment facilities. In consequence, Hosmer's legislation was not persued but it was nonetheless crucial in galvanising the administration into proposing more supportive arrangements, stopping short of a public corporation, for the transition to private ownership. What the remaining enrichment consortia desired from the AEC was more extensive guarantees and assistance which would lead to '...government taking most of the risk in these ventures with the entrepreneurs realising profits if the ventures were successful.' (365)

These were forthcoming, for in mid-1975 the Ford administration proposed new legislation to Congress which would allow the AEC's successor to '...negotiate and enter into co-operative agreements with private organizations to build, own and operate uranium enrichment plants.' (366)

The 'Nuclear Fuel Assurances' bill, as it was named, provided extensive guarantees, assurances, and assistance to the enrichment consortia in return for private construction of new enrichment plants. (367) In effect the administration had succumbed to industry's demands. However, the bill was narrowly defeated in Congress which, with the deepening recession in the nuclear industry, placed the issue of private ownership of enrichment facilities in abeyance. A similar fate befell parallel government attempts to promote private investment in the 'back-end' of the fuel cycle, namely reprocessing and waste management.

3.4.3 Extending Private Ownership to the 'Back-end' of the Nuclear Fuel Cycle

Well before private ownership of nuclear fuels was legalized the AEC began promoting private ownership of reprocessing plants. As early as 1956 the AEC had initiated a programme to encourage corporate interest in the reprocessing business. (368) But with power reactors still under development the response was unsurprisingly circumspect. Nevertheless the AEC's enthusiasm for the policy was not dented and in March 1957 it proposed to negotiate individual contracts with any companies willing to invest in commercial reprocessing plants. (369) The essential feature of such contracts was to be a binding agreement under which the AEC would supply to the company sufficient spent fuel to guarantee base load or cost-effective operation of the plant. (370) Despite this generous arrangement few corporations ventured into serious consideration of reprocessing. However, as power reactor technology edged towards commercial exploitation, renewed interest in reprocessing emerged amongst some of the major corporations in the industry. Thus, during the 1961 JCAE hearings on the state of the industry, the General Manager of GE's Atomic Power Division placed great emphasis on the need, when commercial nuclear power arrived, for private reprocessing services. (371) Within a year the

first private company to enter the commercial reprocessing business had began contractual discussions with the AEC. (372)

In January 1962, a subsidary of the huge WR Grace Chemical Company outlined its design plans for the first US commercial reprocessing plant, which was to be based at West Valley in New York State. On this site, Nuclear Fuel Services (NFS) proposed to construct a 300 mte reprocessing plant. (373) Contractual negotiations between the AEC and NFS commenced in March 1962 and by May 1st 1963 a construction permit had been granted. Three years later, on April 20 1966, the plant became operational. To assist NFS in attaining commercial operation the AEC agreed, through a base load contract, to provide it with sufficient spent fuel to ensure continued operation for five years. (374) This was crucial to the NFS venture for, as a later report strongly underlined, 'without the baseload contract, NFS would not have undertaken the reprocessing venture because there was not enough commercial spent fuel available at the time to support a private chemcial reprocessing plant.' (375) Further AEC assistance to NFS was provided by ensuring access to classified reprocessing technology. And finally, the AEC expedited the licensing and regulatory review of the plant such that no serious delay was encountered. This was later to become an issue of considerable national controversy, provoking accusations of AEC malfeasance, since it was known that two AEC studies had 'concluded that there was not sufficient assurance that the plant could operate efficiently and reliably.' (376) Nevertheless, construction and operation of the plant was authorized.

The NFS plant generated considerable industrial interest and shortly after it had received its construction permit the JCAE held hearings on private reprocessing. (377) Curiously, this was the first and only JCAE hearing on reprocessing per se, perhaps demonstrating the committee's disinterest in this part of the fuel cycle. Essentially, the hearing was called to assess AEC policy and to discuss a staff report, commissioned

earlier by the JCAE, on industrial reprocessing. (378) AEC Commissioner, Dr Wilson, who was also responsible for the private ownership of nuclear fuels legislation, clarified to the JCAE the commission's policy with respect to encouraging private reprocessing, the objectives of which were:

> (1) to have privately owned processing plants in operation as becomes necessary to process different types of fuel from privately owned reactors;
> (2) to eliminate AEC responsibility for reprocessing industrial fuels;
> (3) to have available a private capability for reprocessing certain fuels from the government in order to supplement government facilities;
> (4) to demonstrate the economics of reprocessing as soon as possible for private industry' (379).

To achieve those objectives, the AEC was willing to enter into contractual agreements with any interested private corporation to provide a baseload supply of fuel and access to classified technology. (380) Having encouraged NFS, the AEC hoped that further ventures would be established in the near future. It is interesting to note here that the AEC's contractual approach to encouraging private reprocessing was later resurrected in much the same form to deal with the privatization of the enrichment sector, as reflected in the Nuclear Fuels Assurance bill discussed earlier.

What is curious about the JCAE hearing was that very little discussion occurred on the central ramifications implied by the development of a private reporcessing industry. Neither the environmental safety, waste management and health issues raised by, the operation of the NFS plant were comprehensively examined nor were the serious national and international security aspects of the commercial exploitation of this extremely sensitive

(i.e. weapons related) technology. Indeed, it was at least a decade before these critical issues were given a thorough public airing.

Industry's interest in commercial reprocessing was rejuvenated during the first phase of reactor commercialization. The unbridled optimism of this period, in which the future was perceived (at least officially) in terms of the 'plutonium economy', naturally lent itself to commercial interest in the profitable exploitation of fuel reprocessing. Three material developments also encouraged the belief that commercial reprocessing would be a reliably profitable enterprise. Firstly, with the passage of the Private Ownership of Nuclear Fuels act, the AEC was obliged to withdraw from reprocessing and encourage private ventures. This it was attempting with vigour. Secondly, as the initial phase in the rapid commercialization of power reactors reached its apotheosis there was a recognition that, by the early 1970s, a secure and expanding market for reprocessing services would exist as nuclear plants, then under construction, became operational. Thirdly, contemporary official and industry opinion held that reprocessing was necessary both to recover plutonium for LWR recycling or the FBR and also to provide for the effective disposal of nuclear waste. (381) Moreover there was at this time very little organized environmental opposition to nuclear power. Thus the investment conditions for private reprocessing appeared, in the mid to late 1960s, decidedly propitious.

Two corporate reprocessing ventures were annnounced in the late 1960s: GE's Morris plant; and Allied Gulf Nuclear Services Barnwell plant. (382) GE's Morris plant was designed to process 300 mte of spent fuel per year and projected initial operation was 1972. (383) At an estimated cost of $25m, this sizeable investment was part of GE's corporate strategy of vertical integration through which it aimed by being able to offer a complete range of fuel cycle services, to ensure a competitive edge over its rivals. Its corporate rival, AGNS, was a joint venture between the

multinationals, Allied Chemical and Gulf General Atomic, who were engaged in diversifying their operations into new technologically advanced areas. Barnwell was planned in 1968 as a huge 1500 mte plant, at an estimated cost of $80m, and construction began on it in 1971. (384) Apart from these two plants, various other companies, such as Atlantic Richfield, Exxon and Gulf Oil were carrying out feasibility studies into the prospects for further private investment in the reprocessing sector. (385) With considerable AEC assistance and encouragement the early 1970s witnessed the infancy of a commermcial reprocessing industry.

However, commercial reprocessing became a 'victim' of the crisis which enveloped nuclear power in the mid 1970s. By 1974 combination of political, technological and economic factors led to the forced closure or suspension of construction, of all the above plants. Increased costs, unforeseen difficulties, and tighter regulatory requirements made commercial reprocessing at NFS, Morris and Barnwell economically unviable. Environmental opposition to nuclear power, which from 1969 to the early 1970s was in its first phase, concentrated upon the radioactive pollution caused by nuclear plants. Goffman and Taplin's pioneering work on the environmental hazards of radiation, encourage extensive opposition to the construction and operation of all types of nuclear facilities. (386) By their very nature, reprocessing plants were regarded as potentially the most environmentally hazardous and so tremendous local and national opposition was organized against the construction and operation of NFS, Morris and Barnwell (387). Environmental opposition also forced the AEC to tighten its regulatory standards and this imposed additional engineer ing and financial burdens on the private reprocessors. (388) As a result, NFS was temporarily closed in October 1972 for upgrading and expansion but was never to reopen. (389)

Furthermore, the technological complexity of reprocessing plants too contributed significantly to their eventual commercial demise since the

difficulties encountered in their construction were considerably underestimated. GE's Morris plant was completed in 1971 but technical problems continued to delay its operation until it was finally admitted that, unless the plant was completely redesigned and rebuilt, it could not be operated at all. (390) Modifications were also required at the NFS and Barnwell plants. Thus the technical complexity of reprocessing, under commercial and financial constraints, added to the immense burdens which private reporcessors already had to contend with.

Finally, the interaction of environmental opposition, changing regulatory standards, and technical problems added unforeseen costs to the projects which eventually seriously eroded their commercial viability. By 1972 GE had expended nearly double the original estimated cost of the Morris plant; Barnwell costs too had escalated well over double the original $100m estimate; and NFS estimated that to reopen its facility would require $340m, which approached nearly a ten-fold increase over the original estimated cost. (391) Not only were construction costs increasing but also, because of regulatory constraints and escalating inflation, the projected operational costs of these plants became prohibitive. In effect, mounting costs made reprocessing uneconomic, since at some point, the value of the recovered plutonium would be less than the costs of recovering it. (392) Commercial reprocessing therefore was made increasingly unviable.

The combined result of all these pressures, despite AEC attempts to ameliorate their impact, was to ensure that NFS never reopened. Morris remained unoperable and Barnwell was never completed. (393) Even the ramifications of the oil crisis, which prompted the private reprocessors particularly, and the nuclear industry generally, to promote the economic and resource case for reprocessing, did not materially reverse the dwindling commercial prospects for the reprocessing business. Nor did the AEC's draft statement on mixed oxide fuels, which recommended approval of

plutonium recycle in LWRs, have any significant impact on the outlook for commercial reprocessing. (39) Indeed, by late 1974, the fledging commercial reprocessing business like the reactor vendors, had succumbed to a deepening crisis.

3.4.4 The Politics of Private Ownership

Any assessment of the political dynamics of privatization, as evidenced in the three areas of the fuel cycle which have been the primary subjects of this section, would reveal a number of valuable insights into the state's role in facilitating the commercialization of nuclear power. It illustrates all too clearly the political salience of both the AEC, and the JCAE, in directing, shaping and managing the industry's whole development. In particular, the two organs functioned in a distinct but complementary manner: the AEC promoting, encouraging and assisting the extension of private ownership; with the JCAE providing a forum and institutional mechanism for resolving the intense conflicts of commercial interests which naturally arose out of any substantive arrangements for implementing the private ownership ideal.

But the AEC's role was decisive since, in many respects, it was the determining political force behind the momentum of private ownership: whilst industry was fervently ideologically committed to private ownership individual corporate commercial interests, as well as divisions between different sectors of the industry, sometimes retarded its practical realization. With particular respect to private ownership of nuclear fuels and reprocessing facilities, it was the AEC which both initiated the 'process' and demonstrated greater enthusiasm for privatization than even private industry which remained cautious, and even sceptical, in its approach. Had the situation been the reverse, it is difficult to imagine that private ownership would have progressed at the pace it did. Moreover, since industry required transitional support from the AEC, to reduce the risks and uncertainties entailed in the transfer of ownership, without the

latters acquiescence, private ownership would not have materialized so readily. The AEC's role was therefore critical and whilst it functioned clearly in the general interests of private industry, it was nonetheless substantially autonomous: it did not, as much of the discussion in this section has indicated, automatically promote or respond to immediate corporate interests or demands.

As for the JCAE's role in extending private ownership to the nuclear fuel cycle it was more facilitative than promotional. Since privatization had quite different implications for different sectors of the industry there arose, as illustrated in this section, quite significant conflicts of commercial interests. Thus, with respect to private ownership of nuclear fuels, the demands of uranium producers, for a ban on cheap uranium imports, directly conflicted with the utilities interests in being able to obtain fuel at least cost. Similarly, in discussions over enrichment plans, it was apparent that the utilities were much more directly interested in reliable and guaranteed supplies of enriched uranium than the matter of ownership over which they remained fairly ambivalent. Through the JCAE, and through the legislative process, these conflicts of commercial interests were ameliorated so that acceptable arrangements for the transfer of ownership were arrived at. This was certainly the case with regard to ownership of nuclear fuels but, in the case of enrichment was somewhat obfuscated by the collapse in the enrichment market. Furthermore, the JCAE often provided a mechanism for reconciling the AEC's 'maximalist' proposals and designs for ownership arrangements with the more cautious and 'gradualist' approach desired by the majority of commercial interests. This was most evident in the JCAE's deliberations on the ownership of both nuclear fuels and enrichment facilities. Inevitably such reconciliation took the form of state-supported transitional arrangements, which provided direct assistance to industry throughout a specified period of adjustment to private ownership, giving both the AEC and the JCAE

continued influence over the industry's commercial development. Finally, the fact that the JCAE refrained from any ideological criticism of the principle of transferring ownership rights from the government to private companies, a principle to which it had been deeply opposed in the 1950s, stripped the issue of any political controversy. Congressional deliberations were therefore absorbed by matters of the appropriate means rather than the issue of acceptable ends.

This, albeit but brief, assessment of the formulation and implementation of policy with respect to the private ownership of nuclear fuel and fuel processing facilities, reveals much about the comparative roles and functions of the JCAE and the AEC within the overall structure of nuclear policy making but it supplies only a partial perspective on that structure itself. Therefore the concluding section of this chapter will attempt to sketch out the characteristic features of the government - industry 'partnership' as it had evolved during the period from Oyster Creek in 1963 to the AEC's abolition in 1974.

3.5 Some Concluding Comments on the State-Industry Relationship

The commercialization of nuclear power, and the consequent massive expansion of the nuclear industry, was accompanied by a virtual transformation in the form, content and style of the state-industry partnership which had characterized the earlier period of atomic development. As commercial nuclear power became a reality so the relationship between the elements of the 'atomic triad' - the AEC, the JCAE and the nuclear industry underwent subtle but significant changes. In particular, policy formulation and implementation became almost the sole political estate of the AEC, JCAE, and representatives of industry to the near exclusion of all other interested and affected parties. Camilleri, and others, have referred to this variedly as the 'nuclear establishment', 'nucleoracy', or the 'atomic-industrial complex'. (395) What is common to all these labels is the underlying image of a fusion between the political,

administrative, industrial and technical elites which were responsible for, or engaged in, the civil nuclear enterprise. This would seem to describe the structure of the state-nuclear industry relationship, as it has been portrayed in this chapter.

Intermittent snapshots of the government-industry relationship, throughout the period 1963 to 1974, would reveal the discreet emergence of a quasi-autonomous nuclear policy community; practically an independent sub-system of government. Amongst the distinguishing features of this community were its structure and characteristic policy processes. In general, descriptions of the US public policy process tend to rely upon a pluralistic model in which independent, and competing, organized interests interact with Congress and executive agencies to shape policy outputs which, in turn, reflect a genuine consensus and a balance between sectional demands and the public interest. Power is therefore somewhat diffuse in this model. However, several traits of the government-industry relationship deny the validity of this model as a description of the structure of power and the character of policy making in the civil nuclear sector. The complexity of many of the issues automatically restricted the community of decision makers to the technical cognoscent so that access to and participation in the policy process was not simply dependent on having interests at stake but also being technically competent on the issues under discussion. Thus the policy community tended to become restricted to the experts. Associated with this was a process of cooptation through which the key organized interests, such as the AIF, EEI, and the major corporations, were integrated into government policy networks since they had expertise upon which, the AEC and JCAE, continuously relied. Moreover, both the AEC and the JCAE depended heavily upon industry to implement policies which were regarded as vital to the national interest, as well as their own immediate bureaucratic or political interests. Thus the AEC's drive for the attainment of commercial nuclear power to meet the nation's

expanding energy needs depended entirely upon private industry for its effective realization. But cooptation therefore eroded the formal barriers between government and industry giving industry, as an insider group, preferential and direct access to the key decision making organs. Of course this relationship was not simply one-way; as commercialization progressed it became apparent that industry was perhaps even more reliant, than it ever had been, on the JCAE and AEC, for providing hospitable conditions for its continued expansion. The government-industry relationship was therefore one of inter-dependence and interpenetation since each element in the partnership sought to advance its own particular interests and ensure an environment conducive to the achievement of its own goals. It was in the mutual interests of both to maintain such a 'partnership' but it nonetheless denied the validity of pluralist notions of independent organized interests competing for access to and influence upon government. Rather, the situation was one in which the public domain and the private domain became fused together.

Nor was it simply the public and private domains which became indistiguishable. Within the public sphere the constitutionally distinct roles of the JCAE and the AEC became increasingly blurred as the JCAE absorbed executive functions, and the AEC legislated its own regulatory requirements. Even in 1964, Green and Rosenthal had commented upon the trend towards the integration of JCAE and AEC powers and functions. (396) As the pace of commercial exploitation of nuclear power accelerated that trend was certainly not nullified. Indeed it was reinforced by an underlying 'strategic' consensus which pervaded the policy making community.

Unlike the period of the 1950s when there was considerable ideological conflict between the JCAE and a tacit industry-AEC coalition over the fundamental issue of public versus private development of nuclear power, the era of commercialization brought with it a convergence of political

views. A tacit consensus emerged based upon private ownership and a corresponding attachment to the ideology of technological progress, as witnessed in the general commitment to the FBR and the plutonium economy. Technological and commercial necessity therefore became the essential ideological ingredients of this new consensus. Technical debate about means was not allowed to be corrupted with political controversy about ends. The latter were 'given' so that the function of the policy process became merely one of deciding upon the most efficient means to achieve established goals; a good example of this being the major debates on the private ownership of nuclear fuels and enrichment facilities when the question of privatization was never at issue. Of course, it would be banal to suggest that there were no conflicts of interests between the institutions and indeed this is not what is being suggested. There were obvious conflicts of interests, across a range of issues, and much of this chapter has been spent examining their significance in shaping the commercial development of nuclear power. Nonetheless, it is equally evident that as commercialization progressed those conflicts of interests occurred within a strategic consensus which embraced, amongst other things, a commitment to a robust and expanding private nuclear industry.

Only opposition to nuclear power challenged that consensus since it sought to demolish, on technical and ethical grounds, the case for increased utilization of nuclear power. As political opposition to nuclear power escalated, following the massive expansion of the industry in the 1960s, it became a very real political threat, as this chapter noted, to the nuclear industry's continued expansion. For much of the opposition could not be accommodated or co-optated into the policy community since it was not reformist - it did not desire safer or better ways of utilizing nuclear energy per se - but rather was essentially radical in that it sought to curtail the further commercial and technological exploitation of nuclear energy. The role of the AEC, through the regulatory process,

therefore, became crucial in marginalizing or displacing, with the industry's support, powerful and organized opposition. It is in the parallel reactions and attitudes of industry, AEC and JCAE to the growing nuclear opposition, that evidence of the powerful forces and material interests which united them is most visible. In its reactions to its political opposition the government industry partnership proved itself to be an exclusive political alliance. Whilst opposition groups did obtain access to the policy-making and regulatory processes that access was, as the chapter noted earlier, conditional and subject to many restrictions; the pluralist notion of equal and restricted access to the governmental machine was thereby compromised.

All told the characteristics of the government - industry partnership which have been sketched out in the last few pages suggest that it did not function according to traditional pluralist logic: far from it. Indeed it appears to reflect much more of a neo-pluralist, or even liberal coporatist, logic in which the fusion of state agencies and corporate capital is the determining factor. There are faint echoes here of Galbraith's corporate 'techno-structure' and its intimate connection to the state machine in which both collude to achieve their separate objectives.(397) But however one labels the government-industry partnership in this case, it is clear that it was a circumscribed technological community, in which there was an underlying strategic consensus, about ends, and a framework of formal and informal inter-organizational networks designed to further the mutual interests of each party. In this respect it was a virtually self-governing technological community: Of course, this is an over-exaggeration, but it nonetheless captures some of the distinctive characteristics of the government - nuclear industry partnership which arose in the aftermath of commercialization.

Having described the character of that relationship, it is also important to qualify the description lest any misconceptions arise. Perhaps the most significant qualification is a recognition that whilst they came to share common interests with industry, the AEC and the JCAE remained quite autonomous bodies. They were not, as some studies have argued, 'captured' or 'colonized' by industrial interests. (398) For, whilst they functioned within the overall strategic consensus on many major policy questions, there was not a total unanimity of views. As this chapter has illustrated, on the central issues of the PDRP and private ownership of nuclear fuels and facilities, the immediate interests of the AEC, JCAE, and industry did not automatically coincide. Moreover, on the fundamental questions it was either the JCAE or the AEC which adopted a leadership role whilst industrial interests often cautiously acquiesced. This is certainly evident with respect to the PDRP, private ownership legislation and commercialization of power reactors. Furthermore, to discuss industrial interests as if they were a monolithic entity is to ignore the intense conflict and competition which is a natural feature of commercial activity. As this chapter has demonstrated, on many vital issues there were profound conflicts of interest between different sectors of the nuclear industry. In these circumstances it was the JCAE which attempted to mould a consensus out of dissensus. There is also considerable evidence in the chapter to reinforce the proposition that, despite undoubtedly enormous pressures to conform to the wishes of the strongest industrial interests, the AEC and the JCAE were able to maintain a significant degree of autonomy from direct political pressure, regardless of its source.

Nevertheless that autonomy was not unbridled: it was constrained by the functions which the AEC and JCAE performed to maintain a viable nuclear industry which in turn was vital to the achievement of their own policy objectives. As this chapter has discussed the AEC through its provision of

direct and indirect subsidies, services, the absorption of external costs, and its planning and coordination activities, guaranteed the necessary conditions for the industry's commercial expansion. Since an expanding and profitable industry was essential to the attainment of the AEC's own immediate bureaucratic but also broader state objectives its own autonomy was compromised by the need to ensure that its actions did not undermine that expansion. Within this constraint, as the chapter has illustrated, it had almost unfettered discretion. Moreover, as the following chapter will argue, the AEC's unequivocal promotion of commercial nuclear power domestically was inseperable from its parallel strategy of ensuring US commercial and technological hegemony in the international arena. For the AEC domestic and foreign atomic policy were intimately connected.

CHAPTER 3 FOOTNOTES

1. Sec. 3(d) PL 83-703. (68 Stat. 919).
2. See Northrop R.M. 'The Changing Role of the AEC in Atomic Power Development,' Law and Contemporary Problems, 1956, pp. 14-37.
3. Commenting on this in 1957 Green noted
   "It has since become clear, if it was not clear then [1954], that there is little shortrun economic incentive for private investment in nuclear power under existing technological circumstances."
   Green H.P. 'The Strange Case of Nuclear Power,' Federal Bar Journal, v.17, April 1957, p.101.
4. See Dawson F.G. Nuclear Power - Development and Management of a Technology, University of Washington Press, Seattle 1976, p.103.
5. This was certainly the case with the BWR. This had only been effectively proven in a technical sense in the summer of 1953 but in 1954 the EBWR was sanctioned; and before that was fully operational. Other BWR projects had been sanctioned in the 1955 PDRP Round 2.
6. See Allan W. Nuclear Reactors for Generating Electricity: US Development from 1946 to 1963, Rand Corp. June 1977, R-2116-NSF p.76.
7. See Dawson p.90-1.
8. AEC Press Release No.589 Jan 10th 1955.
9. Sec. 169 outlawed any subsidy to private industry but section 31 allowed it to finance research and development. On the question of subsidies the law, and the AEC's promotional role see Green, H.P. 'Nuclear Technology and the Fabric of Government' George Washington Law Review, V.33, Part 1, October 1964, p.138-140.
10. AEC Press Release No. 589. op.cit.
11. ibid.
12. ibid.

13. See Lessons from Early Experience in Reactor Development, Rand P5715 Santa Monica, Sept. 1976, p.5.

14. Allen op. cit. p.78.

15. ibid.

16. AEC Press Release No. 589 op.cit.

17. For details of the proposals see Allen op.cit. pp.42-46.

18. ibid p.48.

19. ibid.

20. GE subsidized construction of the plant in two ways -

(1) according to Dawson it sold the plant at a reduced price 'on condition that the utility did not accept any government subsidy'.

Dawson op.cit. p.122.

(2) it offered a fixed price contract such that the cost overruns, which were significant, had to be borne by GE.

All that Consolidated Edison and the other utilities paid was the contract price of $45m.

See also Tybout R.A. 'The Public Investment in Atomic Power Development,' Law and Contemporary Problems, 1956.

21. The contract had an historic impact on GE since it then fully committed itself to the BWR.

See Perry R et al Development and Commercialization of the LWR 1946-1976 Rand Corp. Santa Monica, June 1977, R-2180-NSF p.91.

22. Pendergrass B. Public Power, Politics and Technology in the Eisenhower and Kennedy Years, Arno Press NY, 1979. p.73.

23. Allen op.cit. p.52.

24. This resulted in criticism from the public power lobby that the PDRP discriminated in favour of large, private utilities.

See ibid. p.54. and Dawson, p.99.

25. Green (1957) op.cit. pp.113-4.

26. A press seminar on the PDRP was held in late 1955 and in the annual hearings on the state of the industry, held in February 1956, the AEC went to great lengths to explain the rationale behind its policies.
See USAEC Press Seminar on Civilian Power Reactor Development, December 5th, 1955 and
Testimony of Dr K Davis, Director, Division of Reactor Development in US Congress JCAE Hearings; Development, Growth and State of the Atomic Energy Industry, 84th Congress, 2nd Session, Part 1 February 1956.
US GPO Washington D.C., 1956.
(Hereinafter referred to as Section 202 Hearings 1956.

27. Allen, p. 65. op.cit.

28. For details of second round proposals see ibid, pp.55-64.

29. See Dale, A.G. Nuclear Power Development in the United States to 1960, Arno Press, New York, 1979. pp.62-3.

30. US Congress JCAE Hearings Accelerating the Civilian Reactor Program, 84th Congress, May 1956.
US GPO Washington D.C. 1956. p.1. (hereinafter referred to as Hearings Accelerating the Civil Reactor Program).

31 . ibid,. pp. 42-57.

32. On the changes and implications of this policy see Gaddis J.L. Strategies of Containment, Oxford University Press, Oxford 1982, ch.6.

33. Nuclear Engineering v.1 no.6. September 1986, p.221.

34. Hearings Accelerating the Civil Reactor Program, op.cit.

35. Green (1957) op.cit. p.118.

36. Pendergrass op.cit. p.63. See also Dale op.cit p.95 and Dawson op.cit. p.104.

37. Pendergrass p.74.

38. ibid. p.75.

39. ibid. p.76.

40. On this point see Dawson op.cit. p.100. For details of the proposals see Allen op.cit. pp.67-73. Dale op.cit. pp.65-71.

41. Green (1957) op.cit. p.119.

42. ibid.

43. ibid.

44. ibid. p.118.

45. USAEC Remarks prepared by L.L.Strauss, Chairman USAEC, for delivery at the Dedication of the Vallecitos Atomic Power Plant November 25th 1957.

46. Part of the JCAE's demand to obtain expanded authorisation powers also arose from its desire to have sole Congressional responsibility for the AEC and not to share jurisdiction, on financial matters, with the Authorization Committee. A number of conflicts had arisen between the two which the JCAE sought to avoid in the future by obtaining authorization powers.
See, Green and Rosenthal op.cit. pp.169-174.
US Congress, House Report No.571, June 14th 1959.

47. Dawson, op.cit. p.108.

48. It became law on 3rd July as Public Law 85-709(71 Stat.274)(1957).

49. On the bills passage see Green and Rosenthal op.cit. pp.177-79.
Green H.P. and Rosenthal A. Government of the Atom, Atherton, NY, 1963, p.84.

50. The basic requirements of the bill are noted by Dawson op.cit. p.108.

51. As Green and Rosenthal op. cit. p.84 stated -
"Since the AEC's efforts to encourage private enterprise to invest in reactor projects and other phases of the atomic energy industry were based largely on such co-operative programs, the

1957 amendment brought this entire program within the Joint Committee's cognizance".

52. ibid. p.188.

53. ibid. p.182 and Dawson op.cit. p.109.

54. Other studies and projects were also included - Green and Rosenthal op.cit. p.185.

55. Dawson op.cit. p.109.

56. Hanford was one of the AEC's original plutonium production facilities.

57. This was partly due to the fact that both the AEC and JCAE had common interests in opposing the budget cuts which the Budget Office attempted to impose. These cuts were part of a much wider package of expenditure restraint introduced by the administration. In addition Strauss's retirement did much to assist co-operation.

58. See Pendergrass op.cit. Ch.3.

59. ibid. p.67.

60. On the legislative history of the project see ibid. pp.59-75.

61. See Green and Rosenthal op.cit. p.188.

62. ibid. p.138, p.141.

63. On the swap arrangements see Simpson J. The Independent Nuclear State, Macmillan, London 1983, pp.130-32.

64. See ibid. p.130 and Green and Rosenthal pp.240-241.

65. Pendergrass op.cit. p.81.

66. As Green and Rosenthal's study states op.cit. p.111.
"... what makes the JCAE stand out is that its involvement in executive processes and its domination of certain areas of the atomic energy program have become thoroughly institutionalized and accepted - the modus operandi and not merely an occasional occurrence."

67. ibid. pp.17-19.

68. On corporate plans and involvement in the nuclear programme see Dale, op.cit. Ch.4. For detailed examination of major corporations and their involvement see,

Nehrt L.C. International Marketing of Nuclear Power Plants, Indiana University Press. Bloomington 1966, pp.201-290.

General Electric had the most ambitious plans, for BWR development entitled 'Operation Sunrise'. For discussion of this see Dawson, op.cit. pp.121-2.

69. For details of comparative costs see Mullenbach op.cit. pp.64-70. According to the AEC actual PWR and BWR generating costs ranged from 9.28 - 9.61 mills/kwh in 1959 compared with coal fired plants at 6-7 mills/kwh.

Lippke indicated that in 1956 capital costs of LWRs would have to be reduced by between 18-28% if they were to become competitive. See Lippke D.M 'The Facts of Atomic Power Development: Some Aspects of Nuclear Power Economics.'

Law and Contemporary Problems 1956.

70. A point perceptively recognized in early 1956 by Northrop (1956) op.cit.

71. Hearings Sec.202 Part 1 1956 op.cit. p.445.

72. Ibid p.450.

73. See Dawson op.cit. p.123.

74. For details of the legislation see ibid p.124-5.

75. Ibid p.124.

76. Ibid.

77. Indeed following the study and passage of the bill the AEC was virtually forced into internal organizational changes to give greater significance to safety matters.

See Nuclear Engineering March 1958, p.94.

78. Dawson op.cit. p.125.

79. Ibid. o.127.

80. Allen op.cit. p.51.

81. See Hogerton J.F. The Atomic Energy Deskbook. Reinhold Publishing Corp. New York 1963 pp.156-7.

82. See Nuclear Engineering March 1958 p.94.

83. Dawson op.cit. p.125.

84. See Camilleri The State and Nuclear Power, Harvester, Brighton, 1984, p.64.

85. Although originally temporary the act was extended for a further ten years in 1965.
See Dawson op.cit.p.131.

86. Public Law 85-256 (71 stat 576) 1957.

87. Dawson op.cit. p.132.

88 . US AEC 23rd Seminannual Report of the AEC January 1958 US GPO Washington DC 1958 p.161.

89. Green H.P. 'Information Control and Atomic Power Development' Law and Contemporary Problems 1956.

90. JCAE Hearings Section 202 Part 3 1955 p.541-2.

91. For a discussion of the organizational and procedural aspects of declassification see
Hogerton op.cit. p.100-1.
Green 1956 op.cit.

92. Green ibid.

93. See USAEC Twenty-Third Semiannual Report of the Atomic Energy Commission January 1958 US GPO Washington DC 1958.
(hereinafter referred to as Semiannual Report) p.58.

94. Green (1956) op.cit.

95. See US AEC Press Release No.760 January 13th 1956.

96. Ibid. Also see US Congress JCAE Section 202 Hearings 1956 Part 1 p.84-5.

97. In 1956 the AEC established a new procurement programme for domestic uranium but noted that it would cease completely in 1966. Prices declined and the industry's outlook remained bleak until commercial nuclear power developed.
Dawson op.cit. p.162.
Mullenbach op.cit. p.120-124,

98. See Mullenbach P. Civilian Nuclear Power, Twentieth Century Fund NY 1964, p..97.-102.

99. Ibid. p.98,100.
Also confirmed by the Federal Power Commission's own studies. See Hogerton op.cit. p.353.

100. Mullenbach op.cit. p.107.

101. Ibid.

102. Ibid p.79.

103. Dawson op.cit. p.135.

104. Allen op.cit. p.73.

105. Ibid.

106. Perry op.cit. p.15.

107. Allen op.cit. p.74.
Dawson op.cit. p.135.

108. It was entitled Civilian Nuclear Power - A Report to the President 1962. USAEC Washington DC 1962. (hereinafter referred to as USAEC 1962 Report)

109. From the President's letter to the AEC reprinted in ibid.

110. USAEC 1962 Report op.cit. p.5.

111. Ibid. p.43.

112. Ibid p.8.

113. Ibid p.45-6

114. Ibid. p.42.

115. Ibid. p.35.

116. Hogerton op.cit. p.360.

117. Ibid.

118. Larger plant size reinforced the dominance of LWR technology over natural uranium GCR's; and other natural uranium fuelled systems. Since enriched uranium was the fuel for a given larger output the core size in a LWR would be smaller, than in a comparable natural uranium fuelled plant. In consequence capital costs would be comparatively less.

119. USAEC Report to the President op.cit. p.30.

120. Ibid p.33.

121. Ibid p.33-34.

122. Ibid.

123. The major element of costs was capital costs. Here the AEC's and reactor manufacturers estimates were considerably unrealistic. Great reliance was placed upon a 'learning curve' which would bring down real capital costs. In fact real capital costs of plants continuously increased particularly from the early 1960's onwards. Moreover, it should have been evident at the time that capital costs estimates were too low for many of the PDRP projects had vastly overrun their budgets. Shippingport for example cost $70m an increase over the estimated $48m. Nonetheless the expectation was that capital costs would fall just as those of coalfired plant increased or stabilized. Only Phillip Sporn, President of the American Electric Power Company, openly criticized the AEC and industry's optimistic assessments. See Bupp Irvin C & Derian Jean-Claude The Failed Promise of Nuclear Power Basic Books New York 1981 pp.45-48. On cost

overruns of PDRP projects see - Nuclear Engineering December 1957 p.496.

124. On the AEC's ability to tap this ideological commitment to technological process see
Camilleri pp. op.cit. pp.9-13
With respect to the essence and nature of the ideological commitment itself
see Wilson H.T. The American Ideology Routledge and Kegan Paul, London 1978

125. USAEC Report 1962 ... op.cit. p.34.

126. Ibid.

127. This was probably a slightly inflated figure since it exceeds the actual cumulative total of annual figures given in Dawson. The real difficulty in establishing a true figure is that not all costs come within civil reactor development budget heads. It may therefore be an underestimate.
See ibid. p.30.
Dawson op.cit. p.28-30.

128. In 1958 the JCAE had published a statement calling for an expanded civilian nuclear programme. Comments were called for and the AEC prepared its own statement of policy on reactor development. Both were responding to increased pressure from industry to expand the development programme. There was little disagreement about the need to expand but there was a significant difference of opinion about how this should be done. Industry and the AEC wanted private development; the JCAE public development. The AEC followed up its statement with a study in 1959 which formed the basis for the Ten Year Programme in 1960. This latter aimed to achieve commercial nuclear power by 1968.

See Dale op.cit. pp.98-101.

Dawson op.cit. pp.114-122.

Hogerton p.352.

On the significance of AEC fuel use changes, and plutonium credits, for the economics of nuclear power

See Dale op.cit. pp.40-42

Mullenbach op.cit pp.70-76

Both conclude that these factors helped subsidize nuclear costs.

129. See USAEC Report.1962. op.cit pp.49-51.

130. Ibid p.10.

131. Ibid p.48.

132. Ibid.

133. Ibid.

134. Ibid.

135. Dawson op.cit. p.133.

136. The last major demands for a public programme were made in the JCAE's accelerated programme in 1958.

See US Congress JCAE Proposed Expanded Civilian Nuclear Program Committee Print 85th Congress 2nd Session August 1958 USGPO Washington DC 1958.

137. Quoted in Dawson op.cit. p.136.

138. USAEC Report 1962 . op.cit. p.34.

139. Mullenbach op.cit. p.14).

140. See USAEC Report 1962 op.cit.

141. The oil crisis led initially to increased demand for nuclear power followed by a jump in orders as the economic recession bit hard.

142. On these two grants see the chapters in Nehrt op.cit.

143. Both Westinghouse and GE had received orders from foreign utilities and were extending their penetration of foreign markets.

144. These uncertainties were large since there was no experience upon which to base an assessment of construction or operating costs. Moreover since coal costs had recently declined because of the introduction of 'unit trains', which reduced coal transportation costs (a significant portion of total coal costs), the economics of nuclear power too appeared uncertain.
See Perry op.cit. p.20.
Gandara op.cit. p.55.

145. See Gandara ibid. p.27.

146. An FPC study in 1960 predicted electricity requirements were expected to double by 1970.
See Hogerton op.cit. p.353.

147. See Perry op.cit. p.25.

148. See Pringle P and Spigelman J. The Nuclear Barons, Avon Books, NY 1981. p.267.

149. ibid.

150. For more details of the plant see
Oyster Creek Nuclear Engineering, June 1965, pp.225-228. According to Bupp and Derian it was later upgraded to 640 Mwe, see
Bupp Irvin C and Derian Jean Claude, The Failed Promise of Nuclear Power, Basic Books, NY 1978, p.43.

151. Perry op.cit. p.30.

152. Bupp and Derian op.cit. p.47.

153. Perry op.cit. p.28.

154. See Pocock R.F. Nuclear Power - It's Development in the United Kingdom, Unwin Brothers, London 1977, who notes the cost of the BWR was cheaper than any comparable GCR, p.163.

155. Gandara op.cit. p.53.

156. Perry op.cit. p.28.

157. Gandara op.cit. p.53.

158. Phillip Sporn, a respected critic, was doubtful about the robustness of the Oyster-Creek and early cost studies. see Bupp and Derian pp.op.cit. pp.44-48, 211.

159. Gandara op.cit. p.54.

160. See AEC The Nuclear Industry, Wash 174-74 USGPO, Washington DC, 1974 p.14.

161. Calculated from figures supplied in Duffy G.C. and Adams G. Power Politics: The Nuclear Industry and Nuclear Exports Council on Economic Priorities, New York 1978 Table 6:4.

162. Based on figures produced in Wash. 1174-74 op.cit. p.14. measured in terms of capacity.

163. Duffy and Adams op.cit. Table III.

164. Calculated from figures supplied in Gandara op.cit. p.27 and Wash. 1174-74 op.cit. pp.8-9.

165. This was the era of the end of ideology debate as epitomized in works like D. Bell's The End of Ideology Gelncoe 1960. On the nature of this debate and its origins see Bell. D. The Coming of Post-Industrial Society Peregrine, London 1976 pp.1-47.

166. This is a theme reflected in the works of Patterson W. Nuclear Power, Penguin, London 1976 p.223. Bupp and Derian op.cit. Ch.2.

167. Perry op.cit. p.35.

168. ibid p.37.

169. ibid.

170. Gandara op.cit. p.54.

171. ibid. Perry op.cit. p.35.

172. For further discussion of sales see

AEC The Nuclear Industry 1971, Wash. 1174-71 USAEC Washington DC, 1972, pp.79-81.

On GE's abandonment of turnkey sales see Nuclear Engineering, GE Cuts Turnkey Contracts, July 1966, p.507.

173. This was caused by an accident and led to an entire blackout throughout New York City.

174. Gandara op.cit. p.56.

175. ibid.

176. Of course there were significant variations in coal costs between different regions because of the transport costs involved. On the issues see Gandara p.22, pp.55-56.

177. ibid. p.56.

178. ibid. p.19.

179. As Gandara ibid. p.31. notes "Between 1966 and 1972, capital spending by utilities rose at an average annual rate of 18 per cent."

180. ibid. p.59.

181. It was originally believed that a construction learning curve would ensure that construction costs would fall as more construction took place. In fact as Burn and others noted the learning curve was a false dream.

The vendors "thought that a 90% 'learning curve' would probably apply - costs would be reduced by 10 per cent every time the output of plants was doubled, simply because of experience in manufacture."etc.

Burn D. Nuclear Power and the Energy Crisis, McaMillan, london 1978, pp.42-3.

182. These delays were not necessarily due to construction but also to the bottleneck in reactor pressure vessel production. Gandara op.cit. p.60.

183. See Nuclear Engineering, Oyster Creek, December 1967, p.892.

184. Although fossil fuel station costs increased too it was not by as significant an amount.
Gandara op.cit. p.62.
For an explanation of these cost increases see Perry op.cit.pp33-34.

185. It was in 1967 that the AEC, because of the steep rise in costs, began to survey reactor costs.

186. the logic of this was that they had shorter lead times and utilities had more construction experience with these plants. The former meant less harmony and more predictable costs.
Gandara op.cit. p.62.

187. ibid. p.60.

188. Wash. 1174-74 op.cit. p.1.

189. Gandara op.cit. p.23.

190. On the developments in the world oil market in this period see Sowayegh-Al A. Arab Petro-Politics, Croom Helm, London, 1984, Parts 3 and 4.

191. Dependence on oil differed enormously between the utilities but in general it had been steadily increasing. See Gandara op.cit.p.22. Well before the oil crisis the Nixon administration was forced to lift the oil import quotas, because domestic production (plus reserves) was not sufficient to meet domestic demand; on August 18th 1973.

192. See Meadows D.H. et al. The Limits to Growth, Pan, New York 1972.

193. Project Independence was clearly pro-nuclear proposing 30-40%. US electrical capacity be nuclear by 1983.
See Bupp & Derian op.cit. p.98.

194. See Gandara p.62, pp.20-21.
Perry op.cit. p.47.

195. Pressure for plutonium recycle in LWRs was growing in the early 1970s and a number of experimental programmes were under way. In 1974 the AEC published its draft statement on recycle giving its approval to plutonium recycle in LWRs.
See Wash. 1174-74 op.cit. p.57.

196. Gandara op.cit. p.14.

197. ibid. p.36.

198. ibid.

199. A maximum output was fixed in 1973. See AEC The Nuclear Industry 1973, Wash. 1174-73, p.91.

200. For background to standardization see
Patrick Nichols A. 'A Progress Report on the SNUPPS nuclear stations', NEI September 1977, pp.55-68.

201. Wash. 1174-73 op.cit. p.1.

202. See Burn op.cit. p.33.

203. See Gandara op.cit. p.62.-3. It is also important to keep in mind that new orders for nuclear plant exceeded operational capacity by a considerable fraction.

204. Based on figures provided in Wash. 1174-74 op.cit. p.14.

205. See Duffy and Power op.cit. p.89.

206. ibid.

207. Nixon's Energy Message to Congress in April 1973 reflected upon the deepening energy crisis which faced the US.
See Wash. 1174-73 op.cit. pp.1-2.

208. Nuclear News 'Industry Report 1975-76' mid February 1976, p.33.

209. On the utility's financial position see Gandara op.cit. pp.28-35.

210. There is a debate between those who be believe that it was the cost of nuclear power plant construction which was responsible for utility's financial problems, as well as reduced demand, and others who argue that it merely added to already serious problems. On both sides of this see

Lovins A. Nuclear Power-Technical Bases for Ethical Concern, 2nd ed. Friends of the Earth, London, March 1975, p.13.

Gandara op.cit. pp.28-35.

211. The most authoritative critical study on LWR capital costs wasa that done by

Bupp I. et al. Trends in LWR Capital Costs in the US: Causes and Consequences, MIT December 1974.

Bupp I.et al 'The Economics of Nuclear Power' Technology Review, February 1975 p.18.

Quotation from

US Congress Report Nucler Power Costs Committee on Government Operations, April 26th 1978.

US GPO Washington DC 1978, p.31.

212. On these estimates see

Perry op.cit. pp.422-5 and

Crowley J.H. 'Power Plant Cost Estimates put to the Test', NEI, July 1978, p.41.

213. The cause of delays was greatly debated as was its impact upon the actual costs of nuclear plants.

See Burn op.cit. pp.36-51.

Lead times averaged 6.5 years in 1970, 7 in 1971, and 9.3 in 1974.

ibid. p.44.

214. Burns ibid. p.40.

215. For a discussion of causes see ibid, ppp.44-51.
Bupp and Derian op.cit. Ch.9.
Much of the vitrolic debate surfaced in the 1971 hearings on licensing procedure.
See US Congress JCAE Hearings AEC Licensing Procedure and Related Legislation Part 1, June-July 1971.
US GPO Washington DC 1971.

216. Gandara op.cit.

217. Wash. 1174-74 pl. op.cit.

218. Discussion of the considerable lobbyinbg can be found in
Berger J.S Nuclear Power-The Univiable Option
Ramparts Press, Calif. 1976, ch. 8.
Bupp and Derian op.cit. Ch.5.
Camilleri op.cit. p.173-175.
And for evidence of the nature of this campaign see the statements of the AIF, Westinghouse, and General Electric in US Congress JCAE Hearings, Development, Growth and State of the Nuclear Industry, 93rd Congress, 2nd session. February 1974, US GPO Washington DC, 1974.

219. See Westinghouse's response to the President's message in Hearings ibid. pp.135-6.

220. ibid. p.2.

221. ibid. p.96.

222. ibid. p.149.

223. On the nature of the AEc's legitimating role see
Camilleri op.cit. Ch.4.

224. Licensing delays because of the intervention by opponents of nuclear power blamed by the industry for construction delays and increasing costs; in addition new rules and regulations further increased delays and costs as the phenomena of ratcheting and

retro-fitting (namely increasingly stricter standards and the need to apply them retrospectively regardless of how far construction had proceeded) became endemic.

On these issues see Perry op.cit. Ch.5.

Burn op.cit. Ch.5.

For the industry view see also

AIF The Causes of Nuclear Power Plant Delays, AIF Washington DC, April 1974.

However, independent studies of delays suggested that intervenors and increased regulation were not the primary causes of delay not cost increases.

See Rolph E. Regulation of Nuclear Power: Thje Case of the LWR Rand Corp. Santa Monica, June 1977, R-Z104-NSF. pp.55.-62.

225. Hearings Development, State etc. 1974, op.cit. p.15.

226. This was published in early 1967.

See USAEC Civilian Nuclear Power - The 1967 Supplement to the 1962 Report to the President, US GPO Washington DC, February 1967.

227. Dawson op.cit. p.139.

228. Hearings 1974, op.cit. p.12.

229. No exact figures are known but this range is calculated from the total sales in 1972. the first is the proportion which is accounted for by reactor sales and the second reactore sales plus turbines. In both cases the relevant proportion of total costs was calculated from AEC cost breakdowns for a 1000 Mwe plant. See Wash. 1174-73, p VII, 6,8,12.

230. ibid. p.VIII.

231. Duffy and Powers op.cit. Table C:4.

232. See the Summary in Wash. 1174-74 op.cit. p.1. and earlier editions.

233. See Camilleri op.cit. Ch.2.

234. In fact enriched uranium prices fell steadily from 1961 to 1966 and then remained stable until 1969. uranium prices continued to fall from the late 1950s and then stabilized in the mid 80s.
See Mullenbach op.cit. pp.86-87, 167-172.

235. Burn op.cit. p.31.

236. Plutonium credits to fuel users were based on the value of plutonium as laid down by the AEC. Initially this was related to the military value of the material but in the late fifties the AEC shifted its pricing policy to a more commercial bases reflecting the value of plutonium for LWR recycle or FBR. The plutonium credit on average reduced fuel cycle costs by some 8-13%.
See Wash. 1174-71,71, and 73, op.cit. p.92, 15, and 20 respectively and Mullenbach op.cit. pp.179-180. On the economics of the fuel cycle see
Timm M 'Some Aspects of Nuclear Fuel Economics' Atomic Energy Review, V.13. No.4. December 1975 pp.695-742.

237. There has only been one AIF study which was published in 1959 but this can hardly be regarded as independent.

238. Not so much to operational costs as the full costs of plant construction, depreciation, holding stocks of materials, energy sources etc.
See Patterson op.cit. pp.226-8.
Berger op.cit. p.153.

239. See AIF Forum Memo, December 1959, p.28. AIF Washington DC 1959.

240. As the later part of the chapter notes this was in preparation for the transition to private ownership.
See Public Law 91-560 (84 Stat 1472) Dec. 19th 1970.
Nuclear Engineering Intl Issues before the JCAE, November 1970, pp.908-9.

241. See Wash. 1174-74 op.cit. p.51.

242. ibid. p.53.

243. Burn op.cit. p.41.

244. See US Congress JCAE Hearings, Future Structure of the Uranium Enrichment Industry 93rd Congress 1st Session, July-August 1973, part 1. US GPO Washington DC, 1973, (hereinafter referred to as Enrich Ind 1973 Part 1) p.27.

245. See Timm op.cit. discussion on fuel cycle costs.

246. On the AECs R and D programme see Dawson op.cit. pp.78-83 and for more detail the AECs semi-annual reports to Congress.

247. For instance it provided access to enrichment techjnology to allow firms the opportunity to assess the benefits and costs of different enrichment technologies before investing in new plants. See Wash. 1174-71 op.cit. p.33.

248. These accusations were prominent during JCAE hearings in 1965 on legislation to extend the act for a further period.
see Dawson op.cit. pp.131-132.
Patterson op.cit. pp.229-231.

249. In the original 1957 a study of reactor accidents, Wash. 740, the costs of an incident ranged from $0.5 million to $7 billion, or even as high as $17 billion.
See Dawson ibid. p.126.
Cormullen op.cit. pp.64-5.

250. On the acts extension see Dawson ibid. pp.131-2.

251. ibid.

252. See Green H.P. 'Nuclear Technology and the Fabric of Government' George Washington Law Review, v.33. no.1. Oct 1944, pp.121-161.

253. A safety programame development see
Rolph op.cit. pp.35-40,
On Loft see.
USGAO Report This Country's Most Expensive LWR Safety Test

Facility May 26th 1976 RED-76-68.

USGAO Washington DC, 1976 and on the Rasmussen study background

Patterson op.cit. pp.199-200.

Dawson op.cit. pp.210-121.

254. See Category VIII. Wash. 1174-71 op.cit.

255. ibid.

256. Wash. 1174-73 op.cit. p.90.

257. In 1961 and 1970 there were demands for and rumours about impending separation.

On the nature of this contradiction see Green (1984) op.cit.

258. See Berger op.cit. pp.165-170.

and also Camillen op.cit. p.26.

259. The first rumours began in 1970. It was reorganized in 1972 and abolished in 1974.

See NEI 'AEC Rumours' July 1970 pp.566-7. Rolph op.cit. Ch.6.

260. the Calvert Cliffs case arose because the AEC rejected intervenor requests for discussion, during the hearings for the Calvert Cliffs plant construction permit, of issues related to emissions from the proposed plant. the intervenors took the case to court and the AEC was not only overruled but found to be breaching the requirements of the NEPA. From then on it had to issue a complete environmental impact statement for all proposed plants. Calvert Cliffs was a decisive boost to the anti-nuclear movement.

See Dawson op.ciot. pp.198-203.

Patterson op.cit. p.193.

261. The first wave of criticism arose out of Goffman and Tamplin's work on the radiation hazards of nuclear power plants. This fed into a second wave of criticism which focussed upon the probabilities and consequences of reactor accidents.

On these two 'waves' see - Burn op.cit. pp.62-68.

Rolph op.cit. Ch.5.

262. On the substantive issues involved in the ECCS hearings, which were called to examined and approve the AECs regulatory standards for reactor safety systems, see

Ford D.F. et al 'A Criotique of the AECs Interim Criteria for ECCS', Nuclear News, V.15. no.1. Jan 1972, pp.28-35. For an overview of the development and ramifications of the hearings see

Rolph ibid. pp.67-72.

Patterson op.cit. pp.194-198.

Burn ibid. pp.64-68, 74-76.

Pringle and Spigelman op.cit. pp.367-369.

263. See the reports of surveys in Camilleri op.cit. p.105.

264. Bupp and Derian op.cit. p.135.

265. In 1971 major hearings were held on the AECs licensing process and proposed changes to licensing procedure to reduce opportunities for intervenors to delay plant licensing.

During these it was apparent that both industry and the AEC viewed a major problem and source of delay to be intervention in the licensing hearings by opponents of nuclear power. Such delay imposed considerable costs on the industry.

See US Conmgress JCAE Hearings AEC Licensing Procedure and Related Legislation, June/July 1971, 93rd Congress, 1st Session, part 1. US GPO Washington DC, 1971, pp.1-10,

Statement of A.A.Wells, Chairman ASLB Panel, p.135 and pp.433-35.

Also Wash. 1174-71 op.cit. pp.179-80.

266. Indeed that was obvious from the proposed reforms which included legislation to virtually eliminate public hearings at the construction stage. See Wash. 1174-71 ibid. p.187.

In the above hearings Myran Cherry (Friends of the Earth) told the

JCAE that the proposed legislation "... provides practically for the elimination of effective public hearings within the AEC." Hearings ibid. p.387.

267. Even industry objected to the AECs approach to reform, rather than the reforms per se.
See Hearings ibid. pp.433-35.
Nevertheless reform continued to be a major issue with Presidential statements calling for an expedited licensing process. See Wash. 1174-73 op.cit. pp.90-1.

268. For an excellent discussion of the nature and impact of the intervenors, in a comparative perspective see Camillen op.cit. Ch.3.

269. For a deeper analysis of the tensions between efficiency and legitimacy in the modern capitalist state see
Offe C. 'Legitimacy versus Efficiency' pp.130-147 in Offe C. Contradictions of the Welfare State, Hutchinson, London 1984.

270. See AEC PRO-156 'AEC Adopts New Regulations to Implement Court Decisions on NEPA' 3.9.71.

271. See Wash. 1174-71, op.cit. p.180.

272. For evidence of this pressure and the AECs reactions see Dawson op.cit. pp.201-3.

273. Following the 1971 hearings on licensing further hearings were held in 1972 on legislation to amend the Atomic Energy Act to allow temporary licences to be authorized by the AEC whilst it dealt with reducing the huge backlog of work arising from its licensing moratoriums. The latter had arisen because of the Calvert Cliffs judgement which imposed new time consuming requirements on the licensing procedure; whilst pressure for temporary licensing came from utilities concerned about delays,

costs and projected power shortages in 1972-3.

See Dawson op.cit. pp.202-3.

274. As Rolph notes this was an effective strategy because environmental opposition concentrated upon the generic hearings rather than plant hearings.

See Rolph op.cit. p.70.

Dawson op.cit. p.203.

275. See Camullen op.cit. p.112, 122.

276. States rights with respect to regulating emission standards from nuclear plants were first challenged in the Manticello case in 1972. A Minnisota state agency attempted to assert its jurisdiction over radioactive emission standards with respect to the Manticello plant. The AEC took the issue to the courts and the Supreme Court ruled on 3rd April 1972 that only the AEC had jurisdiction over nuclear regulatory matters.

See Dawson op.cit. pp.194-198

277. See Wash. 1174-71 op.cit. p.180.

278. Camullen op.cit. p.109.

279. Nonetheless opposition contributed to the crisis in the industry in 1974 because it delayed plant construction imposing greater financial penalties as an already financially weak utility industry. But opposition was not the cause of the fall in orders merely a mediating variable.

See ibid. pp.133-5, 167-70.

Rolph op.cit. p.55.

280. This was announced by the President in a special message to Congress on June 29th 1973.

281. See Camilleri op.cit. Ch.4 for a discussion of how the tension between these objectives was managed.

282. See Charnoff G. 'Private Ownership of Special Nuclear Material in the US' 1964 Public Utilities Fortnightly.

283. See US Congress JCAE Hearings Development, Growth, and State of the Nuclear Industry, March 1962, 87th Congress 2nd session. USGPO Washington DC 1962, pp.95 ff.

284. See Mullenbach op.cit. p.330.

285. See the statement of G.F. Trowbridge, Chairman AIF Ad Hoc Committee on Private Ownership Legislation in US Congress, JCAE, Hearings, Private Ownership of Special Nuclear Material, 88th Congress 1st Session, July/August 1963.

286. See AIF Commentary on Legislation to Permit Private Ownership of SNM Report by the Ad Hoc Committee on Private Ownership Legislation, May 1963, AIF, Washington DC, 1963.

287. For full details see Dawson op.cit. pp.151-152.

288. What remains curious though is why, after so much consultation with industry, the AEC introduced legislation which the industry was not that keen on.

289. See Dawson op.cit. p.152.

290. A 10 year transition period was originally proposed. See Statement of Commissioner Wilson, Hearings (1963), Private Ownership op.cit. p.5.
During this transition period the AEC would guarantee enriched uranium supplies, keep out imports of uranium, and maintain a stable fuel market. This latter was jsut whjat the utilities wanted - see Public Utilities Fortnightly, July 16th 1964, pp.46-9.

291. See Dawson op.cit. pp.153-156.

292. the Senate Report on the bill noted that
"The availability of these services will provide further assurances of a long term supply of enriched uranium to other

nations and should thereby help to enhance the competitive position of the enriched uranium reactor system offered by US supplies and manufacturers. The sale of American nuclear equipment and materials abroad could be a significant factor in improving our balance of trade. Moreover, the additional volume of business resulting from overseas sales would create a larger base against which domestic suppliers and manufacturers could allocate research and overhead costs."

Senate Report No.1325 August 5th 1964 to accompany S3075 in US Code and Congressional and Administrative News, 88th Congress 2nd Session 1964, v.2. p.3115.

293. Toll enrichment was to commence in 1969 giving a 54 year transition period.

294. ibid. p.157.

295. See Statement of Commissioner Wilson Hearings (1963) Private Ownership,. op. cit. p.3.

296. In its 1964 Annual Report to Congress the AEC noted that private ownership would have a major financial impact in "... the elimination of government investment in enriched uranium for power reactor inventors; this otherwise might have amounted to $3 or 4 billion by 1980." See USAEC Annual Report to Congress of the AEC for 1964, USAEC Washington DC, 1965, p.14.

297. The 1964 Annual Report noted that production of enriched uranium was to be reduced by 40%.

ibid. p.17.

According to Allardice and Trapnell military requirements only accounted for one third of the total capacity of the AECs enrichment plants, Allardice and Trapnell op.cit. pp.75-76.

This reduction and stabilization in military requirements was due to two factors: superpower discussions of a cutoff in fissile

material production; and significant changes in US strategic nuclear policy which emphasised an assured destruction capability.

On the first see Simpson op.cit. p.132.

On the latter see Freedman L. US Intelligence and the Soviet Strategic Threat, MacMillan London 1979 Ch.5.

298. Dawson op.cit. p.159.

299. See ibid. p.158.

300. The AIF made a classified review of the arrangements, well before they were published, suggesting considerable changes.

See AIF Committee Report: A Study of Uranium Enrichment Services Critera and Projected Changes Oct 1965.

AIF Washington DC, 1965.

301. Significant changes in the criteria were made to reflect those interests.

See USAEC Major Activities in the Atomic Energy Programme January-December 1966

USAEC, Washington DC, 1967, p.78.

302. The AEC entered into 30 year guaranteed contracts; promised to meet demand; would provide the necessary expansion in enrichment facilities to meet demand; carried the costs of maintaining stocks of uranium and enriched uranium; allowed a flexible contract where necessary; only 1 years notice of future requirements was necessary; and it was not required to cover all its total costs.

See ibid and also USAEC Uranium Enrichment Services Criteria, June 29th 1966, USAEC Washington DC, 1966.

303. As noted earlier the AEC was forced to increase its prices from 1970 onwards and in 1974 temporarily placed a moritorium on its enrichment contracting because of excessive demand.

304. See AIF Committee Report: A Study of Uranium Enrichment Services Criteria, op.cit.

305. In an article in 1967 Seaborg, AEC chairman, noted that the US would only have enough capacity to meet projected enriched uranium demand until the later 1970s and a little beyond.
See Seaborg G.T. Meeting World Nuclear Fuel Requirements, Nuclear Engineering, Germany 1967, pp.98-100.

306. The JCAE was informed in 1968 that new enrichment capacity would have to on line in 1978. See Statement of Chairman Price in US Congress JCAE Hearings, Future Structure of the Uranium Enrichment Industry, 93rd Congress, 1st Session, July/August 1973 Part 1 Phase 1.
USGPO Washington DC, 1973, (hereinafter referred to as Hearings (1973) Future Structure Phase 1.

307. See AIF Private Ownership and Operation of Uranium Enrichment Facilities Report of a Forum Study Committee, June 1968, AIF Washington DC, 1968. p.2-3.

308. 1968 was the year of the gold crisis and mounting inflationary pressures.

309. See Dawson op.cit. p.170.

310. ibid.

311. This was the fundamental issue which had galvanized all concerned into a full examination of private ownership by the JCAE in 1973. See Hearings (1973) Future Structure, Phase 1, op.cit. p.1.

312. ibid. p.9.

313. See Hearings (1973) Future Structure Phase 21, op.cit. p.1.

314. See USAEC New Enrichment Plant Scheduling, November 1973, USAEC, Washington DC, 1973.

315. ibid. p.4.

316. This was put unambiguously by Rep.Holifield who stated "...if somebody does not do it you are goint to have a gap, there will be a cessation of the export of reactors, there will be a cessation

of the purchase of reactors domestically. I would say that some kind of decision has to be made within at least, at a maximum, a year."

Ibid, p.35.

AEC Commissioner Larson upheld this view suggesting that "...potential private enrichers should plan as having reached their business decisions within the coming year ..."

ibid, Phase 1, p.37.

On the question of lead times see ibid. pp.114-118.

317. On the possible enrichment contracting crisis see ibid. p.138.

318. In the AECs 1973 report on the nuclear industry it stated: "There is considerable concern in the nuclear industry over the possibility that domestic $U_3 O_8$ production capacity might not be adequate to meet domestic requirements by the mid 1980s."

Wash, 1174-73 op.cit. p.33.

319. ibid. p.42.

320. Figures from p.3. of USGAO Allocation of Uranium Enrichment Services to Fuel Foreign and Domestic Reactors. Report by the Comptroller General of the United States, March 4th 1975, US GAO Washington DC, 1975, (hereinafter referred to as GAO (1975) Allocation of Uranium etc.)

321. Quoted in Wash. 1174-73 op.cit. p.42.

322. For a discussion of these issues see -

Spero Joan E. The Politics of International Economic Relations 2nd ed. George Allen and Unwin, London, 1982, Ch.2.

323. See the discussion in Hearings (1973) Private Ownership, Phase 1, op.cit. p.77.

324. The CIP and CUP upgrading programme was quite separate from the question of ownership. This was a programme to make existing plants more efficient and to maximize production output. Even

with CIP and CUP the AEC calculated that it would not have enough capacity to meet the demands of the late 1980s.

See Wash. 1174-71 op.cit,. pp.27-32.

With respect to the politics of CIP/CUP funding see Wander E.F. Nuclear Fuel and American Foreign Policy, Westview Press, Boulder, Col. 1977, Ch.4.

325. For a discussion of the developments in the enrichment markets see Camullen op.cit. pp.193-202. also Wash. 1174-71 op.cit. pp.35-38.

326. Reported in 'Hosmer Warns Wouldbe Enrichers' NEI, May 1969, p.371.

327. See the testimonies of Jerome W Komes UEA; Clement E Sutton GE; Raymond L Dickeman Exxan; and Lawrence F O'Donnell Gulf General Atomic in Hearings (1973) Future Structure, Phase 2.

328. See 1174-74 op.cit. p.50-1.

329. For example Komes of UEA told the JCAE that Congressman Hosmer's plan for a government enrichment corporation "... is one of the options open to the country and it should not be abandoned. We think the Commission and the Joint Committee ought to encourage all options at this time." and Dickeman of Exxan Corp. suggested "The AEC should maintain a viable contingency plan under which the Government could add new capacity from a 1976 decision point in the event private industry was not able to make its commitment to go forward with an adequate program by that time." Hearings (1973) Future Ownership, Phase 2, op.cit. p.73. and 181 respectively.

330. Background to this can be found in Allardice and Trapnell op..cit. p.76-77.

331. This was an attempt to establish commercial pricing to assist the transition to private ownership. On the actual price increases see the annual industry reports, Wash. 1174-71, 73 and 74,

On the legislative amendment see Public Law, 91-560 (84 Stat. 1472) December 19th 1970.

332. On the JCAE views on this legislative amendment see NEI 'Issues Before the JCAE' November 1970, pp.908-9.

333. For details and comparison of the old and new contracting system see
USGAO (1975) Allocation of Uranium Enrichment etc. op.cit. p.5 and Appendix II.

334. ibid. p.5.

335. See Wonder op.cit. Ch.4.

336. About 90% of diffusion technology had been declassified by 1973 but centrifuge technology remained completely classified. Hearings (1973) Future Structure, Phase II, op.cit. p.177.

337. See NEI 'AEC to Permit Access to Enrichment Technology' August 1971
p.618. and for further details, Wash. 1174-71 op.cit. p.33.

338. See Wash. 1174-73 op.cit. pp.44-7.
and Wash. 1174-7774 op.cit. pp.50-1.

339. For details of the DCEF consult Wash. 1174-74 ibid. p.51.

340. ibid,.

341. Major uncertainties remained over the extent of foreign competition, the size of future demand, the impact of plutonium recycle (if allowed). See Wash. 1174-71 op.cit. p.30.

342. See Hosmer's statement already quoted supra fN p.316.

343. Hearings (1973) Future Structure, Phase II op.cit. p.7. For details of USAEC see pp.3-7.

344. Indeed it was explicitly modelled on the TVA. ibid, p.6.

345. ibid. p.19.

346. For instance the EEI testified to the JCAE that "The institute believes that the responsibility for uranium enrichment should be transferred to private industry but in an orderly and timely fashion which will not in any way jeopardize the supply of

enriched uranium to the electric utility industry." ibid, p.46. And Commonwealth Edison noted that "... As to the Hosmer Plan, we feel it is a good way to get along with our shortrun problems." ibid. p.205. These contrast markedly with the AIFs bold statement.

347. Prior to the hearings both the EEI and AIF had recommended some form of government managed transition. See Dawson op.cit. p.171.

348. Hearings (1973) Future Structure, Phase II, p.155.

349. See ibid, pp.46, 73, 185-86, 197.

350. For assertions of industry support for USEC plan see ibid pp.46,73, 157, 185.
The administrations view is contained in corespondence ibid,. pp.10-11.

351. ibid. pp.10-11.

352. See ibid. pp.75 and 84.

353. ibid. p.73.

354. Wash. 1174-74 op.cit. p.48.
On the background and detail of the crisis see USGAO (1975) Allocation of Uranium Enrichment op.cit. Ch.2 and
Brenner M.J. Nuclear Power and Non-Proliferation: The Remaking of US Policy, Cambridge University Press, Cambridge, 1981, Ch.1.

355. See NEI, AEC Suspends Enrichment Contracting August 1974, pp.623-4.

356. USGAO (1975) Allocation of Uranium, op.cit. p.17.

357. See Wash. 1174-74 p.51. and
GE Enrichment Nuclear Energy Division GEZ-S110 1974.

358. ibid.

359. See GE Enrichment, ibid.

360. See GAO (1975) Allocation of Uranium, op.cit. p.18.

361. See Wash. 1174-74 op.cit. p.52.

362. See Testimony of AIF and others in

US Congress JCAE Hearings Future Structure of the Uranium Enrichment Industry, Phase 3, Part 3, V1. 93rd Congress, 2nd Session, US GPO Washington DC, 1974.

363. See Wash. 1174-74 op.cit. p.52.

364. Centar was established on October 29th 1974 by Electro-Nuclearics and Atlantic Richfield ibid.

365. Noted in the Nuclear Energy Policy Study Group Nuclear Power: Issues and Choices, Ballinger, Camb. Mass. 1977, p.375.

366. US Congress JCAE, Membership, Publications and other Pertinent Information Through the 94th Congress, 1st Session, USGPO, Washington DC, 1976, p.71.

367. For details of the proposed legislation see Nuclear Energy Policy Study Group Nuclear Power: Issues and Choices, pp.374-5.

368. See USAEC Press Release, No.753, Jan 5th 1956, and No.760, Jan 13th 1956.

369. For further information see
USAEC 23rd Semiannual Report, Jan 1958
USGPO Washington DC, 1958, pp.150-151.

370. This is discussed at length in
US Congress JCAE Hearings, Chemical Reprocessing Plant, 88th Congress, 1st Session, May 14th 1963.
USGPO Washington DC, 1964 (hereinafter referred to as Hearings (1963) Chemical Reprocessing), pp.15-19.

371. See Statement of Dr L.R.Fink in
US Congress JCAE Hearings Development, Growth and State of the Atomic Energy Industry, February/March 1961 87th Congress 1st Session USGPO Washington DC 1961, p.314.

372. On the background to this plant see
Patterson W.C. The Plutonium Business, Paladin, London 1984, pp.44-5.

373. For more detail on the actual plant and the site see USGAO Issues Related to the Closing of the Nuclear Fuel Services Inc.Reprocessing Plant at West Valley NY, Report by the Comptroller General of the US, March 18th 1977, EMD-77-27 USGAO Washington DC, 1977 (hereinafter referred to as GAO (1977) NFS Report), pp.3-6.

374. The base load contracts in this case guaranteed the supply of 480 mte spent fuel.
See USAEC AEC Contract with NFS Inc. as Formally Negotiated, Contract No. AT (38-1)-344 reprinted in Hearings (1963) Chemical Reprocessing op.cit. pp.249-366.

375. GAO (1977) NFS Report p.2.

376. ibid.
The original GAO report on the contract pointed out the problems of NFS and the agreement recommending against it. See USGAO Review of Proposed AEC Contract with NFS Inc. for Chemical Reprocessing of Irradiated Fuel Elements, Report by Comptroller General B-151475 May 14th 1963.

377. See Hearings (1963) Chemical Reprocessing op.cit.

378. The report is reprinted on pp.104-148 ibid.

379. ibid. p.13.

380. ibid. p.16.

381. See Camilleri op.cit. p.205.

382. Wash. 1174-71 op.cit. p.134-5 and also General Atomic Intil. Shell Press Release December 17th 1973.

383. ibid. p.135.

384. For details see Newman R.I. 'The Barnwell Nuclear Fuel Plant', NEI v.17, 1972, November pp.938-41.

385. See Wash. 1174-71 op.cit. pp.135-6.
Wash. 1174-73 OP.CIT. P.57.

386. See Burn op.cit. pp.62-64.

387. NFS was examined very closely by the Union of Concerned Scientists who were highly critical of its operation.
See Hatfield P.M. 'Nuclear Fuel Reprocessing: Radiological Impact of West Valley Plant', pp.162-218 in Union of Concerned Scientists, The Nuclear Fuel Cycle MIT Press, Camb. Mass. 1974.

388. See Norman C. 'Barnwell-USA An Inevitability Forestalled' Nature, v.264 December 23rd 1976, pp.693-4.

389. See GAO (1977) NFS Report op.cit. pp.2, 16.

390. Wash. 1174-74 op.cit. p.61.

391. See Patterson (1984) op.cit. p.47; GAO (1977) NFS Report op.cit. p.3; and Norman C. op.cit.

392. On the economics of reprocessing see the Nuclear Energy Policy Study Group op.cit. pp.322-28.

393. ibid. pp.321-2.

394. See Wash. 1174-74 op.cit. p.58.

395. See Camilleri op.cit.
Patterson (1976) op.cit.
Berger op.cit.

396. See Green and Rosenthal op.cit.

397. See Galbraith The New Industrial Estate, Penguin, London 1967 Chs.26 and 27.

398. See Berger op.cit.

Chapter Four - Atoms for Peace: The Transnational Expansion of the US Nuclear Industry 1954-1974.

Between 1965 and 1974 the world nuclear industry was dominated by the United States; some 84% of nuclear reactor exports and the bulk of enriched uranium supplies were of US origin.(1) This US commercial and technological hegemony had its beginnings in President Eisenhower's 'Atoms for Peace' plan. Under this plan the US encouraged and promoted the widespread dissemination of nuclear technology and materials for peaceful purposes. In return for nuclear cooperation with the US countries accepted controls over the use and disposition of any nuclear technology and materials supplied to them. These controls were designed to ensure that such technology or materials would not be used for military purposes. By making the transfer of nuclear technology and materials dependent upon the acceptance of these controls the US was laying the foundations of a comprehensive international nuclear non-proliferations regime. This chapter examines the origins of the 'Atoms for Peace' regime and its evolution from an essentially bilateral system to a multilateral regime. In doing so it explores how the US utilized its technological, and later commercial, hegemony to ensure that the evolving non-proliferation regime reflected its own political, security, and commercial interests. Moreover, it seeks to explain how the 'Atoms for Peace' programme promoted and legitimized the transnational expansion of the US nuclear industry, underwriting its commercial and technological dominance in the world market. Finally, it analyses the complex inter-relationship between US domestic and foreign atomic policy, as well as the dramatic transformation in the latter as commercial nuclear power came of age. The constant tension in foreign atomic policy between commercial objectives and non-proliferation objectives is also given particular emphasis.

4.1 'Atoms for Peace'

Contemporary interpretations of the 'Atoms for Peace' programme tend, as a whole, to be highly critical of the apparent naivete of its founders as well as their motivations. At best it is considered a confused and vitally flawed plan for containing the spread of nuclear weapons related technology; at worst a rationalization for US global commercial exploitation of the technology which was indifferent to its proliferation implications.(2) But the methodological flaw in these conflicting interpretations resides in the fact that they are constructed with the advantage of hindsight. To understand properly the origins and the motivations underlying this historic American gesture it is necessary to explore the historical conjuncture which gave rise to it.

4.1.1 Origins

In his address to the UN General Assembly on December 8th 1953 President Eisenhower made a very impassioned plea for a revolutionary approach to nuclear disarmament and to reducing international tension. His plan was encapsulated in two brief but eloquent sentences:

> It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adopt it to the arts of peace.(3)

He was not proposing a revamped Baruch Plan, but rather an initiative which sought to create an institutional framework for the international dissemination and control of peaceful nuclear technology. With construction of Shippingport in October 1953 and Calder Hall in the UK, just a few months earlier, civil power reactor technology was becoming an engineering reality; it was no longer simply a technical possibility. Seeking to capture the political initiative, at this perceived technological crossroads, Eisenhower's Atoms for Peace proposals sought to:

> devise methods whereby ... fissionable material would be allocated to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine, and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world.(4)

It thus signified the end of America's policy of nuclear denial, which had been institutionalized in the McMahon act, and inaugurated a new era in international atomic relations.

To implement this historic vision required revision of the restrictive 1946 Atomic Energy Act for whilst it permitted very limited cooperation, following its amendment in 1951, this was nowhere near sufficient to fulfil the Atoms for Peace programme pledge.(5) New legislation was promised in the President's 1954 State of the Union address and, as chapter three has discussed, proposed legislation was introduced in to Congress in April 1954.(6) After heated and controversial argument over the bill's domestic and international provisions it was finally passed, albeit heavily amended, on August 30th 1954. Under the terms of the 1954 Act international cooperation in the peaceful (as well as military) uses of nuclear technology was made considerably easier.

Explanations for the Atoms for Peace revolution in US foreign atomic policy often emphasize the significant role of industrial interests in influencing the administration's decision to ammend the McMahon act, since it made it impossible for US business to compete in, or capture, foreign markets for civil nuclear technology. Atoms for Peace is thereby reduced to nothing more than a commercial policy in disguise, reflecting the immediate corporate interests of those enterprises which were also simultaneously pressing for a liberalization of domestic controls to promote private development of nuclear power. As Camilleri argues,

> the Atoms for Peace programme and the subsequent changes to the 1946 Atomic Energy Act were intended, as much as anything else, to preserve American dominance in the nuclear field.(7)

Whilst it is undoubtedly valid to assert that the promotion of international cooperation was in the US nuclear industry's direct

commercial interests it is not sufficient evidence from which to argue cause and effect. Indeed other evidence suggests that the role of business interests in determining the Atoms for Peace programme was, at most, marginal. Consider the fact that the original legislative proposals for the 1954 act were contained in two bills: one concerned with domestic matters and the other purely concerned with international cooperation. Clarifying its own priorities the administration strongly asserted that legislation on the latter was more urgent than for the former.(8) This would not have been welcomed by an industry which was lobbying hard for liberalization of domestic controls; industry's priorities were different from the administrations. Furthermore, power reactor technology was far from commercially exploitable, construction of Shippingport having only just commenced and developments in Britain, the most obvious technological rival, were little more advanced than in the US. Industry's immediate priority therefore was to ensure that new legislation contained the most propitious domestic conditions for private exploitation of nuclear energy. It would appear that corporate interests were less directly concerned with shaping the administration's approach to foreign atomic policy than is popularly assumed.

However, it would be facile to conclude that industry did not attempt to influence the administration's approach to international cooperation. Nieburg indicates that industrial interests did lobby hard for greater freedom to conduct business abroad but that these commercial factors played little part in determining the administration's policy.(9) It is also clear from hearings on the 1954 legislation that industry applauded the administration's Atoms for Peace philosophy. Yet this convergence of interests and desired policy was not the result of industrial interests shaping administration actions; rather it was the product of distinctive national security considerations which happened to promote the longer term interests of corporate and industrial capital. Atoms for Peace was much

more a child of the administration's national security policy than a political reaction to corporate lobbying.

When the Eisenhower administration entered office in 1953 it began an immediate review of national security policy. In 'Operation Solarium' the administration set about recasting the containment policy bequeathed to it by the Truman administration. The 'New Look' policy which emerged out of these internal deliberations was codified in NSC 162/2 in October 1953.(10) Central to this 'New Look' were five axioms which established the political foundations to which Atoms for Peace was eventually anchored. These five axioms were: budgetary restraint requiring greater emphasis upon 'cheaper' nuclear as opposed to 'dearer' conventional forces; a strengthening and greater dependence upon military alliances; replacing containment's passivity with an emphasis upon taking the political initiative; a commitment to arms control and negotiation from strength; and finally, a recognition of the political and ideological significance of the Third World in the cold war competition.(11) On the basis of this New Look policy it became obvious that the policy of denying cooperation in nuclear matters, particularly with NATO allies, no longer appeared to cohere with the changed requirements of national security policy. Moreover, the policy of denial had failed decisively, for both the Soviet Union and Britain by then had acquired a nuclear capability. Co-operation, it was assumed, would give the US, because of its world monopoly over nuclear fuel supplies, the opportunity to influence and constrain the development of foreign atomic programmes.

It was in this context that a review of US foreign atomic policy was initiated. Following the escalation of the nuclear arms race, with the development of fusion weapons, Eisenhower injected urgency into the examination of possible nuclear arms control initiatives. Spurred on by growing public anxiety over these new developments, and particularly by the Soviet H-bomb test in August 1953, Operation 'Wheaties' became the focal

point of the administrations review of atomic policy. (12) Under the supervision of AEC Chairman Strauss, who was also the President's Special Advisor on atomic energy matters, a new policy initiative was constructed which broadly cohered with the objectives of the 'New Look'. At the Bermuda Conference in December 1953, Churchill and Eisenhower discussed the Atoms for Peace initiative as well as the need for a greater exchange of nuclear weapons related information so that the NATO allies could 'train their forces effectively for nuclear warfare'. (13) On the basis of tacit inter-allied agreement the President announced his historic proposals to the UN General Assembly on December 8th.

From the US perspective Atoms for Peace was very much an arms control initiative since the essential ingredient was to be the creation of an international agency to which the nuclear weapons states would transfer fissile materials which could then be utilized for peaceful purposes by the agency's members. Moreover, this new agency would also establish safeguards to ensure that states receiving nuclear materials and technology used them solely for non-military purposes. Behind this initiative was an attempt not only to control horizontal proliferation but also to reduce incrementally nuclear weapons materials stockpiles and thus in the longer term nuclear weapon stockpiles too. The latter had great strategic significance for the US at the time since, as Sokoloski and Freedman have argued, Soviet nuclear strategy and war planning was based on massive pre-emptive nuclear strikes, which ipso facto required a large weapons and material stockpile. (14) Accordingly:

> ... the program's original objective was not just to get a general start toward reducing stockpiles, but to limit the Soviets military capability to knock out our industrial base with a large number of weapons. This was to be accomplished, first, by getting the Soviets to join us in making modest contributions to an international atomic energy agency (IAEA) and, then, by getting them to co-operate in a military fissile production cut-off and more substantial contributions to the IAEA. (15)

In effect this was an attempt to maintain a unilateral US strategic advantage since the US stockpile and production capacity far outweighed that of the Soviets. This 'hidden' strategic rationale for Atoms for Peace, as well as its more explicit attempt to control both horizontal and vertical proliferation, cohered well with the administration's broader national security posture.

Of course there were also elements of cold war politics interwoven with the Atoms for Peace proposal. By proposing this historic arms control initiative the Soviets were placed on the defensive. To rebuff such a bold initiative would be politically damaging since it would enhance US international prestige. Undoubtedly, this reflected an underlying commitment to the abandonment of the moral and political passivity of the containment strategy. Furthermore, in emphasizing the role which international co-operation in peaceful nuclear matters could play in materially improving economic and social conditions on the world's periphery the Atoms for Peace progamme coopted nuclear technology into the cold war competition for the political and ideological allegiance of the Third World. This is hardly surprising since the 'New Look' policy also identified the world's periphery as a crucial arena in which US national security interests had to be protected. In these respects Atoms for Peace and the 'New Look' complemented each other quite effectively.

Beyond Cold War politics the US, as a hegemonic power, was also much exercised by the need to establish effective international arrangements for managing and controlling the spread of nuclear materials and technology.[16] Already, besides the superpowers, France, Britain, Italy, Belguim and Canada had embarked on significant civil R & D programmes, and many more states, Japan, GDR, Poland, Switzerland, India, and Argentina had declared a serious intent to engage in civil nuclear R & D. Only through a multilateral framework, to which the Soviet Union adhered, could the US pursue its arms control objectives. International co-operation in nuclear

matters could be achieved through bilateral arrangements but a multilateral framework would impose collectively agreed norms, rules, and standards which would ensure uniformity of controls over peaceful uses and provide greater legitimacy for subsequent co-operation. An orderly regime for international co-operation in nuclear matters offered greater advantages than a competitive anarchy since it allowed co-operation without the fear of further nuclear proliferation. Furthermore, it would establish the essential foundations for a legitimate international market in nuclear materials and technology, which US corporations could take advantage of. To some extent then Atoms for Peace was partly a mechanism for creating a homogenous international nuclear market.

This was not, however, at the direct behest of corporate interests but rather reflected the ideological motivations which underlay the administration's approach to foreign policy generally. Nuclear power was regarded as a technology which promised abundant and cheap electricity, which could underpin the continued expansion and vitality of industrial capitalism, particularly in those states, like Japan, with negligible indigenous energy resources. Moreover, it was believed that nuclear technology offered industrializing states, such as India, a path to sustainable economic growth. (17) Through international co-operation in nuclear technology the administration sought not only to buttress the long term viability of the industrial capitalist order, for which it assumed responsibility, but also to entice states on the periphery into the Western system. As Commissioner Zuckert, testifying to the JCAE on the 1954 amendments to the McMahan act prophesied:

> Supported by a free and vigorous private and Government development effort in this country, the IAEA proposed by the President can demonstrate anew that the creative energy of the American system can contribute to the development of other nations as well as our own. (18)

At root the Atoms for Peace programme represented a natural extension of the administration's 'New Look' foreign policy. It awarded the political

initiative in the Cold War to the US; it represented a major step towards nuclear arms control; it enhanced alliance unity; it promised material advance to the Third World; and it advertised the technological and economic supremacy of capitalism in the face of continued ideological competition with the Soviet Union. To suggest it was merely a commercial initiative is therefore an inadequate explanation of its origins. Nevertheless implementing it was fraught, on both the domestic and international levels, with political controversy.

4.1.2 Implementing atoms for peace

Since the McMahon Act precluded any significant international co-operation the Eisenhower administration was forced to overhaul it in order to implement its Atoms for Peace programme. Reform, however, was already on the public agenda and had been since 1952. As discussed earlier, corporate interests and the AEC desired a liberalization of domestic controls to promote private development of the atom. Moreover, these same interests were able to argue quite forcefully that domestic private development of nuclear power was an essential pre-requisite to the successful implementation of the Atoms for Peace programme. The administration accepted this although they were concerned that it should not interfere with the more urgent reforms which were necessary to allow international nuclear cooperation, between the US and its NATO allies, with regard to military matters. This was vital to the deployment of tactical nuclear forces in Europe which formed an essential component of administration's and NATO policy for modernizing the military arm of the alliance. Furthermore, both the AEC and Pentagon were worried that predicted shortages of uranium would retard the military programme and therefore sought reform of the act to allow greater co-operation with foreign uranium suppliers to secure established sources of supply.[19] Thus a convergence

of problems and political pressures made reform of the act a priority in 1954.

When legislation was finally placed before the JCAE in April 1954 it became, as chapter three has discussed in detail, a source of great political controversy. Since the detailed debate has been rehearsed earlier, only more general points of relevance to this chapter need be made here. A primary focus of intense deliberation was international co-operation. Many Republicans were wary of the national security implications of a greater exchange of military atomic information with the NATO allies, whilst many Democrats were opposed to bilateral civil nuclear co-operation on the grounds that it undermined the President's plans for multilateral cooperation through the IAEA. Furthermore it was thought by many that the bill's international provisions provided the President with far too much discretion. Nor did some Democrats accept the bill's implicit assumption that domestic private sector development of the atom was a prerequisite for international co-operation. It was only by skillful Congressional tactics, combined with intense executive lobbying, that the bill's supporters managed to effect its passsage, although not unscathed by significant amendment, in August 1954. At this point the administration was able to sanction the implementation of its Atoms for Peace programme.

Whilst Congress debated amendment of the McMahon Act, Secretary of State Dulles and Soviet Foreign Minister Molotov, as well as their respective Ambassadors, had been engaged in intense correspondence in response to the President's Atoms for Peace proposal concerning the establishment of the IAEA.[20] This negotiation by correspondence, however, had failed to produce any substantive progress. Negotiations remained deadlocked and the prospects for the agency proposal were not favourable. Recognizing this the administration fell back on the bilateral approach to cooperation, which passage of the 1954 Act had sanctioned, in order to fulfil at least some of the promises made in the President's Atoms

for Peace initiative. Kratzer suggests that the administration was well prepared for this eventuality and accepted that until the IAEA was established:

> ... bilateral agreements would give substance to the programme, and thus help slow the tide already running toward independent nuclear efforts.(21)

The administration's willingness to accept the bilateral path was also conditioned by the urgent need to provide NATO allies with restricted data relevant for nuclear planning. Engaging in such information transfers, whilst simultaneously denying to other states cooperation in purely civil matters until the IAEA was established, would have compromised the political and diplomatic integrity of the US Atoms for Peace initiative. Therefore subsequent to the act's passage the AEC and State Department entered into a series of bilateral cooperation agreements.

Under the 1954 Atomic Energy Act the AEC was authorized to enter into bilateral and regional agreements for cooperation with other states; transfer nuclear materials to foreign governments; and sanction the commercial export of technology and nuclear facilities.(22) Cooperation agreements were designed to enable the transfer to foreign governments, and thereby to corporate enterprises, of nuclear fuels, technology and production facilities whilst ensuring that no such transfers were utilized for non-peaceful purposes. Certain restrictive provisions were therefore an integral part of such agreements. In particular all agreements contained a prohibition applicable to all transferred materials and facilities, against their military use; a commitment that no transferred items or materials could be re-exported without AEC permission; the procedural requirement that reprocessing of US supplied material had to be authorized by the AEC; an unambiguous declaration that transferred items or materials would be used solely for peaceful purposes; and the right of the US to determine the appropriate conditions for the adequate safeguarding of transferred materials '... including an unusual right to send its

inspectors into the sovereign territory of the agreement nation' to ensure against diversion of materials for military uses.(23) All these provisions were designed to prevent and to deter cooperating nations from utilizing transferred materials or facilities or technology for the production of a nuclear weapons capability. In return for agreement to these provisions cooperating nations were to be given preferential access to US nuclear materials and technology. Nevertheless, as Donnelly acknowledges:

> The US through the agreements for cooperation ... obtained unprecedented modification of national sovereignty through commitments of agreement nations to safeguard US supplied nuclear materials and equipment and to permit inspections by inspectors of the US.(24)

Besides these overt non-proliferation controls cooperation agreements also established other rights, rules and procedures which encroached further into national sovereignty. Property rights, specifically the title to ownership of nuclear materials transferred under an agreement, were clearly defined to confine ownership solely to governments until such a time as private ownership was legalized in the US.(25) Nor could cooperating nations dispose with or utilize transferred material, or any by-product material produced by its irradiation, without AEC authorization.(26) This latter was designed to control the independent development of foreign, private, or even government, owned commercial fuel processing capabilities. Indemnity, in the case of accidents involving the use of US supplied material only, was to be provided by cooperating governments absolving the AEC, or US corporations, from liability in the case of an accident. Cooperation agreements were therefore not simply a neutral or passive conduit for channeling and monitoring bilateral transfers of information, materials and technology. Rather they institutionalized a certain set of rights, norms, rules and procedures, for managing inter-state and transnational civil nuclear relations, which as the subsequent chapter will confirm, had significant ramifications for the sovereignty and autonomy of each cooperating state.

Formal control over international cooperation rested with the President since, under Section 123 of the 1954 Act, his approval was necessary for effecting any cooperation agreement.(27) This arose from the constitutional nature of such agreements: they were executive agreements and, unlike treaties, did not require Congressional approval for their implementation. President Truman laid the foundations for this form of agreement when in 1951 he had proposed successful amendment of the McMahon Act to allow international nuclear cooperation with a number of NATO allies without having to establish a formal treaty for which the constitutionally required 2/3rds Senate majority could not be guaranteed.(28) Thereafter the provisions and procedures instituted by this amendment became the basis for the approach to international cooperation adopted in the 1954 Act. But under this act it was the AEC which retained the initiative and the authority to negotiate such agreements rather than the Department of State (DOS), as might be expected.(29) Indeed it was not until 1958 that the DOS was given a formal role in implementing cooperation agreements when, under an executive order, the President delegated to it certain of his responsibilities in these matters.(30)

Once approved by the President a cooperation agreement had to be tacitly accepted by Congress in that it had to be submitted to the JCAE for a 30 day period. The JCAE, however, had no formal power to veto an agreement. Having been submitted to Congress for the requisite period the agreement automatically became effective. However, the formal procedure was somewhat removed from the actual process.

Despite the President's formal authority it was the AEC which came to dominate policy implementation with respect to international nuclear cooperation. Donnelly, in an original study of bilateral cooperation agreements, concluded that:

> The formulation of the functions, negotiation and administration of agreements for cooperation and export licenses was dominated by the USAEC for the period 1955-74...(31)

And in commenting upon government organization of international nuclear activities the McKinney report noted in 1960 that 'The AEC has become the focal point of responsibility for implementing international programmes.'[32]

The AEC Division of International Affairs, which absorbed the previous Office of International Affairs in December 1955, dwarfed the bureaucratic resources devoted to international nuclear energy matters by the Pentagon and DOS.[33] Moreover it continued to expand throughout the 1950s both functionally and even geographically.[34] By 1959 it had a central staff of over 200 and an international network of scientific representatives in foreign embassies who reported directly to the AEC.[35] It also had its own 'safeguards' inspectorate which, throughout the fifties and sixties, made scores of annual visits to verify compliance with cooperation agreements.[36] In comparison the DOS had no specific office for international nuclear cooperation. Rather these matters were dealt with by geographical and relevant functional bureaux and normally coordinated through one particular office at the level of Assistant Secretary or below.[37] Similar arrangements existed in the Pentagon.[38] Thus, because of its relative bureaucratic power, as evidenced in its size, relative autonomy, technical expertise, access to information, independent representation abroad, and promotional responsibility for nuclear power, the AEC not surprisingly came to direct and shape foreign atomic policy. (This was confirmed in interviews with several officials who throughout this early period held responsible senior positions in both the AEC and Department of State.) Even the President, for the most part, had to rely on the expert advice and opinion provided by the AEC. For, throughout the fifties the DOS appeared ambivalent about international nuclear cooperation only reacting where it encroached upon broader foreign policy goals. Commenting upon this, Mullenbach ascribes it to the DOS's view that nuclear cooperation was '...not an end in itself but more a special 'devise' for

advancing the particular aims of American foreign policy.'[39] This was a much more passive approach than that of the AEC which, being motivated more by its own technological and commercial objectives, '...took the initiative in expanding foreign policy programmes for nuclear energy.'[40]

Somewhat surprisingly neither the DOS or the Pentagon was immediately concerned with the proliferation implications of the AEC's vigorous approach to international cooperation since they were confident that the US enriched uranium fuel monopoly, combined with the control which could be asserted over foreign atomic programmes through bilateral cooperation agreements, made further horizontal proliferation '...more academic than real.'[41] It was not until the mid-1970s, with the erosion of that monopoly and Congressional concern over India's nuclear test, that greater external control began to be exercised over AEC policy regarding international cooperation.

Congress was perhaps more circumspect in its attitude towards international cooperation. Whilst in 1951 the JCAE had agreed to ammend the McMahon Act, providing for the limited exchange of information with NATO allies, it also imposed upon the executive significant restrictions on the areas of cooperation as well as a rigorous procedure for effecting it.[42] And in deliberations on the 1954 bill the JCAE, against the administration's advice, adhered to the requirement (as noted above) that all cooperation agreements be presented to Congress for tacit approval.[43] Without the formal power to veto or amend such agreements the JCAE, as Wit recognized could nonetheless:

> ... attempt to persuade the various proposers to reverse their positions, or resort to public criticism of the agreement on the floor of Congress, or introduce legislation to prevent the agreements consumation, or attach riders to other legislation to prevent the agreement from being executed effectively.(44)

Since, as the last chapter had discussed, the AEC became increasingly dependent on the JCAE for financial authorization of its programmes such

informal political pressure was often successfully employed when it was felt necessary. Green and Rosenthal note a number of cases in which political pressure from the JCAE resulted in significant alterations to the conditions and terms of particular bilateral cooperation agreements.(45) Perhaps the most dramatic case occurred in 1974 when, in reaction to President Nixon's offer of commercial reactor sales to Egypt and Isreal, the JCAE resorted to legislation amending the 1954 Act again giving Congress a right to vet any cooperation agreement.(46) However, until then the JCAE never sought to undermine the AEC's predominant role in determining policy on international cooperation but rather was content with holding it publically accountable for its actions.

Given its effective control over the implementation of US nuclear cooperation with other states the AEC quickly set about fulfilling the prior commitments which the President had made to allies, and more generally in his Atoms for Peace address. Four types of civil cooperation agreements were established by the AEC: special agreements; research agreements; power agreements; and regional agreements. These emerged in two distinct but overlapping phases: the first phase from 1955-56 involved special and research agreements; the second phase power agreements and agreements with international bodies. In a subsequent section attention will be focused upon the implications of these agreements for the transnational expansion of the US industry but the concern here is to isolate the main characteristics of the framework established for international nuclear cooperation.

4.1.3 The framework of bilateral cooperation

Shortly after the passage of the 1954 Act the AEC centered into direct negotiations with the UK, Belgium and Canada for the first cooperation agreements. These agreements were to be 'special' reflecting the long standing relationship between the governments which had developed initially

for joint procurement of uranium but which functioned now, almost exclusively, to guarantee sufficient supplies of uranium for the US civil and military programmes.(47) What made these agreements 'special' was the provision for the exchange, not just of unclassified, but also for classified information relating to the civil exploitation of the atom. Moreover, in the case of the UK, because of its advanced civil programme the agreement was to allow for the reciprocal exchange of unclassified and classified information relating to all stages of power reactor development. Under these agreements, which came into force in July 1955, the US guaranteed generous supplies of enriched uranium to meet the needs of these countries with respect to research and development of power reactors.(48) Through these initial special agreements the AEC provided considerable technical advice and nuclear materials to assist power reactor developments in these allied nations.

But for the majority of nations, particularly those eager to embark on nuclear research, what was required was transfer of and assistance with basic nuclear know-how. This after all had been promised in Eisenhower's Atoms for Peace speech. To fulfil its obligations, and also to demonstrate to the Soviets that failure of the IAEA negotiations would not inhibit the administration's cooperation policy, Ambassador Henry Cabot Lodge announced, before the UN General Assembly on November 5th 1954, the AEC's willingness to discuss bilateral research agreements.(49) This initiative was strongly supported by the DOS since it did not raise sensitive policy issues in the way that transfers of power reactor technology, and consequently large inventories of nuclear fuel, would do.(50) Negotiations for research agreements proceeded through 1955 and the first came into operation with Turkey on June 10th 1955, followed closely by Israel on July 12th, just before the first world conference on the Peaceful Uses of Atomic Energy in August 1955.(51)

These research agreements, of which eight were finally negotiated, permitted the transfer of unclassified research and scientific information but did not cover commercial power reactor technology .[52] In part this was because much of this information remained classified. Moreover, only limited supplies of enriched uranium were to be provided and none above twenty percent enrichment.[53] This was because larger amounts of more highly enriched uranium would have required negotiation of costly and time-consuming safeguard rights including the right to on-site inspection.[54] Since, in view of the continuing IAEA negotiations, it was not felt politically expedient to do so, nor was the AEC so predisposed, safeguards on these initial agreements were 'self-implementing'. It was not until late 1956 that this policy was revised and then only in reaction to dramatic changes in materials transfer policy. Under pressure from a number of countries the AEC sanctioned transfer of ninety per cent enriched uranium (normally considered to be weapons grade material) for vital materials test reactors.[55]

Whilst revisions were being made to research agreements, the AEC began negotiations in June 1956 with Australia, the Netherlands, and Switzerland for the first agreements dealing with power reactor technology. These power agreements, which later came to cover research as well, were announced initially in President Eisenhower's Pennsylvania State University speech on June 11th 1955. In that address the President reaffirmed his commitment to the Atoms for Peace promising that:

> Within prudent security considerations, we propose to make available to the peoples of such friendly nations as are prepared to invest their own funds in power reactors, access to and training in the technological processes of construction and operation for peaceful purposes. (56)

Whilst this was undoubtedly premature, since neither Shippingport nor the Experimental BWR had yet been completed, it signalled the AEC's and the administration's commitment to the dissemination of nuclear technology for power generating purposes. Power agreements thus ushered in a new phase of

cooperation specifically in the commercial exploitation of nuclear technology. And it was this form of agreement which became the indispensible mechanism through which the export of nuclear materials and technology from the US occurred in subsequent years. As Donnelly comments, the power agreements provided:

> ... a framework for growing exports by the US nuclear industry and a channel for US influence through our supply of enriched uranium ... or contracts for enrichment services. (57)

By 1958 the AEC had signed over thirty power bilaterals laying the foundations for the largest ever coordinated transfer of technology between states. (See Table 4-1) In return for access to US nuclear technology, materials, and nuclear exports, the cooperating countries entered into agreements which, to an unprecedented degree, compromised their sovereignty and autonomy. For not only were cooperating states subject to safeguards inspection by AEC officials but also on a range of fundamental policy issues ultimate decisions became a matter for joint determination. Thus under these agreements states could not reprocess US supplied material and by implication engage in plutonium recycle, without AEC approval; nor could states reprocess or transfer such material abroad without approval(58); and private ownership of transferred fuels was prevented. In addition since the agreements specified ceilings for the supply of enriched uranium the AEC came to have an implicit role in shaping the domestic nuclear plans of cooperating states.(59) Despite a rather liberal supply policy nuclear material nonetheless had to be rationed and this by definition required negotiations between the AEC and the cooperating state to determine the latter's real needs.(60) In some cases, particularly Japan, this gave the AEC a not insignificant influence over nuclear research and development plans.

Cooperating states also agreed to negotiations on the transfer of safeguarding the agreement to the IAEA. Other conditions in these agreements affected patent rights, indemnity provisions, plutonium prices

Table 4.1

Bilateral Agreement for Cooperation 1958

Country	Scope of Exchange	Effective Date	Fuel Article Provision (U 235)
Argentina	Research	July 29, 1955	6
Australia	Research and power	May 28, 1957	500
Austria	Research	July 13, 1956	6
Belgium	Research and power	July 21, 1955	(a)
Brazil	Research	Aug. 3, 1955	6
Brazil	Research and power		[b] 550
Canada	do	July 21, 1955	(a)
Chile	Research	Aug. 6, 1956	6
China, Republic of	do	July 18, 1955	6
Colombia	do	July 19, 1955	6
Costa Rica	do		[b] 6
Cuba	do	Oct. 10, 1957	6
Denmark	do	July 25, 1955	[c] 12
Dominican Republic	do	Dec. 21, 1956	6
Ecuador	do		[b] 6
France	Research and power	Nov. 20, 1956	[c] 2,500
Germany, Federal Republic of	do	Aug. 7, 1957	[c] 500
Germany: City of West Berlin	Research	Aug. 1, 1957	6
Greece	do	Aug. 4, 1955	6
Guatemala	do	Apr. 22, 1957	6
Iran	do		[b] 6
Iraq	do		[b] 6
Ireland	do		[b] 6
Israel	do	July 12, 1955	6
Italy	do	July 28, 1955	6
Italy	Research and power		[b] 7,000
Japan	Research	Dec. 27, 1955	6
Korea, Republic of	do	Feb. 3, 1956	6
Lebanon	do	July 18, 1955	6
Netherlands	Research and power	Aug. 8, 1957	500
New Zealand	Research	Aug. 29, 1956	6
Nicaragua	do		[b] 6
Norway	Research and power	June 10, 1957	500
Pakistan	Research	Aug. 11, 1955	6
Peru	do	Jan. 25, 1956	6
Peru	Research and power		[b] 800
Philippines	Research	July 27, 1955	6
Portugal	do	July 21, 1955	6
South Africa	Research and power	Aug. 22, 1957	500
Spain	Research	July 19, 1955	6
Spain	Research and power		[b] 500
Sweden	Research	Jan. 18, 1956	[c] 12
Switzerland	do	July 18, 1955	6
Switzerland	Research and power	Jan. 29, 1957	500
Thailand	Research	Mar. 13, 1956	6
Turkey	do	June 10, 1955	6
United Kingdom	Research and power	July 21, 1955	(a)
Uruguay	Research	Jan. 13, 1956	6
Venezuela	do	July 21, 1955	6
			(d)

[a] The specific amounts of fuel to be made available are not stated in the Belgian, Canadian, or United Kingdom accords.
[b] Agreements signed and in process of ratification.
[c] Fuel commitment as amended. (French amendment effective Aug. 19, 1957.)
[d] Adding the additional amounts of uranium 235 necessary for pipeline and inventory purposes, and the 5,000 kilograms pledged to IAEA, the total considered as obligated is approximately 35,000 kilograms.

Source: USAEC Annual Report to Congress 1959 USAEC Washington DC 1959

and the design and operation of particular nuclear facilities.[61] At one stage in early discussions on the formulation of the power agreements the AEC even indicated that it would require in them a provision for US '... industry to supply equipment, facilities, services and materials...'.[62]

Moreover since no insurance cover was available for exports, and many cooperating states had not then established their own indemnity provisions, industry applied pressure to the JCAE and AEC to require indemnity provisions in power bilaterals.[63] But both these demanding requirements were regarded ultimately by the AEC as too controversial to impose upon cooperating parties. Instead the AEC noted that the first was unnecessary since the US had a monopoly over fuel supplies, which gave an obvious advantage to US industry, whilst with respect to indemnity, a less formal approach was adopted, in which the AEC assisted in the promotion and drafting of foreign national indemnity legislation, as well as lobbying for an international convention on indemnity against nuclear accidents..

Following the declassification exercises of 1955 and 1956 virtually all aspects of reactor and nuclear fuel cycle technology, excepting for enrichment technology and some elements of reprocessing technology, could be transferred to another state under a power agreement.[64] Therefore from 1955 onwards a rapid and extensive dissemination of US nuclear technology occurred which '...stimulated and strengthened the growth of nuclear energy industries abroad.'[65] Paradoxically, it was this massive haemorrhage of nuclear technology which eventually contributed to the erosion of US technological and commercial hegemony in the nuclear sector.

Besides bilateral power agreements the AEC also entered into agreements with international agencies. Two agreements were negotiated, one with the IAEA; and the other with the European Atomic Energy Community (Euratom). Both had special provisions differentiating them from all other cooperation agreements. Once the IAEA statute had been successfully negotiated, in October 1956 and ratified by the US in July 1957,[66] it was followed by

the passage of the IAEA Participation Act which sanctioned US cooperation with it.[67] In order to implement nuclear material transfers to the Agency an agreement for cooperation too was signed with it in 1959.[68] What is significant about this particular agreement is that, in return for certain guarantees, the Agency was given complete discretion over the peaceful use and disposition of all nuclear materials transferred to it by the US.[69] Similar arrangements were made with Euratom excepting that the cooperation ageement was much broader in its scope than that with the IAEA.

Discussions about US-Euratom cooperation had begun in 1957 and had culminated in the passage of the Euratom Cooperation Act of 1958.[70] This legislation provided for much more than simply cooperation but established a joint power reactor, and R & D, programme which aimed to quicken the pace of commercial nuclear power development in Europe.[71] To give force to this programme serious negotiations on a cooperation agreement commenced immediately after passage of the Act and on February 18th 1959 it became effective. Replacing the separate bilateral agreements with individual Euratom member states.[72]

Two major concessions were made in negotiations with Euratom. Firstly, in the face of Euratom refusals to the normal unilateral US inspection and safeguarding rights, a compromise was attained in which Euratom was permitted its own independent safeguards system.[73] This system, which was to be established under close US supervision and guidance, was to safeguard not only all US supplied material but all civil nuclear material in Euratom countries. Whilst a momentous decision, its ramifications undermined the notion of a universal system of IAEA safeguards even before it was established, and created a deep antagonism in US relations with all non-Euratom states who remained subject to AEC inspection. This antagonism was compounded further by the US abrogation of its traditionally required consent rights over the reprocessing and the retransfer of US supplied material beyond the cooperating state's national

boundaries.[74] As long as US supplied nuclear fuel was retransferred or reprocessed within the Euratom community no prior approval from the AEC was necessary. Clearly given the political objective behind Euratom, which was to integrate national nuclear programmes and to establish a free market in nuclear fuels and technology, any such prior US consent rights would have been extremely unwelcome. However, because of the US commitment to European integration a decision was taken not to seek normal prior approval rights. This was not a great deal of comfort to those states which were dependent upon AEC discretion for the rights to undertake similar activities.

With the implementation of the Euratom agreement the last major edifice in the complex architecture of the Atoms for Peace programme was completed. In a little over four years the AEC had spun a sprawling global web of bilateral agreements which provided a legitimate framework for the 'great unilateral outflow of nuclear science and technology from the US in the late 1950s' and later underscored 'the commercial nuclear transactions and exports of the US nuclear industry in the world market.'[75] The AEC, utilizing the political leverage provided by US technological hegemony and its nuclear fuel monopoly, had effectively created a proto-regime of internationally agreed rights, norms, rules and controls, for managing the international dissemination of nuclear materials and technology. Moreover it was a regime which appeared to fulfil national security interests as well as the commercial interests of an expanding domestic nuclear industry. Indeed as the next section will reveal the international and domestic commercial exploitation of the atom were organically related.

4.2 The Global Expansion of the US Nuclear Industry

In the early 1970s the two leading US reactor vendors, Westinghouse and GE, supported by the AEC's global nuclear fuel monopoly, had come to dominate the worldwide nuclear power industry. Some 70% of the total reactor export

business (over 80% if calculated in Mwe) to 1974 was claimed by these two corporations.(76) Moreover, both were at the nexus of a web of joint ventures, licensing and technical agreements, which spanned all the major industrialized counties, covering every technical area from reactor construction to nuclear fuel manufacture.(77) Complementing this was the internationalization of the engineering and technical services, provided by a number of major US corporations, essential to the construction of commercial power reactors. But, like the domestic development of a commercial nuclear power industry, the global expansion of the US industry depended upon considerable government assistance and encouragement. In particular, the AEC acted as it had in the domestic context to remove the roadblocks to the international expansion of US industry. As it noted, in evidence to the McKinney panel in 1960, one of its primary tasks from the earliest days had been to:

> ...'normalize' and define the conditions under which American industry could transact business with foreign governments and enterprises interessted in the field of nuclear power.(78)

Underlying the 'push' for internationalization was the widespread official belief that it would contribute significantly to the achievement of the administration's domestic and foreign nuclear policy goals. Encouraging the export of US nuclear technology and materials, as well as the US licensing and foreign investment in foreign nuclear industries, was argued to be a positive step towards achieving US non-proliferation objectives since:

> ...American industrial penetration abroad would be tantamount to United States' government penetration and would help to reinforce American efforts to guide the evolution of peaceful atomic development.(79)

Yet this was a somewhat flawed assumption since US corporations were not passive conduits for the implementation of US foreign policy; they had their own commercial interests to promote. Nonetheless, this remained an unquestioned assumption of US policy makers well into the 1970s. In consequence, so long as US corporations were disseminating nuclear

technology under AEC controls, there was seen to be no conflict between commercial and non-proliferation considerations. Indeed US commercial expansion was regarded as complementing non-proliferation objectives.

Aside from reinforcing the administration's security and arms control policies the AEC viewed international expansion as crucial to the successful and rapid domestic development of commercial nuclear power. According to the AEC

> ... because of the differential in energy costs it has been expected that the fruits of the US reactor development program might manifest themselves at an earlier date overseas than they would in the United States ...

Thus a programme designed to assist foreign development would

> ... contribute ultimately to the realization of economic nuclear power in this country. (80)

It was therefore envisaged that expansion abroad would hasten the achievement of commercial nuclear power domestically, as well as facilitating the penetration of foreign markets by US corporations. Corporate giants, such as GE and Westinghouse, recognized too that their domestic competitive position in the industry would be considerably enhanced by penetrating foreign markets where commercial nuclear power promised to arrive earlier than in the US. For penetration of foreign markets would provide considerable additional construction and operating experience, thereby contributing to the vital search for reduced plant costs and increased efficiency necessary to achieve economically competitive nuclear power in the US. Commenting upon the close association between domestic and foreign nuclear development Vogel argued that:

> ... the Government's programme for international cooperation in the peaceful uses of atomic energy must be considered not only as a unique and effective component of American foreign policy, but also, as a significant step in the development of a private atomic energy industry in the United States (81)

For the AEC and industry it was not so much the prospect of immediate financial gain which encouraged internationalization, since that appeared extremely distant, but rather its spin-offs for domestic development as well as the opportunity to penetrate foreign markets which promised

considerable future commercial opportunities. And in assisting the development of indigenous nuclear industries abroad the administration was also enhancing the energy security of European and Japanese economies in particular. This, in the context of the Cold War was seen to be a significant objective.

There was also a sense in which industry's expansion abroad contributed to the resolution of the domestic political controversy, which raged from the mid to late '50s, over public versus private development of nuclear power. As the last chapter discussed in some detail the years 1955 through to 1959 witnessed a ferocious running political battle between the AEC and JCAE over the form and the pace of power reactor development. By encouraging and assisting industry's international expansion the AEC ensured that private industry was less concerned, than it otherwise might have been, with the administration's staunch refusal to expand public investment in power reactor development so as to accelerate the pace of commercialization. Although the AEC was unhappy with the slow pace of reactor development it was nonetheless united, along with industry, in opposition to JCAE plans for an accelerated programme of public power reactor development. Industry's expansion abroad, however, allowed it to acquire vital construction and operating experience, paid for indirectly by foreign governments, without the need for the AEC to give in to JCAE demands for a massive domestic public power reactor development programme. For this foreign experience would by definition contribute to the acceleration in the pace of domestic development. International expansion therefore was in part a means by which industry and the AEC cooperated in an attempt to accelerate domestic power reactor development without recourse to any massive additional public investment in the power reactor development programme. And it was AEC's extensive assistance to industry which encouraged its global spread in these initial years.

Through the mechanism of the bilateral cooperation agreement the AEC had, by 1957, normalized and legitimized commerce in nuclear technology, hardware, and materials. The bilaterals, as has been noted, provided a framework for the global dissemination of nuclear technology which, in theory,guarded against the further spread of a nuclear weapons capability beyond the existing nuclear powers. In one sense bilaterals were a means by which the AEC created a unified international nuclear market in which US industry could trade quite legitimately without undermining US security interests by unintentionally contributing to further horizontal proliferation. For bilaterals reconciled, at least officially if not substantively, the contradiction between the dissemination of nuclear materials and technology, and the further spread of weapons manufacturing capabilities. But AEC assistance went beyond merely removing this particular security 'roadblock' to international nuclear commerce. Since it viewed the domestic and foreign development of nuclear power as an organic unity it came to externalize its domestic 'enabling' function and role. There were even demands, in the late 1950s, for it to underwrite a nuclear Marshall Plan or the international equivalent of the domestic PDRP.(82) Whilst declining to initiate such exotic ventures it nonetheless provided significant material support for those corporations straining to penetrate foreign markets.

As discussed earlier, in the 1950s there was considerable optimism within industry and the AEC that nuclear power was first likely to become economically competitive in the higher energy cost regions of the world such as Europe and Japan. But to penetrate these markets required direct assistance from the AEC in a number of areas. In particular, since the US retained a virtually total monopoly of enriched uranium fuel supplies, prospective customers had to be assured of reliable supply arrangements.(83) This the AEC did through the bilateral agreements by guaranteeing fuel supplies. For US industry this had immense benefits since

not only could they offer prospective foreign customers an assured supply of fuel but also this placed their nearest prospective competitors, the British, at a singular competive disadvantage.(84) British Magnox reactors were fuelled by cheaper natural uranium but Britain could not guarantee assured fuel supplies on the same scale as the US. Moreover, the US position was continuously strengthened throughout the 1950s by the AEC's decision to allocate increasing amounts of enriched uranium to foreign users.(85) Through its fuel monopoly the AEC was not only able to encourage foreign nuclear establishments to develop American enriched uranium LWR's, the technology which, by the late 1950s, appeared to be the most likely candidate for commercial exploitation, but also able to exploit it as a means to establish control over foreign nuclear programmes in order to guard against proliferation risks.(86) This fuel monopoly was therefore an integral component of both the administration's international commercial and nuclear non-proliferation policies; it was the vital ingredient in resolving the powerful tension between commercial and non-proliferation objectives for, as Baker argues, the safeguards system built into the bilateral agreements:

> ... depended on American dominance of the uranium enrichment sector: the right to inspection has not been tied to the nuclear reactor but to the fissile fuels supplied to run the reactor.(87)

When that US commercial fuel monopoly was threatened, as it was in the 1970s, the basis of US non-proliferation too was undermined.

Beyond the provision of adequate fuel supplies the AEC also provided and coordinated government financial assistance for foreign purchases of US nuclear facilities and materials. Since it had full control over enriched uranium pricing and plutonium buy-back prices, the AEC could manipulate favourably the economics of LWR systems; a fact about which British commercial competition protested bitterly in the 1950s.(88) But it was the AEC's coordination of financial assistance, through the Export-Import Bank and later the Agency for International Development,

which underwrote much of the flood of exports from the US in the late 1950s and throughout the 1960s. In addition some leverage was even exerted in international lending agencies, such as the World Bank, to provid finance for nuclear projects involving purchase of US technology.(89) Financial support in the form of loans, preferential interest rates, and deferred payment schemes became an integral component of AEC policy to assist the international expansion of the US nuclear industry.

All significant 'roadblocks' within the AEC's control or influence, were removed in the drive to facilitate this international corporate expansion. One initial problem had been that of nuclear export controls. Under the 1954 Act all nuclear equipment, materials and technology required an AEC authorization, or an export license, before it could be transferred abroad.(90) Initially companies were restricted from engaging in any nuclear technology transfer from the US, or involvement in nuclear plant or facility construction abroad without AEC approval. But industry regarded this as a serious handicap and Francis McKune, of GE, told the JCAE in early 1955:

> ... Section 57 (a) 3 of the Act raises doubts about the extent to which American companies can engage in atomic activities outside the US ... It should be made clear that Section 57 (a) 3 does not require individual authorization and determination by the Commission for each activity that a company may wish to carry on. If that were required American companies might be placed under a serious handicap in competing abroad. (91)

The AEC's response was almost immediate and industry was given a general authorization to engage in nuclear technology transfer abroad, except in the Communist bloc and so long as no classified information was transferred.(92)

All that was necessary was for companies to keep the AEC informed of their commercial activities. As AEC Chairman Strauss commented at the time, the general authorization:

> ... will assist American companies and individuals in availing themselves of foreign markets and is consistent with US national policy of encouraging peaceful uses of atomic energy at home and abroad. (93)

Under this blanket authorization US companies were permitted to engage in all nuclear fuel cycle activities abroad, including the transfer of reprocessing technology, so long as no classified data was involved.(94) By interpreting the act in this way the AEC encouraged US corporations to spin a tight transnational corporate web of license agreements and joint ventures between themselves and foreign companies. In one sense the AEC had little option but to be liberal in its interpretation of the 1954 Act since, specifically in the case of technology transfer, the larger corporations, like GE and Westinghouse, could have utilised their foreign subsidiary networks to avoid more restrictive AEC regulations. Writing in 1956 Wit perceptively recognized, what later became a major 'loophole' in nuclear export controls, namely that:

> ... the exact relationship between foreign subsidiaries of American business and the home companies, insofar as the legal limitations of atomic power commerce are concerned, is in need of clarification. (95)

The AEC preferred for a long time not to have this clarified, nor did it perceive any vital need to do so.

As for the export of materials and facilities this required AEC, or for some items, Department of Commerce (DOC) approval, although but on an individual basis. Each export of materials or hardware had to fulfill a number of essential requirements: that it did not involve transfers to a prohibited country (normally taken as the Communist bloc); that the importer was authorized to receive the exports, and that the transaction was regulated by a current cooperation agreement.(96) If these requirements were fulfilled, then the AEC granted a licence. Where the DOC was responsible the AEC was consulted before any licence was approved. An inter-agency committee, including DOC, DOS, ACDA and AEC dealt with special cases. In practice standard operating procedures were quickly established

and nuclear export licensing became a routine process. As some participants noted, until the early 1970s, it was an extremely mechanical procedure and as long as a cooperation agreement with the importing country was in existence exports were never refused.(97) Only where so-called problem countries (those with poor proliferation credentials) were involved was any special consideration given, by a special inter-agency group,to export matters.(98) But even here the existence of a cooperation agreement tended to override suspicions about proliferation risks; commerce prevailed over potential security risks.(99) So from the mid 1950s to the early 1970s liberal nuclear export controls facilitated the internationalization of the US nuclear industry.

One major constraint upon the initial pace of international expansion was the problem of indemnity. American exporters were concerned that in any incident involving their exported products, particularly a reactor accident, they would become liable for potentially enormous financial damages. This was not a unique problem since, as the last chapter discussed in some detail, domestically it presented a major constraint upon the pace of power reactor development. It was also one which the AEC was well aware of:

> The extent to which American industry is willing to participate in foreign activities is directly proportional to satisfactory protection from liability for injury resulting from a nuclear incident.(100)

Indeed its awareness had stretched to advising and assisting foreign governments in the preparation of their own national indemnity legislation. In addition within the Organization for European Economic Cooperation it acted in an advisory capacity in the development of an international convention on liability.(101) As within the domestic context, the AEC functioned at the international level to remove restrictions upon nuclear expansion and to promote the conditions for profitable nuclear commerce.

There were two major phases in the international expansion of the US nuclear industry each dependent, to varying degrees, on different forms of

AEC assistance and encouragement. The initial phase which broadly ran from 1955-1964 depended heavily, at first, upon all four forms outlined above: the US fuel monopoly; financial assistance; liberal export controls; and promotion of indemnification legislation. However, the second phase, which was really the period of rapid LWR commercialization was one in which the industry's transnational expansion became less dependent on the AEC in some areas but brought about new dependencies in others. This second phase, which covered the period 1965-1974, was also a period of cyclical growth and decline in the US domestic nuclear market. How the domestic and international expansion of the industry were related throughout both these periods is worthy of further investigation.

4.2.1 The Dissemination of Nuclear Technology 1955-1964

This was the most crucial phase in the industry's transnational expansion since it involved creating a framework for that expansion as well as promoting the domestic development of power reactor technology. The two were connected closely although perhaps less in a substantive sense than in the perceptions of the politicians and the AEC. Industry's expansion abroad was perceived as vital not only to the achievement of Atoms for Peace goals but also as a means to quicken the pedestrian pace of domestic nuclear development. Equally, accelerating the domestic development programme was continuously justified by the need to assist US industry in its penetration of foreign markets so as to challenge foreign competition, which at the time meant the UK. As Chairman Strauss told the JCAE in 1956:

> The participation of American industry in the domestic energy programme is building the foundation for industry's successful, and we hope profitable entry into new and rapidly expanding world markets for atomic knowledge, services and equipment.(102)

Throughout the 1950s the JCAE's sustained pressure on the AEC to expand the domestic civil development programme, derived essentially from the perception that the US was lagging behind British, French and Soviet

development.(103) The EGCR, the Hanford project, and the AEC's Ten Year Programme, (all discussed in the previous chapter), were all in part products of the fear that the global commercial nuclear power market would become dominated by foreign technology unless the US put more resources into domestic development. Cold War fears, and international commercial competition were therefore used by the JCAE as rallying 'cries' to gain support for greater public investment in domestic power reactor development. Senator Pastore captured the intensity of these arguments during the debate on the Gore-Holifield bill predicting that:

> ...if we are outdistanced by Russia in this race, it would be catastrophic. If we are outdistanced either by the United Kingdom or France, there would be a tremendous economic tragedy to our commerce and the international commerce of this great Nation of ours.(104)

The AEC was not fully convinced by these views but nonetheless had little political option other than to act to stem the criticisms emanating from the JCAE. Consequently, it established three major programmes which fulfilled both the President's Atoms for Peace objectives and the domestic demands for accelerating the pace of reactor development. The three programmes were: the 'Research Reactor and Equipment Assistance Program'; the 'Foreign Power Assistance Program'; and the 'Joint US-Euratom Research and Development Program'. Each of these was not only designed to assist foreign nations to develop their own nuclear programmes but also to exploit international ccoperation as a mechanism both for extending US corporate penetration of foreign markets and complementing US domestic nuclear development. In particular the two latter programmes provided a means of overcoming the slow pace of domestic power reactor development in the PDRP by getting foreign governments and utilities to initiate, with US assistance, LWR development projects.(105) The logic behind this was that the construction and operating experience gained abroad by US corporations participting in such projects would contribute directly to a quickening in the pace of domestic reactor development. Moreover, this would be achieved

at minimal cost to the AEC and US corporations since foreign governments and utilities would shoulder most of the financial burden of such projects. The existence of these programmes therefore strengthened the position of the AEC and private industry in their fight with the JCAE over public development of nuclear power since they could argue that the technological progress achieved as a result of these programmes hastened the advent of commercial nuclear power in the US. These AEC programmes were therefore an effective mechanism for combining domestic and foreign atomic policy objectives.

4.2.2 The Research Reactor and Assistance Program 1955–61

Following the passage of the 1954 Act the President announced that 100kg of U-235 would be allocated to assist foreign nations in developing their own nuclear research establishments.(106) This offer was then expanded in a rather incremental fashion into an AEC coordinated programme of foreign nuclear assistance. Through cooperation with the Export-Import bank finance was arranged for the purchase of US materials and equipment. A grant programme was also established to stimulate the '...development of research reactor facilities overseas.'(107) Through this research reactor and assistance programme the AEC provided for a controlled but massive outflow of: basic nuclear research data; declassified information relating to the nuclear fuel cycle and power reactor technology; as well as research equipment including small research reactors. The object of this was not simply to assist the development of nuclear research establishments overseas but to construct an international web of technical cooperation which cultivated a degree of dependence on the US. This was achieved in three ways.

Firstly, by providing fuel for research reactors the AEC removed a considerable constraint upon nuclear research overseas since U235 was in restricted and short supply. The quantity of fuel reserved for research

purposes abroad was, as the last section indicated, increased considerably throughout the late 1950s. Highly enriched uranium, for materials test reactors, was also made available from 1958 onwards. By 1960 over 235 kgs of 20% U235, and some 60 kg of 90% U235 had been transferred abroad for research purposes.(108) These were huge amounts of materials and reflected the US monopoly over U235 supplies.

Secondly, alongside fuel supplies the AEC, through a grant programme announced by President Eisenhower in July 1955, administered funds to assist foreign governments in the purchase or construction of research reactors.(109) Although not specifically tied to US reactors the AEC noted that:

> ... Because of the relative strength of the industrial capacity within the United States to manufacture such facilities,the preponderant number of the grants (17) have been applied to reactors of US design and manufacture.(110)

All told by the date of the programme's termination in 1962 twenty six research reactors had been purchased under the scheme, involving 19 countries and costing the AEC some $27m. (See Table 4 - 2)

It was augmented in 1958 by an Equipment Grant programme which sought to:

> ... strengthen in other important respects the nuclear programs of nations having or acquiring reactors, and to contribute significantly to the programs of nations not prepared to acquire reactors. (111)

Most of the countries receiving such aid were in the developing world and the applications were tailored to meet agricultural, medical and scientific needs. Although a smaller programme than that for research reactors nonetheless some $2.72m was distributed to nineteen countries.

Thirdly, one further integral component of the research assistance programme was the dissemination of technical information and the institutionalization of transgovernmental contacts between the AEC and its foreign counterpart organizations. Visits by foreign personnel to classified and unclassified AEC facilities were arranged: in July to

Table 4 - 2

AEC Research Reactor Grants

ATOMS FOR PEACE PROGRAM

RESEARCH REACTOR GRANTS

FISCAL YEARS 1956-62

Country	Power	Manufacturer	Estimated project cost (millions)	Amount	Fiscal year awarded
Argentina	5 mW	Argentine National Atomic Energy Commission	$ -	$ 350,000	1962
Austria	5 mW	American Machine & Foundry	4.0	350,000	1958
Belgium	25 mW	Centre d'Etudes de l'Energie Nucleaire	10.01	350,000	1958
Brazil	5 mW	Babcock and Wilcox	1.3	350,000	1956
China (Taiwan)	1 mW	International General Electric	1.0	350,000	1958
Colombia	10 kW	American Machine & Foundry	-	350,000	1962
Denmark	5 mW	Foster-Wheeler	1.4	350,000	1956
Greece	1 mW	American Machine & Foundry	1.3	350,000	1958
Indonesia	100 kW	General Atomic	0.8	350,000	1961
Iran	5 mW	American Machine & Foundry	4.8	350,000	1962
Israel	1 mW	American Machine & Foundry	1.4	350,000	1958
Italy	5 mW	American Car & Foundry	3.6	350,000	1958
Japan	10 mW	American Machine & Foundry	1.5	350,000	1957
Korea	100 kW	General Atomic	1.1	350,000	1959
Netherlands	20 mW	American Car & Foundry	3.9	350,000	1956
Norway	10 kW	Norstom	1.8	350,000	1958
Pakistan	5 mW	American Machine & Foundry	3.5	350,000	1960
Portugal	1 mW	American Machine & Foundry	1.0	350,000	1957
Spain	3 mW	International General Electric	1.0	350,000	1956
Sweden	10 mW	American Car & Foundry	4.3	350,000	1958
Thailand	1 mW	Curtiss-Wright	0.82	350,000	1959
Turkey	1 mW	American Machine & Foundry	2.88	350,000	1960
Venezuela	3 mW	International General Electric	5.0	350,000	1957
Vietnam	100 kW	General Atomic	0.75	350,000	1959
West Germany	1 mW	American Machine & Foundry	3.1	350,000	1958
Yugoslavia	100 kW	General Atomic	-	200,000	1961
Total				$8,950,000	

Source: USGAO US Financial Assistance in the Development of Foreign Atomic Energy Programs ID75-65 1975

December 1955 755 such visits took place; in January to June 1956 773 visits by personnel from over thirty five countries were arranged: and by 1958 alone 2459 visitors from seventy countries had toured US facilities.(112) Conferences and seminars, classsified or otherwise, were organized on subjects ranging from power reactor technology to nuclear fuel reprocessing. Foreign scientists were seconded to US AEC facilities for training (113) (Table 4 - 3 gives some indication of the spread and frequency of such visits.) Very quickly the US became the repository for training and disseminating scientific and engineering information to foreign nuclear scientists and engineers; a process through which the AEC and US corporations developed significant international contacts and established an informal global communications network amongst those government and corporate professionals working in industry. This network was somewhat institutionalised by the creation of an International School of Nuclear Science and Engineering, in March 1955, based at the Argonne National Laboratory.(114)

The research and equipment assistance programme was a vehicle not simply for transferring information and providing assistance to other countries but became a crucial mechanism for cultivating a transnational network of industrial, scientific, and governmental contacts which laid the foundations for US corporate penetration of foreign markets. In addition the programme functioned as the first stage in organizing the commercial nuclear market abroad for as the AEC commented to the McKinney panel in 1960:

> The reactor and equipment grant programs have done a great deal to stimulate sound planning and the development of suitable nuclear energy organizations in the participating states.(115)

4.2.3 The Foreign Power Assistance Program 1955-64

Although it complemented the research programme, the power assistance programme was primarily geared to meeting the power needs of the world's

Table 4 - 3

Foreign Personnel Participating in USAEC Research 1955 - 1975

Country	Number of scientists	Country	Number of scientists
Afghanistan	3	*Jordan*	*7*
Argentina	192	Kenya	2
Australia	164	Korea	195
Austria	179	*Kuwait*	*2*
Belgium	176	*Lebanon*	*31*
Bolivia	14	*Libya*	*3*
Brazil	133	Liechtenstein	2
Burma	14	Luxembourg	6
Cameroon	1	Malaysia	16
Canada	539	Mexico	104
Ceylon	12	Monaco	2
Chile	70	*Morocco*	*2*
China, Republic of	713	Netherlands	216
Colombia	86	Norway	101
Congo	8	*Pakistan*	*120*
Costa Rica	11	Panama	14
Cuba	28	Paraguay	11
Cyprus	10	Peru	41
Denmark	96	Philippines	118
Dominican Republic	33	Portugal	26
Ecuador	13	*Saudi Arabia*	*3*
El Salvador	12	Senegal	1
Ethiopia	7	Sierra Leone	1
Finland	41	Singapore	3
France	471	South Africa	88
Germany	833	South Vietnam	23
Ghana	10	Spain	139
Greece	159	Sweden	180
Guatemala	16	Switzerland	229
Guyana	5	Tanzania	3
Haiti	11	Thailand	70
Honduras	1	Trinidad	6
Hong Kong	59	*Tunisia*	*3*
Iceland	9	Turkey	108
India	1,104	Uganda	1
Indonesia	34	*United Arab Republic*	*103*
Iran	*73*	United Kingdom	1,186
Iraq	*24*	Uruguay	22
Ireland	32	Venezuela	59
Israel	*250*	Yugoslavia	106
Italy	693	Zambia	3
Jamaica	15		
Japan	803	Total	10,513

Source: *S. 1439: Export Reorganization Act of 1976*, Hearings before the Joint Committee on Atomic Energy, 94 Cong. 2 sess. (Government Printing Office, 1976), vol. 1, p. 463.

major industrial and industrializing centres outside the US. In announcing the programme in June 1955 the President:

> ... initiated a series of steps which were principally designed (a) to ensure that the results of the extensive reactor development program conducted in this country would be shared with the other countries of the world, and (b) to stimulate and assist the development of economic nuclear power abroad.(116)

Some six months earlier the Soviets had announced a similar programme for their Eastern bloc allies.(117) In Britain too the Ministry of Fuel and Power had published a White Paper in February 1955, entitled 'A Programme of Nuclear Power', which outlined the first nuclear power programme in any industrial state.(118) Both these events formed the backdrop against which the President's remarks were drafted. That the programme was technologically premature, given that the Shippingport PWR had not then even been constructed, is evidence of the strong political motivations underlying it.

In the 1950s there was a recognized need for new and cheaper sources of energy in Europe and Japan, as well as in industrializing countries such as India. Mullenbach notes that the AEC and industry had very:

> ... early come to the conclusion that the pressing foreign need for energy would result in a substantial and growing export demand for American nuclear reactors and equipment.(119)

This was taken up by the first McKinney study in 1956 which recommended that the AEC set aside provide sufficient fuel and assistance to encourage the development abroad of at least 1million kilowatts of commercially generated nuclear power by 1960.(120) A further study by the AIF estimated that some 6GWe of nuclear power could be installed abroad by 1970 bringing the US a potential $650m worth of nuclear exports.(121) Huge potential markets existed, given the unfavourable energy position of most industrialized states, and US corporations recognized the need to establish themselves in these markets, not only to combat potential foreign competition but also to reinforce their domestic competitive position in

the US. US corporate expansion abroad, as Moran has noted, has much to do with the domestic oligopolistic structure of high tech industry which compels corporations to penetrate foreign markets to eradicate foreign competition which thereby strengthens the corporate competitive position in both the home and foreign markets.(122) However, to compete abroad required considerable government assistance; the very nature of nuclear technology itself, with its international security implications, made this inescapable.

The power assistance programme involved the provision, by the AEC, of sufficient U-235 to meet foreign needs, as well as financial assistance for foreign purchases of US equipment and fuel. Beyond that the AEC also provided more direct technical assistance in a range of areas from safety, third party liability legislation, to power reactor economics, programme planning and so on. Each of these elements of the power assistance programme aimed to contribute, not just to the broad objectives of the Atoms for Peace plan, but to easing the difficulties of US corporate penetration of foreign markets.

Following his June 11th 1955 address the President announced that some 20,000kg of U-235 would be available for foreign use, both for research and power reactors. This was later increased to 50,000kg. By utilizing its fuel monopoly in this way the AEC hoped to undermine British competition in the power reactor market since with guaranteed fuel supplies American LWRs, although by 1956 still not demonstrated as a commercial technology, would appear potentially more attractive to foreign customers. In terms of the economics of LWRs, with their lower initial capital cost than British GCRs, the AEC expected that:

> ..the economics will become sufficiently certain and attractive to encourage many countries to seriously consider undertaking nuclear power programs using reactors of US design.(123)

Since the AEC too controlled U-235 prices it had a further lever with which to influence the relative attractiveness of LWR vs GCR designs.(124) It

also introduced a deferred payment plan for U-235 under which foreign customers could delay payment for US supplied fuel for up to 10 years.(125) As the last chapter noted U-235 prices were reduced in 1960 and remained comparatively stable, in relation to fossil fuel prices, throughout the sixties, giving nuclear, and in particular LWR fuel costs, an apparent economic advantage over GCR technology.(126) Ultimately the LWR did triumph over the GCR, although not simply for economic reasons. But in the mid to late 1950s it was still the case that Britain had exported two commercial sized reactors, one to Japan and to Italy, and appeared ahead of the US in power plant reactor technology. It was not until 1957, for instance, that Shippingport and Dresden 1 became operational.

As already noted the AEC and industry viewed the construction of LWRs abroad as a means of expanding by 'proxy' the domestic demonstration programme. Thus the AEC arranged with the Export-Import Bank in late 1956, and with the AID, financial assistance for the export of US fuel and facilities.(127) By 1961 some seven reactors had been exported (Table 4-4) most with the financial assistance of the Export-Import Bank. But whilst the US domestic programme remained at the demonstration stage there was unlikely to be a flood of exports.

Despite this the AEC offered foreign governments extensive support in the planning and promotion of domestic nuclear power programmes. As power bilaterals took over from research bilaterals, in the late 1950s, US companies and the AEC were able to engage in extensive transfers of power reactor technology to foreign companies and nuclear establishments. To assist US industry abroad with this, as well as to provide technical and other advice to foreign governments and civil nuclear organizations, the AEC extended its representation overseas to include offices in London, Paris, Brussels, Buenos Aires and Tokyo.(128) These offices were primarily:

> ... concerned with all aspects of implementation of Agreements for Cooperation, and seek to promote measures for the exchange of information, personnel and materials, to assist in negotiating contracts and agreements related to cooperation programmes, to maintain liaison with Atomic Energy officials in the countries to which they are respectively assigned, and to serve as advisers on nuclear matters to US Embassies.(129)

They became a direct communication link with the AEC in Washington since they reported and were responsible to the AEC's General Manager for International Affairs. In effect the AEC controlled its own 'de facto' foreign policy, albeit that it was more technical and commercial than the 'high policy' matters normally the responsibility of the DOS. Through its 'foreign' offices, and the dispatch abroad of AEC technical missions, foreign governments were provided with extensive technical advice on the key aspects of their domestic nuclear power programmes; US corporations too were given every assistance in their attempt to penetrate foreign markets.

But AEC assistance went beyond simply advice and encompassed the provision of services. Besides the assured supply of U-235 for power reactor programmes it offered, from 1958 until 1967, reprocessing services to foreign customers. This not only contributed to non-proliferation objectives but also resolved one problem for countries without a reprocessing capability. Moreover, for countries like Japan, where environmental concerns were decidedly apparent from the earliest days, such a service removed some objections to planned nuclear programmes.

Public acceptance of nuclear power was also dependent upon the safety of reactor systems. In this regard the AEC offered direct assistance:

> ...in reactor hazard evaluation to any nation contemplating construction of a reactor under the terms of an Agreement for Cooperation with the United States.(130)

This amounted to much more than a simple transfer of safety-related information since it entailed the 'export' of organizational structures and practices for dealing with matters of power reactor safety. To some extent the AEC externalized its own structures, procedures, and processes for managing the safety dimensions of a nuclear power programme. In much the

same way, through an advisory role, it encouraged foreign governments, like the Japanese, to establish similar indemnity laws to those in the US. By helping organize and establish the basic framework for foreign nuclear power programmes the AEC was also implicitly cultivating the world market for US supplied technology and facilities.

Other services provided by the AEC covered by the power bilaterals included: personnel exchanges; joint research programmes; the exchange of data on specific technical areas; and the creation of depository technical libraries. Like the research assistance programme, these were designed not simply to transfer technical information but to encourage cooperative ties between the US and foreign nuclear industries. They were extremely successful and the US AEC trained hundreds of power reactor engineers, technicians, and operators whilst giving experience to many hundreds of others through institutionalized visits, exchanges etc.(131)

Whilst the AEC established the framework of bilateral atomic relations, and provided incentives for foreign nuclear industries to purchase US supplied technology, it was the primary responsibility of US corporations to exploit these arrangements to their maximum advantage. This they did throughout this initial phase of internationalization. Utilizing their domestic monopoly of LWR technology and experience, the major companies, Westinghouse and GE, entered into an array of license agreements with foreign companies in Europe and Japan. At this early stage most licenses covered only the transfer of power reactor technology rather than other aspects of the fuel cycle. Licenses were a means of protecting corporate investment in LWR technology whilst also penetrating foreign markets and combating potential foreign competition. Thus by the mid '60s the two corporate giants, Westinghouse and GE, had established technology and manufacturing license agreements with all the major electro mechanical corporations in Europe and Japan.(132) In establishing these agreeements

both built upon their pre-war relationships with many of these foreign corporations.(133)

The power assistance programme paved the way for US LWR dominance of the world's nuclear power market when commercial power reactor technology finally arrived. With AEC support and promotion abroad, as well as a web of transnational licence agreements and industrial contracts centering on US companies, the incentives for adoption of US LWR technology were enormously attractive. Up to 1961 some seven BWR and PWR plants were exported, or constructed abroad with licencees assistance. (See Table 4-4) By 1963, following the Oyster Creek sale, US LWR technology had penetrated all the major world markets and had become the primary yardstick against which indigenous power reactor designs was assessed, both economically and technolgically.(134) As the AEC noted in 1960:

> Although a substantial number of power reactors have not been authorized or constructed yet in most foreign countries, a number of the necessary conditions have been established to facilitate their undertaking as soon as the economics are sufficiently attractive.(135)

It had been the job of the AEC throughout this early period to establish those 'necessary conditions' through bilateral agreements and the power assistance programme. But perhaps the most ambitious programme for ensuring US technological dominance in the nuclear field, however, was the joint US-Euratom cooperation programme.

4.2.4 The United States-Euratom Joint Nuclear Power Programme

Cooperation with Euratom had numerous advantages for the US government and for US industry. Indeed, on the basis of his classic study of Euratom, Nau concludes that it was the US which gained the most from joint cooperation.(136) Certainly for the State Department cooporation provided a vehicle to promote European political integration. Since the initiation of the Marshall Plan in 1947, the State Department had retained a particularly strong commitment to the furtherance of European integration

Table 4 - 4

Nuclear Reactor Exports to 1961

Country	Name and location	U. S. contractor	Capacity (kw.)	Completion date
Total			651,500	
Italy	SENN, Punta Flume	General Electric	150,000	1963
Belgium	CEN, Mol	Westinghouse	11,500	1962
West Germany	RWE, Kahl-am-Main	General Electric	15,000	1960
Italy	SELNI, Trina	Westinghouse	165,000	1964
Japan	JAERI, Tokai-Mura	General Electric	12,000	1963
France-Belgium	SENA, Chooz	Westinghouse	242,000	1965
Sweden	Simpevarp	Allis-Chalmers	56,000	...

Sources: Atomic Industrial Forum, "Progress Chart: U. S. Nuclear Power Projects," New York, September 1, 1961; and AEC, *Major Activities in the Atomic Energy Programs, January–December, 1961* (Annual Report), Washington, January 1962, p. 479.

Source: Mullenbach P. Civilian Nuclear Power Twentieth Century Fund NY 1964

as a means to consolidate and enhance post-war European reconstruction. Whilst cooperation with Euratom was a further lever with which to bring about closer integration it was also partly necessary to assuage Soviet fears about West German acquisition of nuclear materials and technology.(137) Nuclear proliferation was therefore uppermost in the minds of US foreign policy makers although in practice it was developments in France, rather than in Germany which most concerned the US. How far the implicit US controls built into the cooperation agreement with Euratom met Soviet worries is not known although it is obvious that they did not reflect the more conservative philosophy which informed Soviet approaches to nuclear cooperation with its Comecon partners.

For the AEC the goals sought by cooperation with Euratom were extremely tangible. Essentially the AEC hoped cooperation would inject greater urgency into the domestic programme, since it was under heavy pressure from the JCAE to expand the PDRP by facilitating the establishment of joint ventures using US technoogy. Construction and operational experience gained abroad in these ventures would strengthen the domestic programme. Since these ventures would be largely paid for by Euratom, government's cooperation was an indirect means to subsidize the domestic development of nuclear power and critically without, as noted earlier, endangering the balance between public and private efforts.

Beyond the specific bureaucratic interests of the AEC and DOS there was also a more fundamental compulsion for institutionalizing cooperation between Europe and the US.

Unlike the US the Euratom countries did not have the benefit of large indigenous energy resources. Consequently they had suffered shortages of fossil fuels and this had impeded post-war domestic reconstruction. Moreover, dependence upon foreign, particularly Middle Eastern supplies of oil, had brought with it a strategic vulnerability which was open to external political manipulation. Since energy was the vital ingredient of

an industrial and manufacturing based economy the US recognized that the security of Western Europe was prejudiced by its external dependence. Nuclear power, over the longer term, promised a partial technological amelioration of such dependence. Recognizing this the US had little option but to share its technology with the Europeans, even though they might eventually be competitors, in order to affirm its broader commitment to Western European security.

Of course, it just so happened too that, at this early stage, US industry desired to establish itself in what was the world's most potentially lucrative export market. Through a strategy of licensing agreements and manufacturing agreements the major US companies, such as Westinghouse and GE, effectively neutralized the potential European competition which faced them. As Nau indicates the licensing agreements signed in these early years effectively blocked the development of a strong European-wide nuclear industry which would have acted as a significant challenge to US corporate domination of the world reactor market.(138) For US companies joint US-Euratom cooperation was enthusiastically welcomed and they provided the AEC both with domestic political support, to ensure Congressional passage of the enabling legislation, and also advice in the detailed negotiations with Euratom itself.(139)

What made this institutionalized cooperation attractive for members of Euratom was the possibility of acquiring advanced reactor technology to meet the expanding energy needs of their rapidly growing economies and, in the longer term, providing the basis for an integrated autonomous and competitive European nuclear industry. Having experienced an energy crisis in 1951, when indigenous coal production fell below required demand, and a further crisis in 1956 when oil supplies were curtailed during the Suez debacle Euratom members were only too sharply aware of their dependence on fossil fuels. Following the success of the European Coal and Steel Community in expanding coal production the hope was that Euratom would

provide an alternative and a cheaper source of energy just as successfully.(140) Indeed, even before the Euratom Treaty had been formally ratified the Foreign Ministers of member countries agreed to the establishmemt of a 3 man commission to determine:

> ... the practical role Euratom might play in meeting the energy requirements of member countries.(141)

The report of the three 'wise men', as it became known, was published in May 1957 and recommended the rapid exploitation of nuclear-energy to meet the future requirements of the community.(142) Pointing to the projected 83% expansion in European energy demand over the period 1955 to 1975 the report:

> ... advised that the economic growth of the six countries was in danger of being seriously hampered by lack of another source of energy.(143)

Since, alone amongst ECSC member states only France had any significant nuclear programme the report further recommended that cooperation with others more advanced in nuclear power technology was essential to the success of European nuclear integration.

> Cooperation with others will not limit our opportunities, but create new ones, so that our industries can acquire their own distinct nuclear personality. (144)

Despite the fact that, at this stage, British gas-cooled reactor technology appeared to have the technological lead over US LWR designs, the report was greatly sympathetic to the establishment of institutionalized cooperation with the United States. Such cooperation, it was believed, would facilitate the rapid development of commercial nuclear power in Europe. The salience given to cooperation with the US was based upon several considerations. Technically, it was judged that LWR technology was likely to be competitive with GCR technology. Moreover, the huge enriched uranium production owned by the US made it unnecessary for Europeans to invest in the construction of a tremendously expensive enrichment facility. Rather they could, as the report made clear, rely on the US for assured supplies of relatively cheap enriched uranium fuel. Finally, the British

government's antipathy towards European integration made cooperation with the US, however much it might be opposed by the French, the only realistic option for Euratom. This conclusion was hardly surprising for, as Nau indicates, the committee drafting the final report was 'overwhelmed' by the technical assistance provided by the US AEC.(145) Within months of the actual Euratom treaty coming into force discussions and negotiations were instituted in Washington between Euratom officials and the AEC on the mechanisms for formalizing joint cooperation in nuclear development.

Agreement on the substance and form that cooperation would take was very quickly reached by the negotiators. In July 1958 the JCAE held hearings on the legislation necessary to implement cooperation with Euratom.(146) Apart from some concern that such cooperation would create long term competition for the US nuclear industry, as well as doubts about the viability of the joint programme, there was no element of controversy or any real debate over the proposed legislation.(147) Indeed the bill was expedited rapidly becoming law in late August.(148) This arose largely because there was almost unanimous agreement amongst the representatives of the US nuclear industry, the AEC, the DOS, and the JCAE that cooperation with Euratom realized important foreign and domestic policy objectives. It not only advertised the American commitment to an integrated Europe but also provided an additional boost for the domestic nuclear programme, accelerating the development of commercial nuclear power.(149) Furthermore the AEC and JCAE believed that the potential benefits of the joint programme would accrue more to the US than to Euratom. As the JCAE commented, cooperation had significant advantages:

> Perhaps of greatest interest to the United States is the opportunity in the Euratom joint programme to demonstrate US leadership in atomic energy development, an objective which the Joint Committee considers to be of the highest importance.(150)

Two specific areas of cooperation were provided for in the Euratom Cooperation Act: a joint R & D programme; and a power reactor construction

programme. In both areas funding and support of joint projects was restricted to US LWR technology.(151) This had the consequence of increasing the potential attractiveness of LWR technology, as opposed to French and British GCR technology, in the competition to establish viable commercial nuclear power in Europe. This, after all, was one of the primary motives which fuelled US enthusiasm for cooperative ventures. As the JCAE recognized:

> ... from the standpoint of the United States atomic energy programme, the proposed Euratom arrangements offer an opportunity to develop and construct United States type reactors abroad.(152)

Moreover, the cost to the AEC of underwriting US participation in joint cooperative ventures was likely to be a much smaller claim on its budget than for equivalent domestic projects. This was simply because Euratom was required to match AEC expenditure on cooperative research projects as well as to provide, along with European utility companies, the capital necessary for the construction of power reactors. In consequence, the US benefitted considerably more from cooperation than did Euratom. Not only did the joint agreement facilitate the penetration of US LWR technology in Europe, but also it simultaneously doubled the R & D resources being devoted to the improvement of that technology. As Nau convincingly argues:

> The overall program ... contained major advantages for American participants.(153)

As envisaged originally in the joint agreement on cooperation the US-Euratom programme was extremely ambitious. On the R & D side, a $100m budget was established to finance projects for the first five years. It was also anticipated that a further $100m would be forthcoming for a second five year programme. To complement this a power reactor programme was agreed with the object of constructing a total of 1 GWe in generating capacity (up to six plants) by 1963.(154) Finance for this programme was to come largely from European sources ($215m) with the addition of a $135m loan from the US Export-Import bank arranged by the AEC.(155) The power

reactor programme was the crux of joint cooperation since privately neither party was as fully committed to the R & D programme as they appeared to be in public.(156)

Both parties had quite different conceptions of the role of R&D cooperation in the context of the joint agreement. These conceptions were largely incompatible since the AEC wanted R&D tied specifically to improving existing US LWR technology whereas Euratom, partly for political reasons, desired a fairly autonomous research programme which would stimulate closer European nuclear integration.(157) One of the consequences of this divergence in priorities was that, despite initial enthusiastic funding, cooperation with respect to nuclear R&D failed to develop in the ambitious manner originally envisaged. This was partly because of funding and administrative delays in initiating research projects but equally because, by the early 1960s, major advances in US LWR technology made R&D an increasingly unattractive proposition for the AEC. As the AEC's Director of R&D remarked, cooperation in R&D never really progressed satisfactorily since:

> ... it just didn't seem that we could carry out a sensible research and development program (sic) of water reactors because they have gotten so far toward commerciality ... I think we didn't anticipate when we went into this program (sic) originally that water reactors would have gotten as far along during this period as they have.(158)

With the Oyster Creek purchase in 1963, signalling the commercialization of nuclear power in the US, the AEC gracefully withdrew from the R & D cooperation programme. The joint power programme, however, was relatively more successful.

Although the initial expectation was that up to six demonstration LWR plants might be constructed under the auspices of the joint power programme only three were finally constructed.(159) This was largely because the European energy situation changed radically for the better, shortly after the publication of the Three Wise Men report, combined with the unexpectedly early transition to commercial nuclear power in the US. The

combination of these factors reduced considerably the incentives for completing or intensifying the joint cooperation which began in 1958. But the cooperation which did occur was by no means unsuccessful. Moreover, from the US perspective, the joint programme had, by the mid '60s, proved extremely beneficial. It had achieved three particular objectives. First, it had stimulated the development and exploitation of nuclear energy in Europe. Secondly, both the nature of the joint programme and the incentives provided by the AEC ensured that US LWR technology came to dominate the European reactor market. And thirdly, a major consequence of cooperation was US corporate penetration of the European nuclear industry through a web of license agreements, foreign subsidies, and joint ventures.(160) It is therefore impossible to disagree with Nau's assessment that, because of its technological superiority, the US, (in this case both government and private industry) gained the most from the cooperation.(161) This is not to argue that Euratom and European industry were therefore 'exploited' but rather that the distribution of benefits was, from the outset, skewed unambiguously in America's favour.

One of the consequences for European joint cooperation was the tacit assistance and the legitimacy awarded to US corporate penetration of national nuclear industries Europe. A prerequisite for participation in the joint power progrmme was that any project bid had to include both US and European companies.(162) This requirement, although it did not by itself forge the creation of an extensive European wide network of license agreements and joint ventures between the major US reactor vendors and major European companies undoubtedly stimulated it. According to Nehrt the actual:

> ...terms of the US-Euratom joint programme ... made it almost essential that US reactor manufacturers establish licencees or subsidiaries within Euratom countries ... .(163)

Yet more significantly the joint programme actually legitimized this remarkable corporate penetration of national nuclear industries. For it was

perceived as a natural concomitant of the joint programme: how, it was asked, could the transfer of vital technology occur except through license agreements and joint ventures with US corporations? Even the French government, which had so vociferously condemned the joint programme as a '...sellout to the United States...'. chose not to block corporate tie-ups between US and indigenous companies.(164) Whilst there was general concern about the long term implications of US penetration of the European nuclear industry this was overriden by the imperatives of acquiring the necessary technology so as not to fall behind in the race for commercial nculear power. Longstanding corporate ties with the major US electro-mechanical multinationals were reactivated by European companies so that by the early 1960s they were all tied to one of the two American giants, Westinghouse or General Electric. This unwittingly undermined one of the central objectives of Euratom, for rather than bringing about closer industrial co-operation within Europe, the joint programme effectively ensured that:

> European firms associated individually and bilaterally with stronger American partners. In most instances ... contacts with American partners were far more intimate than contacts with European firms or Euratom. (165)

In many cases such contact made European industrial collaboration impossible, for license agreements contained prohibitive clauses effectively precluding such collaboration and therefore according to Scheinman inhibited closer nuclear co-operation in Europe.(166) Moreover, licensing agreements also made it extremely difficult for, and in some cases prevented, licensees from competing in foreign markets againsts their licensors.(167) Closer relations with the major American corporations thus had dramatic implications for both the future structure, and the competitive position, of the European nuclear industry. But these were, on the whole, unforeseen by the European enthusiasts for US-Euratom cooperation.

Whilst the joint US-Euratom co-operation programme may have eased the path for US corporate expansion into the European nuclear market its most

profound achievement was to establish the commercial hegemony of American LWR technology. This, above anything, must be acknowledged as a strategic triumph. For by providing considerable incentives for the utilization of LWR technology, the joint programme demolished the perceived commercial lead which GCR's initially held in 1958. So intense was the competition between the proponents of US LWR technology and the GCR technology developed in Britain and France, that it erupted, in the early 1960s, into what later was called the reactor war ('la guerre des filieres').(168) France, in particular, sought unsuccessfully to persuade Euratom to promote the GCR; it even initiated a major export programme.(169) Britain, too, attempted to break into the European market in order to demonstrate the technological and commercial superiority of the EGCR over LWR systems. But even when bids to construct GCRs were made, under the second round of the joint power programme in 1961, the incentives to develop LWRs made such a contest decidedly unequal. What also acted as a disincentive to investment in the GCR was its relatively higher capital cost.(170) The combination of these realities was decisive in ensuring the commercial attractiveness of the LWR. This was demonstrated with the Gundremingen project where the GE BWR bid was accepted in preference to the English Electric GCR.(171) There seems little doubt that the bias towards US LWR technology embedded in the US-Euratom agreement had a critical influence upon the development of commercial nuclear power technology in Europe. According to Nau:

> The existence of this program (sic) altered expectations in favor (sic) of American reactors from 1958 on. Europeans were assured of a hand in research results in the United States, and US guarantees of enriched uranium supplies removed a primary obstacle to light water developments in Europe. Without these provisions, European authorities would possibly have had to invest more attention and resources in gas graphite reactors. (172)

The outcome of the 'reactor war' was an unambiguous victory for US LWR technology. Following the Gundremungen decision, the German nuclear industry, in association with their American licensors, concentrated almost exclusively upon the development of commercial LWRs. Even France, the most

vociferous exponent of GCRs within Euratom, had by 1969 formally abandoned its GCR programme in favour of the LWR.(173) Just at the moment when nuclear power became commercially viable in the US, American nuclear technology had established a hegemonic position for itself in Europe. This, in succeeding years, shaped both the character and the pace of the commercial exploitation of nuclear power throughout Europe.

In turning to US LWR technology, European nations were also locked into dependence on US supplies of enriched uranium fuel. At the time nuclear power was becoming commercially attractive in Europe there still remained only one major source of enriched uranium: the US. America's monopoly of nuclear fuel supplies gave it implicit leverage over the pace of nuclear development in Europe. It also put the European nuclear industry at a further competitive disadvantage in potential export markets which, by the late 1960s, were beginning to expand enormously. Although Britain and France had constructed enrichment facilities for their military programmes these had limited capacities and could not hope to compete on price or contract terms with the US. In this regard US-Euratom cooperation arrangements were crucial in dissuading European governments from embarking upon costly and risky investment in the construction of commercial scale enrichment plants. Through deferred payment plans, a generous pricing policy, and enticing contractual arrangements for subsidiary fuel services, the AEC very consciously sought to deter, or at least delay considerably, European interest in commercial enrichment facilities.(174) Initially this was an extremely effective policy for, apart from conducting independent R&D into different enrichment techniques, Euratom countries explicitly eschewed any interest in commercial enrichment ventures.(175) It was also reinforced by diplomatic pressures, which, at one point, was used to undermine European collaboration with regard to centrifuge enrichment technology on the grounds that it was a 'sensitive' technology, i.e. it was a proliferation risk.(176) By using its monopoly over nuclear fuel

supplies, together with appeals to national security interests, the US erected powerful barriers against progress towards an independent European enrichment capability. Although in the long term this strategy failed, in the short term it secured US hegemony in the commercial nuclear power market. For Europe could not attempt to compete successfully in the world LWR market without some ability to offer assured supplies of nuclear fuel.

Rather than joint cooperation establishing a relationship of interdependence between Europe and the US, in the civil nuclear sector, the evidence suggests that it was instrumental in creating and legitimating a structure of dependence in which the costs and benefits of cooperation were largely asymmetrically distributed. By facilitating the penetration of the European nuclear industry by US corporations, encouraging the development and construction of LWRs and dissuading European governments from investing in commercial enrichment ventures, the US-Euratom agreement operated largely to the advantage of the US government and private industry. This is confirmed by Nau's study which argues that '...the Euratom-US joint program was primarily the brain child of US participants and reflected American interests and requirements more than European ones ... American technical and industrial superiority were built into the structure of nuclear relations at the time...' with the consequence that: 'The over-all program (sic) ... contained major advantages for American participants.'(177)

Whilst Europe did benefit from the transfer of nuclear technology, specifically through the resultant accelerated development of a commercial nuclear power industry, the political and commercial costs of this were not insignificant. In particular, European industrial collaboration was hampered because of commercial ties to US companies. This too together with the lack of an independent enrichment capability, restricted opportunities for Europe's entry into the future world market for commercial nuclear power - a market which, given the first phase of

commercialization in the US in the early 1960s, was just beginning to come of age.

However, Europe's dependent position cohered well with American national security objectives, which sought to restrict the development of independent nuclear capabilities, because of the longer term proliferation risks. By being in a position to contain and control the global diffusion of nuclear technology and materials, the US government believed it would be able to limit drastically the scope for nuclear proliferation, particularly at a time when a potentially lucrative world trade in commercial nuclear power technology was beginning to materialize. US corporate interests were also favoured by such a policy for it suppressed the potentially competitive challenges to US commercial hegemony of the nuclear sector. Under the cloak of the beneficient US-Euratom joint cooperation programme that hegemony was endowed with an almost natural legitimacy. But paradoxically, as the world market for commercial nuclear power developed in the 1970s, US technological and commercial dominance became increasingly vulnerable to European competition. In its own peculiar way, this was a testament to the actual success of the joint programme in promoting the predominance of US LWR technology in Europe and assisting in the development of the European nuclear industry. But this will become more apparent in exploring the period in which commercial nuclear power reached maturity.

4.3 Creating a World Nuclear Market: US Commercial Dominance 1964-1974

With the long-awaited domestic breakthrough to commercial nuclear power, heralded in 1963 by the Oyster Creek project, interest in the potential global market for nuclear power dramatically revived. The major reactor vendors, Westinghouse and General Electric, recognized that to sustain their preeminent positions in the LWR industry at home they also had to capture foreign markets. Equally, the Johnson administration understood

that if it was to ensure that the global commercialization of nuclear power did not increase the danger of further horizontal proliferation this was best achieved by supporting and extending US commercial hegemony in the world nuclear market. The foundations for this US commercial dominance had been well constructed in the form of the American monopoly over enriched uranium fuel supplies and the corporate penetration of key markets in Europe and beyond. What Patterson refers to as the 'charge of the light water reactor brigade' was therefore already well advanced as commercial nuclear power became a reality in the industrialized and industrializing worlds.(178) Apart from Canada there was, at this stage, no credible challenge to US corporate and technological dominance of the world market for commercial nuclear power.

As foreign markets for nuclear power expanded considerably in the mid to late 1960s, with orders and national nuclear plans confirming an exponential growth in nuclear generating capacity worldwide, the future of the US nuclear industry appeared very much assured. However, rapid commercialization created some profound challenges to the existing Atoms for Peace regime. This regime was largely bilateral in character, in that at its core was a worldwide network of bilateral nuclear cooperation agreements between the US government and cooperating governments, which established the basic principles, rules, norms and procedures for governing

international nuclear transactions. Despite the existence of the IAEA no significant transfers of nuclear technology or materials were routed through the agency. Nor until 1961 did it have an operational system of international safeguards with the consequence that the USAEC effectively policed the Atoms for Peace regime up to the mid-1960s.(1979) But there was a growing recognition within the State Department and AEC that with the pace of commercialization abroad existing arrangements would have to be reviewed. In particular, it was obvious that the US government would not be able to sustain the regulatory burdens of the anticipated massive

commercial exploitation of nuclear power abroad. There was also concern that as countries, particularly in Europe, developed their own nuclear export potential that the fundamental basis of the Atoms for Peace regime, namely the US reliance on its monopoly of fuel and technology as a diplomatic tool to deter potential proliferation, might be increasingly eroded as alternative sources of supply emerged. Consequently there was tacit agreement within the US government that the Atoms for Peace regime had to be transformed from an essentially bilateral framework for regulating international nuclear commerce into a much more comprehensive, multilateral framework in which non-proliferation constraints and commitments were explicitly defined and agreed amongst all states engaged in the exploitation of civil nuclear energy. This process of 'multilateralization' began, in the early 1960s, when the US government initiated the gradual transfer of responsibility for safeguarding its bilateral nuclear cooperation agreement, to the IAEA. It was followed in 1968 by the establishment of the Nuclear Non-Proliferation Treaty, discussions and agreements amongst potential nuclear supplier nations in the 1970s and in the mid 1970s, as the US nuclear monopoly was challenged, international discussions on multilateral measures to strengthen the regime, including the construction of regional nuclear fuel cycle centres. As the commercial exploitation of nuclear power gathered pace outside the US so too did the domestic political pressure to transform the Atoms for Peace regime into a multilateral framework for reconciling national security objectives with the requirements of international nuclear commerce.

This process of 'multilateralization' had a number of distinct advantages for the US, although at the time these were not always fully recognized nor did they necessarily motivate the key actors in the policy process. Firstly, transferring AEC safeguards responsibilities to the IAEA relieved the Commission of a potentially awesome regulatory burden with

which it was not equipped (nor likely to be so) to deal with the requisite rigour and effectiveness. Moreover, it removed safeguards from the often highly politicized arena of bilateral relationships, where they could be manipulated or exploited for vicarious political reasons, replacing them with a system of internationally administered safeguards which was less vulnerable to such potential manipulation. This in turn greatly enhanced international confidence in Agency safeguards. Secondly, because of its hegemonic position in the world nuclear power industry the US was able to take a leadership role in promoting an internationally acceptable set of rules and procedures for regulating the emerging world market in commercial nuclear power. In effect this translated into the near universal acceptance of many of the key principles, norms, rules and procedures which governed US bilateral nuclear cooperation with other states. These principles, norms and rules were accepted by most states as a legitimate international framework for conducting nuclear commerce not because the US exerted overt pressure or attempted to coerce countries into conforming but rather, on the whole, because they recognized that it was in their interests to do so. This apparent deference to US leadership was in part a product of an underlying consensus about the essential groundrules for international trade in nuclear technology and materials. The existence of this consensus and the legitimacy accorded to US hegemony in the nuclear sphere made it much easier for the US to ensure that any multilateral framework for regulating international nuclear commerce was in harmony with its own conception of what should be the proper nature of that multilateral order. Thirdly, and finally, by assisting the development of multilaterally agreed rules and procedures there was a sense in which the US was also creating barriers against any potential competition between nuclear-exporting nations spilling over into the regulatory arena, particularly with respect to the controls placed upon the use or exploitation of exported technology and materials. For it was clearly

understood that if such competition were to occur it would result in controls being so diluted that they would cease to act as an effective restraint upon horizontal proliferation. By facilitating the creation of multilaterally agreed controls for nuclear commerce this scenario it was hoped, was made much less likely to occur. This was not without its advantages for the US since the existence of common standards for nuclear exports strengthened its relative position in the world market. For such commonly applied controls meant that any potential competitors to the US would have to compete in the world market primarily on commercial terms where the US retained a distinct comparative advantage - specifically on cost, financing deals, reactor operating experience and assured fuel supplies. The drive to consolidate the Atoms for Peace regime by making it more multilateral rather than bilateral in character therefor had a number of perceived commercial advantages for the US. This will become more transparent as focus shifts to bring into relief the forces which shaped US policy throughout this period.

4.3.1 Commercialization and the Consolidation of the Atoms for Peace Regime

Although, up to the mid 1960s, the Atoms for Peace plan was implemented largely through bilateral mechanisms from the outset, this had always been envisaged as only an initial phase prior to the creation of an effective multilateral framework for regulating the dissemination of nuclear materials and technology.(180) With the arrival of commercial nuclear power in the early 1960s pressures within the US increased to consolidate the Atoms for Peace regime, by institutionalizing it further and formalizing the international consensus against proliferation. There was an awareness that as the pace of commercialization accelerated the US could lose its ability to shape nuclear developments abroad. American industry also recognized that this would contribute to the loss of vital foreign

business. Despite quite different motivations both industry and government therefore understood the need for a stronger, more institutionalized, multilateral framework to ensure that security objectives were met without hampering international nuclear commerce. The stakes involved were awesome: commercial nuclear power was potentially a huge business for the US whilst equally further proliferation posed a real threat to national security.

American policy in this period initi ally underwent few traumatic changes. The basic philosophy of Atoms of Peace, namely the promotion of US controls by the widespread dissemination of US technology and materials was further amplified as commercial nuclear power came of age. According to Scheinman:

> As long as the government maintained a monopoly over reactor fuel supply, US industrial penetration abroad would be tanatamount to US government penetration and would help to reinforce US efforts to guide the evolution of peaceful atomic development.(181)

There was a strong belief that, despite the worldwide drive for the exploitation of commercial nuclear power, only incremental or adaptive responses were necessary to the basic framework of the Atoms for Peace regime. Commercialization was not perceived as a problem which required a dramatic transformation in existing policy, but rather 'more of the same' with marginal changes to its implementation. This approach was underpinned by the lack of any realistic challenge to US commercial hegemony in the nuclear business and the widely accepted belief that civil nuclear power had little military potential.(182) And a very strong attachment to safeguards within the DOS, the Arms Control and Disarmament Agency (ACDA) and the AEC, reinforced this belief in the clear separation of the military and civil exploitation of the atom.(183) As a result foreign atomic policy in the initial phases of commercialization stressed the need for US business to continue to penetrate markets abroad whilst simultaneously internationalizing US controls over the commercial atom. There was

virtually no critical evaluation of this general policy approach for the simple reason that it met with the particular parochial concerns of the various organizational interests involved, and was a convenient 'ideology' for legitimizing the continued international expansion of the US industry.

Between 1962 and 1972 the two major US reactor vendors, General Electric and Westinghouse, sold 24 commercial power reactors in the world market compared with only 6 by their potential foreign competitors: the UK, France, Germany and Canada.(184) Moreover, the US maintained its monopoly over enriched uranium supplies meeting the bulk of worldwide demand.(185) But despite its dominant position, commercial exploitation of nuclear power imposed considerable strains upon US policy. The projected expansion of nuclear power both at home and abroad suggested a level of demand for enriched uranium which the US alone could not possibly fulfil.(186) This fact, together with the drive for greater energy independence, stimulated investment in enrichment facilities abroad and the search for alternative sources of supply. By the late 1960s the US recognized that it would no longer have a monopoly over fuel supplies. Additionally, with the almost worldwide adoption of the LWR as the basis for commercial nuclear power stations, there was growing recognition that the widespread dissemination of US technology would eventually erode its commercial dominance in the world market. This came sooner than anticipated with the announcement in 1970 that the German KWU was to sever its licensing arrangements with Westinghouse and entered the world market as a in competitor to the US.(187) Responding to these potential challenges the US adopted the twin strategy of using the growing international demand for commercial nuclear power both to deepen its own penetration of nuclear industries abroad and to institutionalize a more comprehensive multilateral regulatory framework for reducing the potential proliferation risks arising from the increased commercial exploitation of nuclear power.

As early as 1962 the State Department perceived the need to adapt foreign atomic policy to meet the potential challenges of commercialization. In fact the policy review which culminated in the publication of the Smyth Report in 1962 had been in progress for a number of years.(188) What emerged from the Smyth Report was a greater emphasis upon the IAEA both as a channel for the promotion of nuclear power but more importantly as a mechanism for safeguarding nuclear facilities and materials.(189) Perhaps the most significant of the report's six recommendations was the proposal that all US bilateral cooperation agreements and future exports be placed under Agency safeguards.(190) This marked the first step towards institutionalizing a more multilateral framework for conducting international nuclear commerce. It was wholeheartedly supported by the State Department which viewed it as a critical step towards a more comprehensive non-proliferation regime.(191) Moreover, the State Department was firmly convinced that with a comprehensive system of international safeguards in place the likelihood of nuclear proliferation would be considerably diminished even though an increasing number of states would have acquired a sophisticated indigenous nuclear infrastructure. Indeed it has been suggested by some that, during this period of rapid commercalization, there was a somewhat complacent attitude towards proliferation within the DOS underpinned by a fervent belief in the technical separation of the military and civil atom together with a tremendous faith in the preventative role of safeguards(192); as long as safeguards were applied the belief was that this took care of the potential proliferation problem.(193) Such attitudes permeated the bureaucratic culture not only of the State Department but also those organizations like ACDA, and the AEC, which were largely dominated by technical experts.(194)

Whilst the State Department promoted greater internationalization of controls and non-proliferation commitments the AEC, although supportive,

still tended to favour a much more unilateral approach to foreign atomic policy. It remained attached to the basic tenets of Atoms for Peace, namely that the dissemination of US technology and materials provided a mechanism for spreading a web of US non-proliferation controls, commitments, and norms.(195) With the evolution of a lucrative world commercial nuclear power market the AEC believed that the US could use the consequent US corporate expansion and deeper penetration of foreign nuclear industries to guide nuclear developments abroad in ways which complemented US policy. As Scheinman suggests:

> Viwed from an international perspective private industrial success would mean AEC success and would fulfill the latters goal of promoting peaceful nuclear development. (196)

For this reason, whilst the AEC formally supported State Department policy with respect to internationalizing safeguards and promoting the NPT, it nonetheless continued to promote the international expansion of the US nuclear industry as a quite independent strand of foreign atomic policy. Although there was no overt bureaucratic conflict between the two organizations, the AEC did act at times to constrain the State Department's fervour for multilateralism. It made clear its dislike of an enhanced role for the IAEA in the nuclear supply business, for as when Commissioner Hawarth noted, in hearings on the Smyth report '...many countries have greater confidence in, and preference for, the bilateral channel.' (197) Initially, it was somewhat suspicious of the transfer of safeguards tasks to the IAEA, because it viewed this as undermining its international regulatory role. Nonetheless, publically it supported the State Department policy.

This emphasis upon sustained US corporate penetration of foreign nuclear industries was also widely supported by the JCAE, the Treasury and by industry. The JCAE believed that capturing foreign nuclear markets would ensure a healthy domestic nuclear industry, and one which continued to maintain a commercial edge over potential competitors. This was

something which the major reactor vendors understood only too well, for a dominant position in the expanding world nuclear market would act as a protective cushion against the cyclical trends in the domestic market. In addition the worldwide commercial dominance of the US LWR would, it was believed, establish a tacit dependence on the US as the world's monopoly supplier of enriched uranium. This had obvious political benefits since it placed the US in a much stronger bargaining position with respect to the furtherance of its non-proliferation objectives. Finally, the Treasury Department too welcomed the projected growth of nuclear fuel and technology exports since this would have a considerable impact in alleviating the chronic balance of payments deficits of the late 1960s.(198) With such a unanimity of agreement amongst the key players in the policy process and importantly, given the lack of any expressed opposition, US industry forged ahead extending its penetration of the world commercial nuclear power market. It was assisted greatly in this task by various state agencies.

4.3.2 Government Assistance for Corporate Expansion Abroad

Between 1964 and 1974 the two major US reactor vendors captured the largest slice of the world's commercial nuclear energy business. In addition they also tightened their corporate grip on most foreign nuclear industries through a comprehensive web of licensing agreements, investment in joint ventures, and the incorporation of foreign subsidiary companies. This marked a new stage in US corporate penetration of foreign markets. A stage which, in commercial terms, was altogether much more intensively competitive, in comparison with the early days of the Atoms for Peace programme, and which was designed to ensure a primary role for US corporations in the very rapid development of commercial nuclear power programmes in Europe, Japan, and the industrializing states of the Third World. Just as in the first phase (1955-64) of US corporate expansion abroad the intensity and extent of this corporate activity was underwritten

by significant government assistance, both financial and technical. In particular the Federal government provided: large loans and financial guarantees for nuclear exports through the Export-Import Bank and the Agency for International Development; nuclear fuel supplies and fuel services were guaranteed; and nuclear export controls and procedures were interpreted by the AEC in a very liberal manner. Finally the AEC offered extensive assistance to foreign governments with the establishment of appropriate technical and administrative infrastructures for supporting a viable commercial nuclear power programme. All of these factors contributed to the sustained US corporate dominance of the world nuclear industry in the initial phases of commercialization: each will now be explored briefly.

(a) Financial Assistance

From 1964 to 1974 the US nuclear industry exported nuclear fuel and reactor components valued in excess of $3.3 billion.(199) Although only a small percentage of the annual balance of payments deficits suffered throughout this period, it was nonetheless a significant contribution to reversing the worsening trade balance. The largest proportion of these exports were financed partly or wholly by the Export-Import Bank, primarily at the behest of the AEC. Something approaching $2.1 billion worth of Export-Import Bank loans were provided to finance the major slice (up to 45%) of 36 commercial nuclear power projects, in 11 different countries.(200) In addition to these direct loans, at competitive interest rates, private financing was arranged for the balance of these exports, amounting to a figure in excess of $1 billion.(201) Where private financing proved difficult to arrange the Export-Import bank agreed 29 loan guarantees, to private financial agencies, amounting to some $736 million.(202) These guarantees ensured that the commercial banks would be repaid should the borrower default. Thus, for instance, in the case of Japan, which is the subject of the following chapter, Export-Import Bank

loans totalling well over $1 billion were provided to finance the bulk of its civil nuclear programme. This finance was also available at extremely competitive interest rates of between 5.5 to 8% (averaging 6%) all somewhat below the then prevailing commercial interestrates.(203) Export-Import financing was therefore an attractive incentive to foreign purchasers of US nuclear exports for it acted in essence as a quasi-subsidy to the major reactorvendors. According to Duffy the Export-Import Bank actually subsidized nuclear exports to a much greater degree than other industrial exports.(204) There can therefore be little doubt that the Bank played quite a significant role in facilitating American corporate dominance of the world market for commercial nuclear power. But it was not by any means a decisive factor in this respect for it was also the case that there was no effective competition to the major US corporations in the construction of LWR systems. Ready availability of finance thus did not act to influence the decisions of foreign utilities or governments on the question of which nuclear suplier to purchase LWR technology from, since there was in the initial period of commercialization no real competition to the American giants. Rather it shaped the more strategic calculations about the cost-effectiveness of nuclear power and the pace at which development of an indigenous commercial nuclear power technology should proceed. In the case of Japan this was certainly the case. The comparative advantage which the major US corporations had in key areas of LWR technology, together with readily available Export-Import Bank finance undoubtedly affected government and corporate calculations about the particular direction and pace at which the development of the indigenous nuclear power industry was to proceed. This is something which will be explored in the following chapter.

Besides financial assistance from the Export-Import Bank, the Agency for International Development disbursed grants totalling in excess of $75m to 13 countries in the period 1964-72.(205) These direct grants were

largely designed to provide additional technical assistance to nuclear energy projects already in existance. The object was to improve the basic nuclear technology infrastructure in the recipient states, most of whom had, by the early 1970s, either embarked upon or were planning commercial power reactor programmes.(206) In addition to loans for technical assistance AID also established a capital assitance programme to assist with the construction of large nuclear projects. India was the largest beneficiary of this programme, receiving $76.3m in loans and grants, largely for the construction of the Tarapur BWR nuclear station purchased from General Electric.(207) Although only comparatively small sums of money were disbursed through AID assistance programmes these nonetheless had a significant impact in stimulating or extending technical, scientific, and industrial links between recipients and the US as donor.

(b) Nuclear Fuel Supply Arrangements

According to Scheinman (1972) the dominance of US LWR vendors in the world's commercial nuclear power markets (in the period up until the early 1970s) was accounted for not only by favourable loans from the Export-Import Bank but also the AEC's fuel supply policy.(208) Since the inauguration of the Atoms for Peace programme in 1953 the US government was well aware of the political and commercial advantages which flowed from the AEC's almost total monopoly on the supply of enriched uranium. As has been noted earlier through an extremely liberal fuel supply policy, in which most of the risks were borne by government, the AEC subsidized the domestic development of the nuclear power. By similar means it also made US LWR technology much more economically attractive than rival technologies, and, as noted in the discussion of Euratom, this contributed greatly to the American penetration of the European nuclear industry. There seems to be almost unanimous agreement amongst observers of the international nuclear power industry that the AEC manipulated its enriched uranium pricing and

supply policy to promote US technological and corporate dominance in the world commercial nuclear power market.(209)

The AEC's worldwide monopoly over the supply of enriched uranium provided the major US reactor vendors with considerable advantages in foreign markets. Firstly, it allowed them to offer prospective purchasers, directly or through foreign licensees or subsidiaries, secure supplies of reactor fuel. This was a significant factor in shaping foreign utility calculations about investment in commercial nuclear power stations, as opposed to other types of generating capacity. After all this was a long term investment of 25-30 years duration and security of fuel supply had to be guaranteed. Secondly, by controlling fuel prices and the conditions attached to supply contracts the AEC was able to increase the total attractiveness of the sales package which could be put together by the major US reactor vendors. Whilst the price of enriched uranium fuel, as noted earlier in Chapter 2, was not likely to be a decisive factor in utility calculations with respect to investment in commercial nuclear power it was nonetheless a significant consideration.(210) Thirdly, the existence of an AEC monopoly established quite formidable economic and commercial barriers against any prospective competitors breaking into both the enriched uranium market and thereby to the reactor market. Because of the vast sums of finance required for the construction of enrichment plants only foreign governments could effectively mount a competitive challenge to the AEC monopoly.(211) Until the late 1960s this failed to materialize enhancing the US corporate dominance of the commercial nuclear power business since potential competitors, like Germany, could not provide any prospective purchasers of LWRs with guaranteed fuel supplies. Only the Canadians were successful in export markets during the initial phase of power reactor commercialization, largely because they marketed a natural uranium fuelled system for which they could readily provide guaranteed fuel supplies.(212) The US monopoly of enriched uranium fuel, although not the

only factor contributing to US corporate dominance of the world nuclear market, was nonetheless a vital ingredient. This can be seen in the very fact that once the Europeans broke into the enriched uranium supply business in the 1970s it made it much easier for France and Germany to penetrate the power reactor export market.

(c) Technical and Administrative Assistance

Alongside the supply of reactor fuel the AEC also offered potential purchasers of US LWR technology direct assistance in establishing a proper scientific, industrial, and regulatory infrastructure to support an advanced nuclear power programme. There were many aspects to this, from the provision of nuclear research materials and equipment, to direct assistance with personnel training and the organization and management of a civil programme.(213) In the case of Japan, for instance, the AEC, through its representatives in Tokyo and specialist staffs in Washington, offered guidance, advice, and assistance with the establishment of effective structures and procedures for planning, promoting and regulating all aspects of the civil nuclear programme.(214) In one sense the US 'exported' its domestic bureaucratic and organizational structure for administering and promoting the atom. This is evident, for instance, in the way in which many countries, including Japan, modelled their own administrative apparatus upon that of the AEC.(215) Indeed, most countries established a single executive agency which had responsibility for both the promotion and regulation of nuclear power. In assisting foreign governments with the development of the necessary administrative infrastructure for the civil nuclear sector, the AEC exported much more than simply its own organizational blueprint. What was also exported, in a more indirect or unconscious manner, was a particular style or approach to the planning and management of civil nuclear power, which incorporated technical values, standards and assumptions which, in effect, amounted to

an 'organizational culture'.(216) This 'shared' organizational culture helped to promote very strong transnational bonds between the AEC and some of its foreign bureaucratic counterparts. Certainly in the case of Japan the relationship was, from the outset, extremely close. One of the consequences of this 'shared' administrative culture was that it made it much easier for the US nuclear industry to penetrate foreign markets since the administrative and regulatory environment was not an alien one but was indeed partly geared to their own technical standards and expectations.(217) This could only benefit, as it did, the American nuclear industry.

(d) Nuclear Export Controls

One of the most significant ways in which the AEC assisted the major reactor vendors in their efforts to capture the foreign market for commercial nuclear power was through the enactment of fairly liberal nuclear export controls, combined with a particularly mechanical approach to their implementation. In section 4.2 of this chapter it was noted that in reaction to pressure from the nuclear industry, the AEC ensured that the initial export regulations and procedures did not hinder the potential export opportunities of US business.(218) This liberal approach to nuclear export control policy became even more vital to the major reactor vendors once the market for commercial nuclear power began to develop. For a restrictive or heavily regulated export regime would have inhibited the full and expeditious exploitation of foreign markets. This, as noted earlier, was fully recognized by the industrialists in 1955 and accounted for an export control policy which Senator Stevenson, during Senate hearings in 1974, described as lacking coherence and rigor:

> At the present time, the US does not have a coherent nuclear export policy - unless it is to promote the indiscriminate sale of nuclear facilities abroad. Nor does it have a coherent procedure for controlling nuclear exports.(223)

Although somewhat exaggerated the Senators' observations were prompted by the concern, increasingly voiced in the 1970s, that commercial objectives, rather than non-proliferation objectives, took precedence in both the formulation and implementation of nuclear export controls policy.(224)

During the period 1964-1974, which was one of massive growth in US nuclear export activity, the rules and procedures of the nuclear export control changed very little. The strong belief that the civil and military uses of the atom were quite separate, together with a touching faith in nuclear safeguards, led successive US administrations to regard nuclear export control largely as a highly formal, routinized, administrative exercise. It was therefore almost the exclusive responsibility of the AEC, in particular the Division of Licensing, to approve and issue nuclear export licenses for materials and hardware. Indeed there are few known cases of export licences being refused by the AEC during this period of rapid growth in the world market for nuclear power.(221)

Two key areas were covered by the AEC's nuclear export control regulations: the supply of nuclear technology together with private technical assistance (i.e. transfer of knowledge and techniques); and exports of nuclear materials, facilities or components.(222) Whilst different detailed rules and procedures were applied in both areas the one common, overriding statutory requirement was that exports, or technology transfers, would only be authorized by the AEC if there was an existing agreement for cooperation in force between the US and the foreign government concerned.(223) This did not amount to a very restrictive or prohibitive criterion for, as noted earlier in the chapter, the US had entered into cooperation agreements with scores of nations. In effect all this criterion ensured was that there was no trade with the communist bloc, with which there were no cooperation agreements, and those not allied politically to the US.(224) But very importantly it did guarantee that any exports would be governed by the conditions and requirements of the

applicable cooperation agreement. This, as noted earlier, gave the US considerable legal control over the use and disposition of any exports.(225) It is therefore not surprising that, according to one senior AEC official, the export licensing process became fairly routine:

> ...the operating assumption was that if exports were within the scope of the cooperation agreement it was OK. Export licensing was a mechanical process.(226)

This largely reflected a deeper underlying belief, in the AEC and DOS, that with safeguards attached the risk of exported materials or technology being utilized for military purposes was negligible. Accordingly, there was no rationale for the AEC to establish prohibitive and complex export controls for this would only make it difficult for US business to penetrate foreign markets. And after all that was one of the primary objectives of US non-proliferation policy at the time. In comparison with contemporary nuclear export controls those existing prior to 1974 have been described as 'lax'. Yet in many respects this is an unfair description for in the context of the then prevailing 'nuclear' orthodoxy the AEC's nuclear export control policy is quite easily rationalized, even though it may now appear to be decidedly permissive.

(i) Controls over Technology Transfers

From 1956 through until 1973, US companies could engage in the transfer of any unclassified nuclear technology to a foreign country (so long as it was not on the restricted list i.e. the Communist bloc) or company without having to acquire specific authorization from the AEC.(227) Moreover, even if sensitive technologies, such as reprocessing or the construction of nuclear reactors were involved , there was no requirement for companies to do anything other than report their involvement to the AEC.(228) In effect prior approval was not required for the transfer of any unclassified technology to a foreign government or company so long as it was not on the AEC's excluded list i.e. essentially the Communist bloc. Since, as noted

in Chapter 3, there was a massive and sustained declassification exercise, throughout the 1950s and 1960s, virtually every aspect of commercial nuclear fuel cycle technology, except for enrichment techniques, became publically available to US companies. Combined with permissive export controls over nuclear technology the major US corporations were given in effect the almost unrestricted right to transfer nuclear technology abroad. This was a deliberate policy decision by the AEC and not, as some have more recently suggested, the consequence of bureaucratic insensitivity to its proliferation implications. Far from it, since the AEC considered its mission within the Atoms for Peace policy was to neutralize potential independent weapons development through the widespread dissemination of US nuclear technology under appropriate controls.(229)

This permissive approach to nuclear technology transfer greatly facilitated the ease with which the major US corporations could enter into license agreements with foreign companies. As commercialization gathered pace the major US corporations in the nuclear industry extended their license ties in foreign countries, so that by the late 1960s they had a significant corporate presence, not just in the foreign power reactor sector, but also in key aspects of the fuel cycle. [Table 4-5 indicates the extent and diversity of these license agreements.] This corporate drive to penetrate the foreign commercial nuclear power market, through licensing agreements and the incorporation of foreign subsidiary companies, was encouraged by the AEC. As one AEC official, from this period recalled:

> In general the AEC encouraged licensing of unclassified technology and generally supported, pushed US nuclear industry's international expansion.(230)

Without such encouragemement the pace and extent of US corporate penetration of foreign nuclear industries may have been considerably more limited. Indeed it was the overly liberal nature of these export controls which prompted Senate hearings in 1974 on the whole question of the regulation of nuclear exports and technology transfers.(231)

Table 4 - 5

License Ties of Westinghouse and General Electric

Westinghouse: nuclear subsidiaries and licensees

Country	Company	Business	Westinghouse Interest
Belgium	Eurofuel/FBFC	Fuel fabrication	16% direct 24% indirect licensee
	WNE (Westinghouse Nuclear Europe)	Nuclear steam supply system design	100%
	Ateliers de Constructions Electroniques de Charleroi (ACEC)	Internals, pumps, valves, instrumentation	majority licensee
	Cockerill-Ougree	Steam generators and pressurizers	licensee
France	Eurofuel/FBC	Fuel fabrication	34%
	Framatome	Nuclear steam supply system design, steam generators, pressure vessels and fuel	15% licensee
	--Jeumont Schneider --Creusot-Loire		sublicensee sublicensee
Italy	Fiat	Pumps, valves, instrumentation, reactor internals	licensee
	SOPREN	Nuclear steam supply system design	15% licensee
	Combustibles Reattori Nuclear (COREN)	Fuel fabrication	licensee
Japan	Mitsubishi Nuclear Fuels	Fuel fabrication, nuclear steam supply systems	34% licensee
Spain	Empresa Nacional del Uranio (ENUSA)	Fuel fabrication	licensee
Sweden	WENOKAB	Fuel fabrication	100%
	AB Monitor	Engineering	majority
Switzerland	Westinghouse International Atomic Power Company	Engineering	majority
West Germany	Nuklearbrennstoff	Fuel fabrication	60% licensee

General Electric: nuclear subsidiaries and licensees

Country	Company	Business	General Electric Interest
Canada	Canadian GE, Ltd.	Reactor components	91%
France	Companie Generale d'Electricite (CGE)/Alsthom/ Sogeria	Boiler and reactor systems	licensee
	SICREL	Fuel fabrication	licensee
Italy	Ansaldo Meccanico Nucleare SpA (AMN)	Reactor components	licensee
	AGIP Nucleare	Fuel fabrication	licensee
	Fabbricazioni Nucleari	Fuel fabrication	licensee
Japan	Tokyo Shibaura Electric, Ltd.	Reactor components	10% licensee
	Japan Nuclear Fuel Co., Ltd.	Fuel fabrication	40% licensee
	Hitachi	Reactor components	
	Kobe Steel	Fuel fabrication	
Spain	ENUSA	Fuel fabrication	licensee
Sweden	Allmanna Svenska Elektriska Aktiebolaget (ASEA-ATOM)	Reactor components	licensee
West Germany	AEG Telefunken (part owner of KWU)	Reactor components	8%
	Reaktor-Brennelement Union GmbH	Fuel fabrication	20%
	Kraftwerk Union	Reactor components	licensee

In 1965 two US corporations engaged in the nuclear fuel cycle business were involved in a consortium bidding to construct a reprocessing plant in Japan. It became clear that, under the existing export regulations, these companies could transfer reprocessing technology to Japan, or a licensee, without any requirement that a facility constructed with that technology should be subject to international inspection.(232) This was a major loophole in the regulations. Not only did it allow US companies, or their subsidiaries, to assist in the design and construction of highly sensitive reprocessing plants abroad, but more disturbingly such a plant could be utilized for military purposes, since there was no compunction on the state concerned to apply safeguards to the plant.(233) Only if US supplied materials were processed in the plant or if US supplied exports were used in its construction could the US government enforce the application of its own or IAEA safeguards under the prevailing bilateral agreement for cooperation.(234) Moreover, the worst possible scenario was that US companies could, through their foreign licensees or subsidiaries, actually transfer reprocessing technology to states which did not have a bilateral agreement with the US.(235) These loopholes illustrated the inadequacies in US nuclear export policy and the lack of any comprehensive international regime to deal with the consequences of the widespread dissemination of nuclear technology. But whilst this prompted a review of AEC policy, no significant reform occurred until 1972.

This reform was prompted by the Nixon administration's desire to privatize the enrichment sector. Privatization required the declassification of enrichment technology which the AEC feared, under prevailing regulations, could end up being licensed abroad so undermining the long term commercial prospects for a private, profit making US enrichment industry.(236) Added to this since the late 1960s the AEC had become increasingly concerned that the dissemination of reprocessing technology by US firms would damage its non-proliferation objectives.

According to one official this:

> AEC concern over reprocessing was not that reprocessing was inherently bad but that the plant was only safeguarded when US fuel was processed in it and thus the plant was available for reprocessing non-safeguarded fuel.(237)

The fact that the AEC saw no way to resolve this problem unilaterally increased internal pressures for a change in export control policy. Together with the desire to prevent a similar situation developing with respect to enrichment technology, the AEC introduced more restrictive export regulations in 1972 governing all technology transfers.(238) In future transfers of any sensitive technology, such as reprocessing or enrichment, had to be individually authorized by the AEC and were subject to much more stringent criteria.(239) Nonetheless, it is important to recognize that exports of sensitive technology, like reprocessing, were not prohibited, the new policy was:

> ... not against reprocessing, it indicated that if certain criteria were met and agreed with then reprocessing technology exports would be authorized.(240)

If the AEC acted decisively, if somewhat belatedly, in changing this aspect of policy it failed completely to confront another fundamental loophole in its export policy. As early as 1957 it had been pointed out that under existing rules neither the licensing arrangements, nor the activities of subsidiaries of US multinational companies in the nuclear industry were subject to AEC review.(241) By the early 1970s, partly as a consequence of a more general concern within Congress and the labour movement about the 'export' of American jobs and capital by US multinationals, there was a growing recognition that this loophole potentially undermined attempts at controlling the dissemination of nuclear technology, particularly to countries which refused to sign the NPT.(242) What was at issue was simply the fact that through their foreign subsidiaries or foreign licensees US companies could bypass AEC controls over nuclear exports or technology transfer to a third party.(243)

Although this had always been the case three factors precipitated its increased salience as a regulatory problem. Firstly, the rapid expansion of US corporate licensing arrangements, in the wake of commercial nuclear power coming of age abroad, increased the potential scale and seriousness of the problem. Secondly, there was evidence that some European licensees of American companies were engaged in supplying nuclear technology to non-parties to the NPT. Whilst this did not contravene US policy it infuriated American supporters of the NPT, and made it difficult, they argued, for the US to control nuclear developments abroad.(244) Thirdly, with the prospect of potential competition in the world market between the US and the emerging nuclear suppliers in Europe, there was concern that foreign licensing arrangements were merely giving away US technological lead to their competitors. However, despite growing recognition of the problem the AEC had no effective means to deal with it unilaterally except through attempts to extend its jurisdiction to the actions of US companies abroad. But this extra-territorial application of US law was already a significant source of conflict between the US and its European allies.(245) Nor would foreign governments willingly accept the US government utilizing American corporations as a 'transmission belt' for US foreign policy.(246) The only effective solution to the problem was a multilateral one, in which all potential supplier governments agreed upon a basic set of rules which would be applied to all nuclear exports or transfers of nuclear technology. Paradoxically, the transnational expansion of the US nuclear industry had conspired to create a situation, with respect to nuclear technology transfers, in which the US government had little effective control over the use and disposition of American nuclear technology; a situation which was the very antithesis of what the original architects of the Atoms for Peace plan had desired. Whilst the actual significance of this particular loophole was somewhat exaggerated, in that little evidence suggests it was extensively utilized, the inability of the AEC to resolve it effectively

through unilateral action was a testament to the powerful constraints imposed upon the policy makers by the complex web of transnational relations and interactions arising out of the global expansion of the major US nuclear corporations. As will be discussed in a later section, the recognition of this 'complex interdependence' encouraged US policy makers in their attempts to complement the Atoms for Peace regime with a multilateral framework for regulating the commercial exploitation of nuclear power. Here is a particularly good illustration of the way in which transnational activity in the nuclear sector undermined the ability of even the hegemonic state, the US, to regulate unilaterally international nuclear commerce thereby creating the requirement for a more comprehensive multilateral approach to governing nuclear technology transfers.

(ii) Controls over the Export of Nuclear Material and Facilities

Under the 1954 Atomic Energy Act the AEC was given statutory responsibility for controlling the export of nuclear materials, nuclear reactors and other nuclear facilities.(247) However, the situation was complicated by the existence of more generic export legislation which gave the Department of Commerce, State, and Defense jurisdiction over certain specific items of nuclear commerce.(248) This division of responsibilities gave the impression of a slightly incoherent nuclear export licensing process whereas in practice the AEC retained overall control and, to a substantial degree, marginalized the role of other agencies.(249) Nonetheless, there were aspects of the export control procedure which invited bureaucratic confusion and as a result were a recipe for potential circumvention.(250) Indeed by the mid 1970s the reform of the export licensing process had become a highly controversial issue on the congressional agenda.

In formulating its approach to export controls with respect to nuclear materials and facilities, the AEC, from the outset, gave primacy to its promotional role. The result was an export control process which became

highly routine in character and one dominated, almost exclusively, by the AECs own bureaucracy.[251] Under the formal procedure, established in the 1950s well before commercial nuclear power came of age, the AEC was required to review each request for the export of nuclear materials, reactors, or associated production facilities (e.g. reprocessing or fuel fabrication).[252] According to the AEC the formal review took the form of:

> ...confirmation with the foreign country involved that (1) the ultimate consignee was authorized to receive and process the material, and (2) the transaction was covered by an agreement for cooperation. Based on this confirmation the General Manager [AEC] determined if the issuance of the license would be harmful to the interests of the United States. If the General Manager's determination was favorable, an endorsement would be sent to the Director of Regulatory staff to issue the license.[253]

As noted earlier, in effect so long as there was a cooperation agreement in force the export license would invariably be granted.[254] Since this was virtually always the case the export licensing process became highly routine and, in general, was handled at the lower levels within the AEC's bureaucracy who merely applied standard operating procedures.[255] This was particularly the case from the late 1960s onwards, since the combined effects of implementing the private ownership of nuclear fuel legislation together with the significant growth in export activity, as foreign nuclear power programmes expanded, multiplied the licensing workload of the AEC to the point where it became increasingly stretched. In these circumstances it was not unreasonable that the process became essentially mechanical since for the most part few 'problem' countries were ever actually involved. Moreover, when this was the case the AEC would consult the State Department, ACDA, and the Pentagon through the normal inter-agency review process. For the most part such consultations would occur where exports were destined for a state which had refused to sign the NPT. Although this was, in general, the 'trigger' for inter-agency review it was by no means the only one since, for example, up until the mid 1970s Japan and a number

of other US allies had not then ratified the NPT. But even the process of inter-agency review only provided the State Department and ACDA with an informal and reactive role in the licensing process.(256) Of course there is no firm evidence to suggest that either the DOS or ACDA took a more cautious or restrictive approach to nuclear exports than did the AEC. Indeed, available evidence suggests that, for the most part, they normally accepted the AEC's recommendations.(257) Consequently, until 1974, the export licensing process was never a significant bureaucratic or political hurdle to the international expansion of the US nuclear industry. On the contrary the major corporations regarded it as a fairly routine and uncontroversial activity. This was extremely important for it confirmed the image of the US very much as a reliable suplier in the world market. For foreign countries embarking upon a commercial nuclear power programme, in which investment was counted in billions and the lead-times were of the order of 8-10 years, one of the paramount concerns, had to be supplier reliability. By cultivating and reinforcing the image (and reality) of the US as a reliable supplier, through a brisk, uncomplicated and predictable export licensing process, the AEC underwrote much of the success of US corporations in penetrating foreign markets for commercial nuclear power.(258) However, by 1974, several developments had forced export controls into the public arena and a radical review of export control policy ensued with fairly dramatic consequences.(259)

Three developments in particular thrust the AEC's nuclear export licensing regime onto the Congressional agenda. Firstly, the Indian nuclear test on May 18th 1974 prompted a very powerful adverse reaction in Congress.(260) Legislation was introduced to restrict US nuclear exports and tighten up nuclear export requirements.(261) Congressional reaction grew fiercer too once it became known that the Canadian supplied CIRUS reactor, which had been the source of the plutonium for their nuclear device, had been operating with US supplied heavy water.(262) Moreover,

the failure of the State Department to do little more than diplomatically admonish India reinforced the belief amongst many legislators that the only effective insurance against further proliferation risks was through Congressional action.(263) Whilst Congress considered new legislation a second development occurred which sensitized everyone to the prime importance of controls over nuclear exports. This was President Nixon's proposed sale of commercial nuclear power reactors to Israel and Egypt, made during his visit to the Middle East in July 1974.(264) Almost overnight US nuclear export controls became a controversial national issue. Hearings were held during which many legislators became increasingly concerned by the testimony of executive branch officials, that the whole licensing process was desperately in need of reform.(265) With the administration's Energy Reorganization Bill proceeding through Congress, and several other legislative items connected with export regulation also under consideration the 93rd Congress was in a rather unique position to initiate major reforms to the whole nuclear export control process. The third major develoment was the tidal wave of domestic opposition to nuclear power, something which has already been discussed in the previous chapter. One of the consequences of this organized political opposition to nuclear power was the generation of vast amounts of publically available information, covering every aspect of the functioning of the nuclear industry. Several highly critical reports on domestic safeguards, physical security of nuclear plants and materials, as well as transport arrangements for nuclear materials, were published in 1973 and 1974.(266) These contributed to the controversy in Congress concerning the inadequacy of existing controls over nuclear exports. Growing political pressure from both opponents of nuclear power, and the influential arms control community, made the imposition of more restrictive controls over the use and disposition of US nuclear exports, a significant litmus test of the new Congressional activism which began to surface in the wake of Vietnam and

the Watergate crisis.[267] The technical question of reform of the whole nuclear export control process was thus swept along by the more powerful historical forces of environmentalism and the changing balance of power between Congress and the Presidency.[268] By 1974 it was evident that every single aspect of US foreign atomic policy was about the undergo a rather traumatic review.

In one of the initial attempts to constrain executive power in the foreign policy arena Congress enacted an ammendment to the 1954 Atomic Energy act requiring legislative approval for future bilateral agreements for cooperation.[269] This requirement gave Congress a legislative veto over future cooperation agreements which it was believed could be utilized to shape the fundamental conditions and requirements under which US technology and materials could be exported, and exactly which countries the US would continue to do nuclear business with.[270] Although it had little immediate impact, except perhaps to rule out the possibility of reactor sales to Egypt and Israel, the belief was that it would become increasingly significant in the future since many bilateral agreements had to be revised or renewed.[271] This gave Congress considerable political leverage over the AEC which it sought to use in order to extract a more prohibitive and restrictive aproach to nuclear export control.[272]

Major changes in export control policy occurred after 1974 although recognizing the transformation in public and Congressional attitudes towards non-proliferation and the question of US nuclear exports, the AEC had begun from early 1973, to reform its own procedures and regulations applicable to nuclear exports, with the object of making them more stringent.[273] In implementing fairly significant changes in export policy the image of the US as a reliable supplier took a continual buffeting. This would not have been so significant were it not for the fact that by the mid 1970s the US nuclear industry was faced with European competition in the world market; competitors who were much less restrained

commercially by restrictive bureaucratic export controls.(274) This had the most profound consequences since for the AEC it made multilateral controls over nuclear trade much more pressing. Establishing a multilateral agreement on a common set of nuclear trade rules might, it was believed, counterbalance the AECs dwindling unilateral control over international nuclear transactions. Simultaneously it might also protect the US nuclear industry against further potential erosion of its competitive position in the world market as well as neutralizing those domestic political forces which were continually pressing for ever more restrictive conditions on US nuclear exports. Multilateralism, as a solution to the problems of nuclear export control, arose as a rather pragmatic political response to the gradual transformation in the competitive structure of the world nuclear industry and the domestic politics of nuclear export regulation.

For almost the whole decade following the arrival of commercial nuclear power in 1963, AEC administered nuclear export control policy had the twin objectives of ensuring national security whilst promoting US commercial hegemony in the world market for commercial nuclear power. There can be little doubt that the latter could not have been achieved without the AECs indirect assistance in the form of a liberal nuclear export regime. This is partly confirmed by the rather dismal export record of the US nuclear industry in the years following the abolition of the AEC, a record which can be attributed partly to the overt politicization of the export control process which led to constant alterations in nuclear export requirements and procedures and eventually the demise of the US as a reliable nuclear supplier.(275) Yet this is only a partial explanation of the US predicament for equally as important was the emergence of an increasingly competitive world market. Even if these forms of direct and indirect state assistance to the US nuclear industry enumerated in this section of the chapter had been expanded it seems likely that they would still have been

insufficient to recapture the competitive advantage which, by the mid-1970s, appeared to be being won by the Europeans.(276) It was in this context that multilateralism gained increasing salience in US policy making circles as a mechanism for reconciling American commercial and security objectives.

4.4 Institutionalizing the Atoms for Peace Regime

Until the early 1970s the US retained an unparalled commercial and technological hegemony in the world market for civil nuclear power. Not only had the LWR became the mainstay of virtually every significant national nuclear programme but also the two major US reactor vendors accounted for well in excess of a 80% share of the world export market. (See Table 4-6) (277) Both Westinghouse and General Electric between them had sold 44 units up to 1974 compared with only 10 units by the four major foreign competitors. (278) But even these remarkable figures conceal the true extent to which US corporations, though license agreements and foreign subsidiaries, had captured strategic positions in key sectors of foreign nuclear industries. Combined with a global network of bilateral cooperation agreements, all of this together should have placed the US in a unique, and powerful position, to impose unilateral controls over and constraints upon the exploitation of civil nuclear power to ensure that it was not utilized for military purposes. But as the commercialization of nuclear power gathered pace it became increasingly apparent to US policy makers that the unilateralism of the early Atoms for Peace years now had to give way to much greater emphasis than ever before upon multilateral mechanisms for preventing further horizontal proliferation. How can this change in policy be explained ?

There are three major factors which, when combined together, provide some insight into this readjustment in US foreign atomic policy. First, as the world market for nuclear power began to expand visible signs of a developing tension between commercial interests and non-proliferation

objectives began to emerge. This resulted in an increasing emphasis upon multilateralism. Second, the gradual erosion of American hegemony in the nuclear sector, through the emergence of European competition, made international cooperation an increasingly vital ingredient of non-proliferation efforts. Thirdly, the arrival of commercial nuclear power brought with it a whole series of regulatory issues, like the environment, safety, safeguards which were not simply national problems but had international consequences. These could only be dealt with effectively through multilateral cooperative mechanisms. Together these three factors combined to make US reliance on unilateral controls an increasingly ineffective strategy for 'managing' international nuclear relations. Let us explore each of these three factors in turn.

The Atoms for Peace plan had been fashioned on the assumption that commercial interests and non-proliferation goals were largely synonymous. But by the mid-1960s concern surfaced at State and the AEC with regard to potential trade in sensitive technologies, such as reprocessing.(279) American Corporate involvement in the bids for construction of a commercial reprocessing plant in Japan prompted a major review of policy once it was realized that such technology could be transferred without comprehensive safeguards.(280) By the early 1970s, too the partial declassification of enrichment technology precipitated similar fears that the pressure to commercialize the technology might lead to its international dissemination withough adequate controls. (281) Combined with the almost universally shared assumption amongst the nuclear technocrats, in government and industry that the plutonium economy' (which would normalize trade in plutonium and require widespread commercial reprocessing) was only years away, the appearance was created of commercial pressures and requirements pushing non-proliferation objectives very much into the background. (282) This impression was reinforced by the AECs decision, following the signing of the NPT, in 1968, to continue nuclear trade relations with states which

Table 4 - 6

US Share of World Nuclear Reactor Market (Including US Market) 1953-1977

Year	Reactor Orders	Orders from US Suppliers	US % of Market
1953-64	31	23	74
1965	12	10	83
1966	23	23	100
1967	35	32	91
1968	22	15	68
1969	21	13	62
1970	25	18	72
1971	32	22	69
1972	45	35	78
1973	49	40	82
1974	61	27	44
1975	18	7	39
1976	32	5	16
1977	10	0	0

Source: Kidder, Peabody & Co., "Worldwide Nuclear Reactors," Industry Analysis, Research Department, April 19, 1977.

had not signed nor ratified the treaty. (283) It was also given a further boost in 1974 when Nixon offered to sell nuclear power plants to both Israel and Egypt. Indeed there appeared to exist an almost uncontrollable commercial momentum which had the effect of promoting the ever wider global diffusion of nuclear technology, and seeking to legitimize trade in virtually every aspect of the nuclear fuel cycle, including sensitive technologies, with little regard for its national and international security implications. Of course the US nuclear industry was now very big business indeed with annual domestic revenues of some $1 billion and projected export revenues of $3 - 4 billion per annum by the early 1980s.(284) But its international commercial success had began to transform the very nature of the proliferation problem. By the late 1960s access to weapons materials was growing apace and many countries, including a number in the third world, were already planning the construction of indigenous facilities for commercial reprocessing or enrichment.(285) In this rapidly changing technological environment there was a growing recognition amongst some officials in the AEC and the State Department that complete reliance on largely unilateral controls and bilateral agreements was not longer, by itself, a coherent strategy for dealing with nuclear proliferation. What was required, it was believed, was a more comprehensive system of multilateral cooperation and control. This conviction grew stronger as it became more and more apparent that European competition was slowly eroding Amercian commercial and technological hegemony.

Although the US has always faced some foreign competition in the world nuclear market, particularly from Canada, this became increasingly fierce over the decade 1964-74. Indeed by the mid 1970s the US was no longer the dominant nuclear supplier and had to compete for reactor sales in the world market, with Germany, Sweden, Canada and France.(286) This was particularly the case in the aftermath of the oil crisis, which opened up a

new and rapidly expanding market for nuclear power in the third world.(287) And in order to break into these potentially lucrative markets, European suppliers were willing to offer enticing deals, including the sale of entire nuclear fuel cycle capabilities (288). This together with low-cost financing and in comparison with the US, less restrictive conditions attached to nuclear cooperation heightened the appeal of German and French nuclear suppliers in the Third World market.(289) But much more critical was the fact that the US also found its monopoly over world supplies of enriched uranium threatened. This, in many respects, was a deeply disturbing development for, as Baker noted:

> "The American international inspections system depended on American dominance of the uranium enrichment sector the right to inspection has not been tied to the nuclear reactor but to the fissile fuels supplied to run the reactor'(290)

With the emergence of alternative sources of supply, countries would no longer have to accept US conditons of supply, with the consequence that the US lost a vital mechanism for controlling the development of foreign nuclear activity thereby limiting its scope for unilateral action with respect to preventing proliferation. Paradoxically, it was the rapid commercialization of US LWR technology that had triggered a massive increase in demand for enriched uranium which the US, even with increased capacity, could not possibly meet all by itself.(291) This, together with a desire for greater national independence in all fuel supply arrangements, stimulated investment abroad in the construction of indigenous commercial enrichment facilities. In Europe the URENCO consortium was formed in 1970 and later in 1973, Eurodif.(292) American reaction to the developing threat to its monopoly was complicated by the domestic politics of the enrichment sector which, as Chapter 3 discussed was dominated from 1971 onwards by the question of commercialization. This made it impossible for the Nixon administration to formulate a coherent policy with respect to enriched uranium supply.

This confusion in US enrichment policy directly contributed to the more rapid emergence of alternative sources of supply. Although, up until the mid 1970s, the AEC remained the dominant supplier of enriched uranium in the world market, by 1974 it no longer held a monopoly and projections suggested that by the early 1980s it would have a decreasing share of worldwide demand.(293) Expectations of decline also reinforced official perceptions and anxieties about the burdens of being a hegemonic power in the nuclear field. AEC ownership of enrichment plants had been utilized as a mechanism for subsidizing domestic and foreign commercialization of the LWR, as well as achieving non-proliferation objectives. This could not continue if the plants were turned over to private enterprise. Indeed the debate about private ownership reflected opposition to any subsidies to the US nuclear power industry, either at home or abroad, now that it had achieved 'commercial' status. In particular, the Nixon administration had vehemently opposed Italian and Japanese suggestions that it provide cheap enriched uranium supplies as a means of ensuring foreign adherence to the NPT.(294) And the severe economic adjustments brought on by the 1971 economic crisis, made it inevitable that the US would no longer be in a position, as it was in the 1950s, to bear the financial burdens of any such open ended commitments. It would also have been politically impossible for the administration to gain Congressional, particularly JCAE, support for private ownership legislation had it also been proposing to continue subsidizing enriched uranium fuel prices, even for arms control reasons. The early 1970s therefore witnessed a growing rejection in the US of both the economic burdens and the external constraints upon desirable domestic initiatives, such as commercialization of the enrichment sector, resulting from its hegemonic role in the nuclear arena. Combined with the gradual erosion of its hegemony, the conditions were established for a major shift in the orientation of foreign atomic policy toward mulitlateral mechanisms

and institutions of control. As Scheinman concurs, with the demise of its hegemony in the nuclear energy field the US:

> turned to multilateral mechanisms as a compensatory approach to the problem of ochestrating world nuclear transactions.(295)

Alongside these competitive pressures there was deepening awareness, as civil nuclear power programmes gathered pace, that a number of regulatory issues would require international cooperative solutions. Just as in the domestic sphere the AEC increasingly concentrated upon its regulatory role once nuclear power was commercialized so too did it come to concentrate upon international regulatory issues. In particular the question of environmental controls, safety standards, and rules and regulations for the transportation and protection of nuclear materials and components were amongst the most salient. Whereas in the past the AEC had disseminated, almost unconsciously, its regulatory philosophy and standards through the medium of nuclear exports, and cooperative relations with its foreign counterparts, the strong commitment to national technological independence, together with the emergence of alternative sources of nuclear supply, limited the potential effectiveness of such a unilateral approach. In effect, since prospective foreign purchasers could now turn to alternative suppliers the US was no longer in a position to 'suggest' they adopt its regulatory standards, unless it was also ultimately willing to risk sacrificing export orders. Given that it was not willing to do so, the AEC was caught in a difficult policy dilemma. For domestic political reasons it could not be seen to sanction nuclear exports under less rigorous safety and environmental standards than applied domestically.(296) But equally, as competitive pressures increased in the world market, it could not endanger the competitive position of US industry nor its own reliable supplier policy, by imposing additional requirements on nuclear exports, above those requested by its major competitors.(297) One partial solution to this dilemma was to be found in attempts to develop some basic,

internationally accepted regulatory standards through, for instance, the International Commission on Radiological Protection and the international convention on physical security measures. After all there was much common ground to be exploited here between the major exporting nations, and between exporters and importers, since a single nuclear accident, or the theft of significant amounts of nuclear material, would have serious national and international repercussions, even for those not directly involved. In seeking to promote multilateral measures for dealing with these important regulatory problems, the US was by definition acknowledging, and contributing to, the further erosion of its own power to determine unilaterally the conditions under which commercial nuclear power was exploited. This was something which later proved to be an irreversible trend.

Throughout the period 1964-74, US foreign atomic policy gradually divested itself of the rather crude unilateralism, which had largely characterized the period 1954-64. Instead it sought reliance on multilaterial mechanisms for institutionalizing the decade old Atoms for Peace regime. Precisely what this entailed and how it was effected will be explored in the ensuing section.

4.4.1 Promoting International Safeguards and the International Atomic Energy Agency

In addressing the United Nations in December 1953, President Eisenhower called for the creation of an International Atomic Energy Agency to promote and regulate the international exploitation of atomic energy. However, the intrusion of cold war politics into the diplomatic negotiations over the agency's statutes delayed its actual formation until July 1957.(298) Once established, however, the agency's activities were somewhat overshadowed by the much greater enthusiasm shown, by the US, for bilateral modes of co-operation. Eisenhower's vision of an international agency disseminating

nuclear technology and materials was not to be. Indeed, until the early 1960's the agency had an extremely limited role in international nuclear co-operation and a low priority in US foreign atomic policy. But, within a decade, this had changed dramatically. Official expectations of the proximate arrival of commercial nuclear power led, in 1962, to a comprehensive review of US policy towards the agency. This marked a crucial stage in the transformation of US foreign atomic policy.

As part of a wider re-examination of US foreign atomic policy the State Department appointed an Advisory Committee, under the direction of Henry Smyth (then US Representative to the agency) to 'review the policy of the United States toward the International Atomic Energy Agency'.(299) Underlying the report was the conviction that predictions of increased reliance on commercial nuclear power demanded a fundamental reappraisal of the agency's future role in international nuclear transactions. As the report suggested:

> We believe that various circumstances now combine to give the Agency considerable promise of future usefulness. This opinion is based on the judgement that the development of nuclear power is the key issue in determining the fate of the Agency and that nuclear power is on the threshold of economic attractiveness. (300)

Underlying the report was a perceptive recognition that with the emergence of commercial nuclear power abroad the US would find it increasingly difficult to control, or unilaterally impose its own conditions upon, the international dissemination, and use of nuclear technology and materials. Indeed the report noted that:

> Since we are convinced that international commerce in the atomic industry will increase significantly during the next decade, we believe that it is necessary for the United States to work together with the other nations of the world to reach agreement on some of the terms and conditions of this trade. (301)

Anticipating a global spread of nuclear technology and materials the report was one of the first official acknowledgements that a significant

transformation in US foreign atomic policy was required to confront the changing commercial and technological environments. It argued for a quite radical shift in policy, by recommending that 'activities now being conducted under existing bilateral agreements should be transferred to Agency auspices wherever practical'.(302) But it also went further than this for it recommended that the US should secure international agreement that the jurisdiction of the Agency be expanded to include the formulation and implementation of policies with respect to international health, safety and waste management standards.(303) In effect, the report signalled the beginnings of a powerful attachment, amongst key policy making elites, to consolidating the Atoms for Peace regime through multilateral measures. But initially the radical implications of the report precipitated a highly charged debate amongst the policy makers in the executive and the Congress.

Central to this debate was the relationship between bilateral and multilateral approaches to nuclear co-operation and regulation. Both the JCAE and the AEC were somewhat sceptical of the reports emphasis upon multilateralism. The JCAE's concerns were consistent with its deeply rooted suspiscion of policies which limited the ability of the United States to control or influence nuclear developments abroad.(304) A strong supporter of the bilateral co-operation programme, the JCAE was concerned that an expansion in the agency's role in regulating international nuclear commerce would lead to a corresponding diminuition in US power and influence to shape the conditions under which international nuclear transactions were conducted. This could only bring, it was believed, a weakening of the existing arrangements for preventing further proliferation. With slightly different concerns the AEC too voiced opposition to the report, particularly against suggestions that the agency be given a significant role in nuclear supply arrangements. As one AEC commissioner told the JCAE:

> While complete and full use of the agency as a supplier of nuclear materials would be a significant step in strengthening Agency safeguards many countries have greater confidence, and preference for, the bilateral channel.(305)

With discussions concerning private ownership of nuclear materials already in progress the AEC was decidely unwilling to contemplate suggestions for establishing the IAEA as a significant channel for US nuclear fuel supply. Nor did such a suggestion find much support amongst the nuclear industry which was much more concerned with reducing the barriers to further commercialization of the nuclear fuel cycle. Even the State Department too considered it unwise, for as Mr Cleveland (Assistant Secretary of State for International Organization Affairs) explained to the JCAE:

> I do think Mr Chairman that it is worth calling attention to one piece of doctrinal progress.....I think that we are at last questioning the assumption that in order to be the international inspectorate the agency needs to a channel even for fuel supply.(306)

As a result the report brought about no significant alteration to the established policy of supplying nuclear material and technology primarily on a bilateral basis. However, it did lead to a major change in policy with respect to the safeguarding of all bilateral agreements for co-operation.

In 1961 the first system of agency safeguards was introduced, after years of detailed argument about the principles upon which it should be based.(307) This was a historic achievement and the Smyth report recommended that the US should promote the worldwide adoption of Agency safeguards as 'the best attainable assurance against diversion of material and equipment to military purposes'.(308) It suggested that this would be best achieved by the US taking the lead in transferring, to the Agency, its responsibility for safeguarding all existing and future bilateral agreements for nuclear co-operation.(309) In fact, the State Department and the AEC were already discussing this shift in policy since they both recognized that with the projected growth in nuclear transactions the

existing system of AEC administered safeguards could no longer be sustained.(310) Bilateral safeguards imposed an already considerable financial and administrative burden on the AEC, which could only increase. More important though was the belief that as countries abroad developed a sophisticated nuclear infrastructure they were likely, for commercial and political reasons, to become increasingly disenchanted with a safeguards system based purely upon US inspections.(311) Consequently, following the publication of the report, the State Department announced its intention:

> ...to make a practical start on an international programme of safeguards ... looking into the enormously complex question of how best to relate an international agency to the bilateral agreements which have thus far been the dominant pattern of our international atomic energy programme.(312)

Whilst, the State Department was somewhat cautious in its approach to the question of transferring safeguards responsibilities to the Agency, perhaps recognizing the diplomatic problems which lay ahead, the AEC, after initial anxieties had worn off, became much more decidely enthusiastic. This was partly because the Smyth Report finally destroyed the notion that the only effective way to promote the widespread application of Agency safeguards was by giving the Agency a significant role in the nuclear supply business.(313) Such a development, as previous discussion has shown, would have contradicted the whole thrust of AEC policy which was primarily geared to facilitating US commercial hegemony in world market for nuclear power. Nor did it mesh with the AEC's drive to commercialize the whole nuclear fuel supply business. In supporting the move to transfer safeguards responsibilities to the Agency the AEC did so as part of its desire to prevent the Agency adopting a potential role as a channel for nuclear fuel supply. Commissioner Howarth explained to the JCAE the AEC's qualified support of the Agency in the following terms:

> Important as it may be to the Agency for it to serve as a supplier of nuclear material (a question on which there have been different opinions) it is even more important that Agency safeguards become generally applied. It is therefore of great significance, in the interests of strengthening the safeguards function of the Agency, that greater emphasis be given to the voluntary application of IAEA safeguards to bilateral transactions.(314)

Following detailed discussions between Japan, the IAEA, and the United States the very first agreement, transferring to the Agency the administration of safeguards under a bilateral agreement for co-operation, was signed in Vienna on September 23rd, 1963.(315) This signalled the beginnings of the comprehensive transfer of US safeguards responsibilities to the Agency so that by the early 1970's safeguards on all US bilateral agreements were administered by the Agency. Not only did this bolster international confidence in the Agency but also it considerably enhanced the legitimacy of both the concept of international safeguards and the Agency's unique role in administering a system of international inspection. To ensure its success this policy was also complemented by the provision of financial and other support for developing the Agency's other functions.

In financial terms the US was the largest single contributor to the Agency budget throughout the decade 1964-1974.(317) As Table 4-7 indicates almost a third of the Agency's regular budget was provided by the American government. Moreover, even in 1972 when Congress set a ceiling of 25% on US financial contributions to international agencies, the Agency was exempted because of its special status.(318) But in addition to its regular assessed contributions, agency funding has also been further supplemented by the Arms Control and Disarmament Agency's provision of specific funding for safeguards research.(319) US funding therefore underwrote a significant proportion of the growth in the Agency's activities once commercial nuclear power arrived in the mid to late sixties.

Aside from financial support the AEC also provided technical assistance and donations of nuclear materials to the Agency.(320) This amounted to

Table 4 - 7

U.S. FINANCIAL PARTICIPATION IN THE

INTERNATIONAL ATOMIC ENERGY AGENCY

1958 THROUGH 1974

Calendar year	Agency regular budget (note a) U.S. assessment	U.S. percentage (note b)	Agency operational budget (note c) Voluntary U.S. cash contributions	Voluntary U.S. gifts-in-kind (note d)	Total
	(000 omitted)		(000 omitted)		
1958	$ 1,363	33	$ 65	$ -	$ 65
1959	1,699	33	592	1,050	1,642
1960	1,900	33	500	608	1,108
1961	2,000	32	631	354	985
1962	2,139	32	690	472	1,162
1963	2,201	32	719	387	1,106
1964	2,305	32	678	397	1,075
1965	2,456	33	597	401	998
1966	2,765	32	531	400	931
1967	2,924	32	492	400	892
1968	3,238	32	478	407	885
1969	3,437	32	499	407	906
1970	3,734	32	630	750	1,380
1971	3,977	32	786	764	1,550
1972	4,882	32	945	604	1,550
1973	5,725	32	946	804	1,750
1974	7,383	32	950	1,050	2,000
	$54,208		$10,730	$9,255	$19,985

a/ U.S. contributions to the regular budget represent State Department appropriations.

b/ Represents percentage of U.S. contribution to total assessments made by the Agency.

c/ Before enactment of the Foreign Assistance Act of 1961, U.S. funds for the operational budget were provided under the Mutual Security Program.

d/ U.S. gifts-in-kind include cost-free fellowships, experts, training courses, and equipment.

over $10m from its inception until 1974.[321] Such assistance was directed towards the development of safeguards but also included other areas of technical need.[322] These have included programmes in technical assistance to the Third World, physical protection, and safety and environmental protection.[323] By providing technical and financial assistance in some of these latter areas the AEC sought to promote a much greater role for the Agency in regulating the international exploitation of the atom. This was complemented by working within the Agency's bureaucratic structures to promote the development of internationally agreed rules, regulations and procedures covering safety matters, physical protection and transportation of nuclear materials and facilities, as well as nuclear waste disposal. As the worldwide exploitation of commercial nuclear power gathered pace so too did US enthusiasm for expanding the regulatory jurisdiction of the Agency into these new areas.

Almost a decade after the publication of the Smyth report, a further review of US policy towards the IAEA ws initiated.[324] The Aspin report was published in 1972 and recommended, in the light of the Agency's crucial role in policing the NPT, that the US provide it with much greater financial and political support.[325] Significantly, it also proposed a further expansion of the Agency's responsibilities to include 'broad environmental matters' and to involve it in regulatory matters to do with nuclear trade.[326] Coming at a time when the first visible signs of the erosion in the American nuclear monopoly were evident the report confirmed the secular trend in US foreign atomic policy towards greater reliance upon multilateral mechanisms of control and regulation.[327] And this is illustrated nowhere better than with regard to the extensive involvement of the US in the formulation and promotion of international safeguards.

From 1961, when the Agency introduced its first rudimentary safeguards system to 1971, when NPT safeguards were agreed, the nature of international safeguards underwent radical change.[328] During this time

the US played a major role in each successive set of negotiations to revise or extend existing safeguards systems. As Willrich and Taylor acknowledge, the US was

> ... largely responsible for the marked expansion in the applicability of the IAEA's safeguards system during the years which preceeded the NPT.(329)

Since the AEC had considerable technical and operational experience of safeguards, and pioneered much of vital research and development work in this area, the US had an undeniably critical role in determining the form of international safeguards.(330) Crowson recalls that:

> ... we recognized the need early and later saw that the US system could be an effective and defensible model for worldwide safeguards.(331)

Moreover, the evolution of policy with respect to domestic safeguards and Agency safeguards was intimately connected. Critical reviews of domestic safeguards policy often stimulated review of agency safeguards, and vice versa.(332) This contributed to the extension reforms of Agency safeguards. But by the mid 1970's, particularly following the Indian nuclear test, the credibility of international safeguards was challenged by a series of highly critical reports initiated by Congress.(333) What is interesting is that, despite the intensity of the criticism, there was no sympathy for a return to bilateral safeguards. Rather, there was a general consensus that, with the growing spread of nuclear capabilities, international safeguards, however imperfect, provided the only effective mechanism for ensuring '... increased international scrutiny of the peaceful nuclear fuel cycle'.(334) This explicit commitment to Agency safeguards was reinforced by their active promotion.(335) By 1970, all bilateral safeguards arrangements had been transferred to the Agency and, following President Johnson's 1967 offer, negotiations were in progress concerning the application of Agency safeguards to US commercial nuclear reactors.(336) This active promotion of international safeguards had important benefits for the US.

Appearing before the JCAE, in an effort to extract political support for the establishment of the IAEA, Secretary of State Dulles, had argued before the JCAE that once nuclear power came of age few states, for commercial and political reasons, would continue to tolerate a system of US administered safeguards inspections.(337) Agency safeguards, it was argued, would relieve the AEC of the considerable financial and administrative burden resulting from its already heavy programme of foreign inspections, predicted to expand enormously with the commercial exploitation of nuclear power.(338) Equally, international safeguards solicited greater international confidence and credibility than bilateral arrangements since they could be applied uniformly and consistently without regard to the vagaries of bilateral political relations between the co-operating parties.(339) They also had the advantage of creating universal standards of inspection, materials accountability, and physical security.(340) And, very importantly for the AEC and the Arms Control and Disarmament Agency, an internationally agreed system of safeguards would prevent the real possibility that safeguards requirements could become the potential focus of future competition between nuclear suppliers; a situation which would invite a decline in safeguarding standards and thereby undermine international confidence in their application. Accordingly the proponents of IAEA safeguards within the executive branch, particularly ACDA, considered the internationalization of safeguards to be a rational response to the anticipated problems of ensuring that nuclear technology and materials were used only for peaceful purposes in a world in which the commercial exploitation of the atom was fairly widespread.(341) International safeguards, however, were not simply conceived by US policy makers as a mechanism for enhancing international security, they also had a commercial dimension. By transferring its safeguards responsibilities to the Agency, the AEC was able to extricate itself from the highly intrusive and politically sensitive task of foreign inspections. This benefitted the

US nuclear industry since it removed a potential disincentive to foreign purchase of American civil nuclear technology. As one State Department document noted, comprehensive international safeguards were essential '...if we want long-term and safe foreign markets for our nuclear materials and technology.'(342)

By adopting a leading role in both the formulation and promotion of international safeguards, the US contributed to the evolution of a system which elicited considerble (but qualified) international and domestic support since it prevented international nuclear anarchy which would have increased the risk of further proliferation.(343) Until the early 1970's this worked mostly to the commercial advantage of the US nuclear industry since international safeguards facilitated the regulated expansion of the world market for nuclear power, which US corporations, because of their industrial and technological supremacy, were in a strategic position to exploit.(344) Agency safeguards therefore complemented US commercial hegemony in the nuclear field since they acted to legitimize, both domestically and internationally, the global trade in nuclear technology and materials.

By the late 1960's, when the world market for commercial nuclear power began to expand rapidly, those responsible for foreign atomic policy were almost unanimously, and irreversibly, commited to expanding the international regulation and supervision of nuclear technology, largely (although not exclusively) under the auspices of the IAEA.(345) Utilizing its hegemonic position in the world nuclear market the US was able to persuade others to participate in and accept a system of international regulation and oversight of nuclear transactions. Moreover this US commitment grew stronger with the gradual recognition that it no longer had the ability or the mechanisms to control unilaterally the spread of nuclear capabilities. The Agency therefore became increasingly salient in US foreign atomic policy since it was regarded as central to the promotion of

a legitimate international civil nuclear order; an order which attempted to reconcile the desire for international security with the requirements of international nuclear commerce. With the coming into force of the NPT in 1970 the Agency's vital role, in this evolving international nuclear order, was confirmed.

4.4.2 The Nuclear Non-Proliferation Treaty

On January 18th 1968 the Soviet Union and the United States presented to the United Nations Eighteen Nation's Disarmament Committee, in Geneva, a jointly agreed draft of a treaty to prevent the further spread of nuclear weapons. This draft was the basis for extensive multilateral negotiation which subsequently led to the signing of the Nuclear Non-Proliferation Treaty on July 1st 1968.(346) The NPT was an historic achievement not only because it was an initial step towards nuclear disarmament but also since it dramatically transformed the Atoms for Peace regime into an almost universal non-proliferation regime. As Smith describes it:

> The NPT institutionalized a regime by enlarging and making more explicit the 'bargain' first made with the Atoms for Peace program. For the first time, recipients of nuclear equipment and fuel were asked to renounce formally and officially the development of nuclear explosives and to accept safeguards on their entire nuclear programs, including both indigenous and foreign - assisted facilities.(347)

This, it was widely believed, would ensure that the rapidly expanding world market for commercial nuclear power and technology did not create the potential conditions for further horizontal proliferation.

In signing the NPT in 1968 President Johnson brought to a close a rather intense inter-bureaucratic struggle over the nature of US non-proliferation policy. Although, throughout the fifties and early sixties, successive Presidents and Secretaries of State had ritualistically confirmed American opposition to the spread of nuclear weapons, in fact a distinctly ambivalent policy had been persued. Under Eisenhower and Kennedy, the British had received extensive assistance with their

'independent' nuclear deterrent.(348) Together with the deployment of nuclear weapons in Europe, and the proposal to assist NATO with the creation of a multilateral nuclear force (MLF), US policy gave the impression of favouring selective proliferation as opposed to unconditional opposition to it. Underlying this apparently ambivalent stance was a raging inter-bureaucratic debate concerning the relative priority of alliance commitments over non-proliferation objectives.

Writing in 1968, in a study of the evolution of US non-proliferation policy, Bader suggested that:

> ... the evidence is conclusive that the United State's present policy of total resistance to the spread of nuclear weapons ... is in fact of very recent origin.(349)

Indeed, throughout the early 1960s the State Department and the Pentagon were somewhat preoccupied with alliance problems. European concerns about the credibility of the American nuclear guarantee to Europe had led the Kennedy administration to propose the establishment of a NATO nuclear force.(350) But the MLF proposal was incompatible with the Arms Control and Disarmament Agency's fervent promotion of an international non-proliferation agreement. Few states would commit themselves to a non-proliferation agreement which on the one hand prevented them from acquiring nuclear weapons whilst on the other hand permitting the US to 'share' nuclear weapons with its allies. Because it was so critical to the future of the Western alliance, the MLF issue took priority, although a fierce rearguard bureaucratic struggle raged between those committed to the MLF and those concerned to persue an active non-proliferation policy. Compromises were reached which permitted some diplomatic progress to be made on non-proliferation.(351) But the fundamental incompatibility of these two policies meant that no comprehensive international non-proliferation agreement would be possible until the MLF initiative was either discarded or faded away. Bader confirms this, noting that by 1963:

> ... it was clear that the effort to organize European nuclear talents and ambitions into a collective force that would be reconcilable with a policy of non-proliferation had failed.(352)

However, negotiations on the MLF made little progress, and became decidedly acrimonious. This gave ACDA the opportunity to establish non-proliferation policy as a major priority.

Several factors combined to commit the Johnson administration to the rapid conclusion of an international agreement on non-proliferation. Firstly, the failure of the MLF negotiations removed an important roadblock to the attainment of a non-proliferation agreement. Secondly, the cultivation of detente with the Soviets, particularly with respect to arms control measures, greatly facilitated progress with respect to non-proliferation. This was one area where there was common agreement between the two superpowers since a treaty was in their mutual interests. Thirdly, following the reviews of domestic and foreign atomic policy in 1962, both Kennedy, and subsequently Johnson, became deeply disturbed by the potential proliferation implications of the rapid global spread of nuclear technology and materials.(353) The fear was that as more nations developed their own independent nuclear capabilities some might be tempted to misuse them for military purposes.(354) This suggested the vital importance of some form of universal and verifiable international agreement on non-proliferation. Accordingly, not long after his election, President Johnson '...made the attainment of a non-proliferation treaty a national **jihad**'.(355)

This commitment was carried over into the negotiations both in Geneva, and amongst its more sceptical allies, as the administration, now united in its desire to attain agreement on a treaty, sought to remove all the political roadblocks to the achievement of a non-proliferation treaty. Trading subtely on its technological and commercial dominance of the world nuclear market the administration set out to assuage the fears and concerns of critics and sceptics of the proposed treaty, particularly those

emanating from its Western allies. The diplomatic and technical resources of the State Department, ADCA, and the AEC were mobilized to remove political and technical barriers to agreement at Geneva.(356)

The major sources of disquiet with the first draft treaty arose largely from European and Japanese concern over its safeguards provisions, combined with a more general dislike of its discriminatory tone and its potential for inhibiting nuclear trade and cooperation.(357) But on all these major issues the US made some significant compromises and announced some important initiatives in order to ensure a successful conclusion to the Geneva negotiations. In particular, it compromised over its desire for the universal application of Agency safeguards, which was opposed by the member states of Euratom which had operated its own safeguards system since its inception.(358) Moreover, in an attempt to combat fears that international safeguards and inspection would be intrusive and commercially damaging, the Johnson administration offered to place all US commercial nuclear plants and facilities under Agency safeguards.(359) On July 1st 1968 the Nuclear Non-proliferation Treaty was opened for signature and almost two years later it came into force.

With the entry into force of the NPT a new era in international nuclear relations was inaugurated for the treaty symbolized a transformation in the Atoms for Peace regime. It institutionalized many of its essential norms, rules and procedures and extended its jurisdictional scope, transforming the regime from a framework of essentially bilaterally agreed regulation and supervision, to an almost universal order based largely upon multilateral regulation and control. But the success of this transformed regime in preventing proliferation depended crucially upon how far its rules, regulations, norms and procedures were universally accepted. The State Department therefore sought to persuade those states that had refused to sign the treaty to adhere to its requirements. In doing so the US demonstrated its commitment to non-proliferation by supporting a range of

arms control initiatives, including the Tlateloclo treaty and treaties banning the deployment of nuclear weapons in space and on the sea-bed.(360) But the Pentagon refused to be drawn into either specific security guarantees to, or pledges not to use nuclear weapons against, non-nuclear weapon states. Equally as important was the intense diplomatic pressure focused upon close allies, such as West Germany and Japan, in order to persuade them to ratify the treaty. According to Baker, American officials even used an implied threat to withdraw enrichment services in an effort to influence the domestic debate in Japan over the question of ratification.(361) However, this extensive diplomatic campaign to promote adherence to the NPT was not assisted, in fact it may have been undermined, by the many commercial deals struck between the major American nuclear suppliers and states which refused to sign the NPT. President Nixon's offer of power reactor technology to Egypt and Israel was extremely controversial in this respect. Indeed, the emphasis upon commercial criteria and the commitment to being a reliable supplier meant that adherence to the NPT was not (for some time) made a significant consideration in nuclear export matters.(362)

Despite the lack of universal adherence to the NPT, it was nonetheless a crucial watershed in the evolution of the international civil nuclear order. It consolidated and institutionalized a genuine multilateral consensus upon the international norms, rules, procedures and structures for governing the peaceful exploitation of the atom. As Schiff describes it, the NPT established:

> ... a wide-spread, if not universal, set of norms of behaviour, in which prescriptions of action are explicit, and the scope of acceptable behaviour is relatively well defined. (363)

Such collective agreement was decidely welcomed by the United States since its ability to control unilaterally the pace and character of worldwide nuclear developments continued to dwindle as more states acquired a sophisticated nuclear infrastructure. Moreover, it sought to build upon

the multilateral consensus underlying the NPT by urging collective action with respect to the many problems which increasingly appeared to ellude unilateral solutions.

4.4.3 Initiating multilateral regulation and cooperation

Reflecting upon the impetus for the evolving commitment in US foreign atomic policy to multilateral forms of regulation and cooperation, a number of writers have explained it in terms of a reaction to hegemonic decline. Smith puts it succintly:

> Between the time the United States tabled a draft non-proliferation treaty to the Eighteen-Nation Disarmament Committee in August 1965 and the formation of the Nuclear Suppliers group in 1974, the United States began to suffer from the class if symptoms of a hegmon in decline... (364)

Thus, so the argument goes, as the US began to lose control over worldwide nuclear developments its strategy became one of encouraging multilateral forms of nuclear cooperation and regulation to limit the potential risks of further proliferation. Yet whilst a convincing explanation it is not entirely accurate for two reasons. Firstly, the US initiated discussions amongst nuclear suppliers well before its technological and commercial leadership was challenged by foreign competition.(365) Secondly, even in 1974 the US remained the world's dominant nuclear supplier, although the AEC's own projections indicated a secular erosion of its competitive position.(366) It would therefore be more accurate to argue that it was official expectations of its commercial and technological decline in the nuclear field that energized an already existing American attachment to multilaterialism, rather than decline 'per se' that precipitated it.

Expectations of decline were confirmed, in the late 1960's and early 1970's, as several European nations announced their entry into the commercial enrichment business and European competitors tendered for power reactor contracts mostly in the Third World. This reinforced perceptions of decline amongst American policy makers and increased fears that the United States was rapidly losing its ability to 'police' the international

exploitation of nuclear power. The situation was also expected to deteriorate since industry predicted a massive growth in the demand for nuclear power in the 1970's, bringing with it more intense foreign competition for a share of the lucrative Third World export market.(367) Two issues in particular were at the centre of ACDA's, and to a lesser extent the State Department and the AEC's, concerns. One was that once the US enriched uranium monopoloy was breached '... it eliminated the principal American lever in influencing other nation's nuclear energy policies'.(368) The whole basis of the Atoms for Peace policy would thereby be undermined. The second issue related to the spread of enrichment and reprocessing technologies (as appeared likely in a more commercially competitive world market) which unintentionally provided more nations with an independent capability to manufacture nuclear weapons. This prompted a gradual redefinition of the proliferation problem within the bureaucracy, one which emphasized technological capabilities much more than political intentions.(369) These particular worries reinvigorated existing policy to promote multilateral cooperation as one means by which to regulate the international commercial exploitation of nuclear energy.

Three specific initiatives were taken in the early 1970's; discussions were held amongst nuclear supplier states with the object of developing a common approach to nuclear exports; negotiations occured amongst the major western states on the question of proposed multinational enrichment ventures; and studies of multinational regional nuclear fuel cycle centres were initiated. Although portrayed as essentially non-proliferation initiatives it would be disengenous to discount the commercial motivations which shaped them.(370) In each case the evidence suggests that the proposals were geared also to protecting the vital interests of the US nuclear industry in the world market, as it entered a period of increased commercial competition.

(i) Cooperation Amongst Nuclear Suppliers

According to Kratzer cooperation with other nuclear suppliers was a significant component of US foreign atomic policy from the 1960s onwards.(371) Certainly there is evidence of such collaboration, for as early as 1966, John Hall, then Assistant General Manager for International Activities, reported to the JCAE that the Commission was continuing its:

> ...efforts, in conjunction with the Department of State to persuade other supplier countries to require safeguards in connection with assistance to chemical processing plants.(372)

However, with the prospect of increasing commercial competition and trade in sensitive technologies many policy makers, in ACDA, State and the AEC sought more formal cooperation between nuclear suppliers, building upon the consensus reached over the NPT. This was to ensure that all transfers of sensitive technologies took place under Agency safeguards and to plug loopholes in existing nuclear export controls.(373) But such cooperation was also aimed at persuading suppliers to adopt a collective policy of self-restraint in not seeking to pursue competitive advantages at the expense of safeguards requirements on exports to non-NPT members.(374) This was extremely important since the big growth in demand for commercial nuclear power was expected to be amongst the newly industrializing states in the Third World, many of whom refused to sign (or be bound by the terms of) the NPT.(375)

Following discussions amongst suppliers within the IAEA - a special committee, the Zangger committee, had been established in 1971 to devise a list of items which could only be exported under agency safeguards - an informal consensus was reached in early 1974, on a 'trigger list' of items which required safeguards when exported.(376) As American officials noted:

> ... the trigger list was an attempt to take safeguards out of the marketplace. That is, if all exporting countries could agree to a common policy of safeguarding exports, no one country would have a commercial advantage because it did not require safeguards.(377)

However, not all suppliers were party to the consensus, including major states such as France and Italy. Consequently, a secret Nuclear Supliers Group, whose membership included all the seven major exporters, was convened by the United States in late 1974. Its objective was to formulate a more comprehensive 'trigger list' which would be adhered to by all nuclear suppliers.(378) This was successfully achieved, largely as a result of the widespread concern about proliferation following the Indian explosion and the spate of controversial nuclear deals, such as that between Germany and Brazil which involved the export of sensitive fuel cycle technologies.(379)

The NSG was a rather successful attempt by the US to establish a suppliers 'cartel' in order to prevent the uncontrolled spread of nuclear technology and materials.(380) Of course this multilateral cooperation was also to its commercial advantage since it brought some harmonization of national nuclear export policies. This was an area where there was a divergence between suppliers since, for domestic reasons discussed earlier, the US was tending to adopt relatively more restrictive criteria.(381) As competition in the world nuclear market became more oligopolistic in character, cooperation amongst nuclear suppliers developed an increasingly salient position in American foreign atomic policy.

(ii) Multinational Enrichment Ventures

Supplier cooperation, however, was not assisted by the contradictory impulses in AEC enrichment supply policy. As Chapter 3 explained, from 1968 onwards the Nixon administration sought to privatize the AEC's enrichment business. Indeed it was almost obsessed with establishing the best conditions for the transition to private ownership.(382) Developments in Europe, however, threatened to create serious problems for an easy transition to private ownership. Desiring to lessen their dependence on the US for enriched uranium supplies and to capture a slice

of what was projected to be a lucrative world market, Britain Germany and Holland formed a multinational enrichment venture, Urenco, in 1970.(383) France too sought to break into the commercial market with a similar multinational arrangement and others, like Japan, considered the construction of indigenous facilities in order to diversify sources of supply. These developments enraged the JCAE and worried officials in the AEC and State Department.

Some members of the JCAE pressed for retaliatory action against the Europeans since they saw no reason why the US should continue to supply them with enrichment services, on quite favourable terms, whilst they developed the capability to compete with the US in the enrichment market.(384) For the proponents of privatization in the AEC and White House potential European competition complicated planning, creating more uncertainties for prospective private investors in the enrichment business. Equally State and ACDA were disturbed both by the implications for the US ability to influence foreign nuclear developments once alternative sources of supply were available and the proliferation implications of the spread of enrichment technology. It was in this context that proposals for US sponsored multilateral enrichment ventures were adopted.

On February 25th 1971, in his foreign policy report to Congress, President Nixon announced that the administration was initiating exploratory discussions with interested governments on the possible construction of multinational enrichment ventures.(385) The objective of the discussions was to:

> ... determine whether possibilities exist for making US gaseous diffusion technology available outside the US, under appropriate financial and security arrangements, for the construction of additional enrichment capacity on a multinational basis.(386)

The rationale for this initiative was simply that it reconciled commercial and security objectives without compromising privatization measures or foreign policy interests.(387) But the proposals were not well received in

Europe where, as Gallucci points out, they:

> ... only confirmed European suspicions that the United States intended to commit as little as possible while trying to gain as much control of whatever share of the market the Europeans were able to capture.(388)

Discussions continued and further initiatives were taken in the wake of the oil crisis which prompted greater concern for energy independence.(389) Japan, in particular, was extremely interested in cooperative ventures and representatives of private industry even appeared before the JCAE to testify to their commitment.(390) However, the prospect for such multinational ventures lessened with the increasing priority given to privatization by the AEC and JCAE.

In his study of American enrichment policy Wonder argues that the primacy of domestic interests, combined with a much more neo-mercantilist approach to international trade policy following the 1971 economic crisis, prevented effective multilateral cooperation.(391) For in an attempt to force the pace of privatization the AEC, never totally enamoured by the proposals for cooperative ventures, introduced new contract terms for its enrichment services in September 1973.(392) Whilst the new contracting system greatly enhanced the privatization policy it had disastrous foreign policy implications. As Gallucci explains:

> The effect of the change was to force European utilities to commit themselves to American services for periods up to eighteen years. The American move was interpreted as an attempt to use a current monopoly on commercial enrichment services to guarantee a share of the market well into the 1980s.(393)

The policy was perceived widely as an attempt to undermine the economic viability of European and foreign plans for indigenous enrichment facilities. But the policy had the opposite effect and stimulated greater investment in planned indigenous and European multinational ventures. It also precipitated an enrichment 'crisis'.

One of the unintended consequences of the switch to new longer-term contracts was that present and future demand for AEC enrichment services

soon outstripped available and projected supply.(394) Therefore in June 1974 the AEC temporarily suspended signing long term contracts whilst it reviewed its policy.(395) The foreign policy implications of this decision were catastrophic since it was largely foreign utilities which were affected by the contract moratorium. Not only did it destroy America's image as a reliable nuclear supplier but also it resulted in expanded investment amongst the AEC's foreign customers, in alternative sources of supply.(396) This single act made the probability of an agreement upon multilateral enrichment ventures, involving the US, almost zero.

As expected discussions on multinational enrichment ventures made no progress and the American initiative collapsed. This was not because of insurmountable diplomatic obstacles but almost wholly because of the consequences of American domestic policy decisions. Here is an episode which demonstrated vividly the ramifications of the complex inter-relationship between American foreign and domestic nuclear policies. What is particularly interesting is that despite the outcome it did not signal the end of such initiatives.

(iii) Regional Nuclear Fuel Cycle Centres

Addressing a meeting in September 1974 ACDA's Director Fred Ikle, called for greater emphasis upon:

> ... multinational cooperation so as to strengthen the acceptability and reliability of safeguards. Particularly, the processing of nuclear fuel can best be done in cooperative arrangements.(397)

His remarks evolved from a growing interest within ACDA in the concept of regional nuclear fuel cycle centres (RNFCC).(398) Concerned by the desire of many Third World countries to establish an indigenous fuel cycle capability, and the willingness of some European states to provide it, RFCC's were considered to be a much more economical and proliferation resistant path to providing the services they desired. RFCC's, it was believed, would limit the spread of sensitive reprocessing or enrichment

technology and ensure that all flows of fissionable material took place under agency safeguards.(399)

Underlying ACDA's concern was the prospect, in the near future, of a significant commercial reprocessing industry in both Europe and the United States which could lead to a global trade in fissionable materials. Combined with this was the expectation of a growing diffusion of reprocessing technology, as more states sought greater autonomy in the nuclear energy sector, which would increase the latent capabilities of states to manufacture nuclear weapons.(400) ACDA too was acutely aware of the increasing Congressional and public oposition to reprocessing on grounds that it was both environmentally hazardous and increased the risks of proliferation. Moreover, by the autumn of 1974, the Indian test, and more specifically the State Department's ambivalent response to it, together with President Nixon's offer to sell power plants to Israel and Egypt, had elevated proliferation into a major political issue.(401) A new initiative was required before Congress acted in response to growing calls for domestic and international restraints on commercial reprocessing and exports of reprocessing technology. Consequently, US representatives to the IAEA urged the formation of a study group on RFCC's to formulate workable proposals. A preliminary study was completed in October 1974 and a more substantive report published in 1975.(402) These formed the basis for international discussions throughout 1975 and 1976.

Multilateral cooperation, whether in the form of RFCC's or the NSG, came increasingly to be perceived by the State Department and ACDA as a solution to the problems posed by the worldwide commercialization of the nuclear fuel cycle. International cooperation was given increasing prominence in policy statements on proliferation throughout 1974 and 1975.(403) Indeed many officials in State and ACDA were gradually coming to the conclusion that, irrespective of the adequacy or inadequacy of international safeguards, the dissemination of sensitive technologies

undoubtedly increased the risk of further proliferation and this called for a greater emphasis upon policies of denial. The problem of horizontal proliferation was slowly being redefined, much as at the dawn of the nuclear age, in terms of the spread of technological capabilities. But since a policy of unilateral denial would no longer be effective in a highly competitive world market, US reliance upon multilateral policy solutions became almost inevitable.

4.5 Some Concluding Observations: The Decline of US Power

This chapter has documented several remarkable transformations in the nature of US foreign atomic policy during the post-war years up until 1974. Whilst the initial policy of denial and restraint was replaced in 1954 with a policy of nuclear cooperation and dissemination, by the early 1970s the very success of the 'Atoms for Peace' programme brought with it new problems which American policy makers sought to combat by tilting the balance in foreign atomic policy back towards denial. Closely connected with this change was a considerable shift in emphasis away from unilateral modes of control towards multilateral modes of regulation. Because of the erosion of its technological and commercial hegemony, and the loss of its nuclear fuel monopoly, the US was no longer in a position, as it had been in the 1950s and 1960s, to dictate the conditions attached to international nuclear commerce. Paradoxically, the actual success of the 'Atoms for Peace' programme, in promoting the development of nuclear power industries abroad, contributed enormously to the gradual undermining of the technological and industrial basis of US dominance of the world nuclear industry. Within only two decades the relative power of the US within the nuclear issue-area had declined considerably with the consequence that it lost its ability to shape unilaterally the rules of international nuclear trade and cooperation.

American policy makers to some extent anticipated this process of decline. As this chapter has illustrated the increasing emphasis upon multilateral mechanisms of control, to complement bilateral controls, commenced in anticipation of the commercialization of nuclear power and was not, as some have argued, primarily a reaction to it. Once the commercial exploitation of nuclear power gathered pace in the 1960s so too did the US enthusiasm for multilateral solutions to the problems which arose because of the availability of alternative sources of nuclear supply and the diffusion of sensitive technologies. But the enthusiasm for multilateralism also developed out of its inability and unwillingness to continue to accept the burdens and full costs of being a hegemonic power. Transferring bilateral safeguarding arrangements to the IAEA provides a particularly graphic illustration of this. In addition multilateralism offered a potential mechanism for protecting the commercial interests of the US nuclear industry by establishing universally applied rules for the conduct of international nuclear trade. But multilateralism brought its own problems and difficulties.

Although, by the mid 1970s, the US had lost its commercial and technological hegemony it still retained a significant leadership role within the international non-proliferation regime. Other states expected it to offer leadership in attempts to resolve the difficult problems which faced the international community particularly in reconciling the growing spread of nuclear capabilities, urged on by unrestrained commercial competition, with the desire to prevent the further spread of nuclear weapons. But, as has been demonstrated here, providing such leadership proved an intractable problem since it was impossible in the US to insulate foreign atomic policy from the hurly-burly of domestic politics. Enrichment policy is a prime example of how domestic politics undermined attempts to provide leadership with respect to the formation of multinational enrichment ventures. Moreover, in this particular case the

consequences of failure were profound since it contributed directly to the erosion of the US nuclear fuel monopoly by encouraging the expansion of alternative sources of supply.

The consequences of this decline in US power will be returned to in the following chapter where some assessment is made of how the 'Atoms for Peace' regime, and the changing nature of US foreign atomic policy, conditioned the development of nuclear power in Japan.

Chapter Four Footnotes

1 Figures for reactors are for the period 1965-1974; see Walker W.& M. Lonroth Nuclear Power Struggles George Allen & Unwin, London, 1983 p.34. For enriched uranium fuel supplies the US controlled nearly 95% of the market up until 1975. Until 1973 there were no substantial competitors. See Donnelly, W.H. Commercial Nuclear Power in Europe CRS Dec 1972 US GPO, Washington DC, 1972, p.125.

2 In this 'school' see Lovins, A.B. Soft Energy Paths, Penguin, London, 1977, Ch.11. See Foreward by Fred C. Ikle in Wohlstetter, A. Swords from Plowshares Chicago UP, London, 1979. Lovins, A.B. and L.H. Energy/War, FOE, San Francisco, 1980, Ch.2. Markey E. Nuclear Peril, Ballinger Camb. Mass, 1982, Ch.2.

3 See 'Atomic Power for Peace' Address before The UN General Assembly, December 8th 1953, Congressional Record v.100, Jan. 7, 1954 pp.61-63.

4 ibid

5 The amendment only allowed very restricted cooperation and moreover most nuclear information remained classified. On the nature and history of the 1951 amendment see: Toll, D.R. 'Background Paper - Legislation and Congressional Reports on International Atomic Energy Programs and Policies 1945-1960' in US Congress JCAE Report. Review of International Atomic Policies and Programs of the United States October 1960 US GPO Washington DC 1960. (Hereafter referred to as McKinney Report) v.3 pp.930-932.

6 ibid pp.932-3

7 See Camilleri, J.A. The State and Nuclear Power Harvester Press, Brighton 1984, p.27.

8 On this see Green, H.P. & Rosenthal, A. Government of the Atom Atherton Press, NY 1963, p.124.

9 Nieburg, H. Atomic Secrecy and Foreign Policy, Phd. Diss. University of Chicago 1961, pp.106-15, 130-54.

10 The background and substance of this policy can be garnered from Gaddis J.L. Strategies of Containment Oxford UP, Oxford, 1982.

11 ibid Ch. 5 & 6 for a discussion of the substance and implementation of the policy. Also consult Ambrose, S.E. Rise to Globalism 3rd Ed. Penguin, London, 1983, Ch.8. Lafeber, W. America, Russia and the Cold War 4th Ed. John Wiley, NY, 1980, Ch.7

12 On the background see Schiff, B. International Nuclear Technology Transfer Croom Helm, London, 1984 pp.46-7.

13 Simpson, J. The Independent Nuclear State, Macmillan, London, 1983, p.113. Also on the background to Bermuda and the discussions see Thomas, M. and Northrop, R.M. Atomic Energy and Congress, University of Michigan Press, Michigan, 1956 p.160-167.

14 The US had minimal air defenses at the time and so felt doubly vulnerable. On the impact of Soviet strategy on US thinking see Sokolski, H. 'Atoms for Peace: a Nonproliferation primer' Paper presented to 1980 Midwest Political Science Assoc. Annual Meeting 24th April 1980, Chicago. For a discussion of Soviet nuclear strategy in the period see Freedman, L. The Evolution of Nuclear Strategy Macmillan, London, 1981, Ch.10.

15 Sokolski ibid p.1

16 For a discussion of the US hegemonic role in establishing post-war regimes see Keohane, R.O. After Hegemony, Princeton UP, Princeton 1984, Ch.8. He notes that 'America was not able simply to dictate terms to the world, but it had multiple ways of providing incentives to others to conform to its preferences.' p.177.

17 Mullenbach notes that this was a prevalent misconception amongst many 'based on an inflated theory of the primary role of electric power in economic growth and development.' Mullenbach, P. Civilian Nuclear Power, Twentieth Century Fund, NY, 1963, p.266.

18 Testimony of Commissioner Zuckert in US Congress, JCAE Hearings, To Ammend the Atomic Energy Act of 1946, 83rd Congress 2nd Session, Part 2, (US GPO Washington DC 1954) p.588. (Hereinafter cited as Hearings 54 Ammends).

19 See Testimony of Secretary Dulles ibid p.694-5

20 This correspondance is reprinted in Dept. of State Atomic Pool Proposal Press Release 531, Sept. 25th 1954.

21 Kratzer, M. 'Nuclear Cooperation and Non-Proliferation,' Atomic Energy Law Journal, v.17 No.4 1976 pp.250-288.

22 See PL 83-703 (68 stat.919) The Atomic Energy Act of 1954, Section 54, 57 & 123.

23 Donnelly, W.H. United States Agreements for Cooperation in Atomic Energy. An Analysis CRS Oct 19th 1976 US GPO Washington DC 1976 p.47. (Hereinafter Donnelly 1976 (i)) For details of agreements see Ch.4 & 5.

24 ibid p1

25 This had important implications in Japan where the government wished to encourage the private sector. On this provision see Article VII D in Agreement for Cooperation between the Government of the USA and the Government of Japan Concerning Civil Uses of Atomic Energy (US GPO Washington DC 1958) TIAS 4133.

26 Donnelly (1976)(i) op cit pp.39-40, 43-45.

27 PL 83-703 op cit Sec.123.

28 See Toll op cit.

29 PL 83-703 op cit Sec.123.

30 See Executive Order 10841 Sept.30th 1959 Sec.4. in Donnelly (1976)(i) op cit p.31.

31 ibid p1

32 'Summary of Organization of Executive and Legislative Branches of US Government for International Peaceful Atomic Activities,' Staff Memorandum in McKinney Report v.3 op.cit. p.857.

33 On its creation and its functions see - AEC 'AEC Division of International Affairs Established' PR-745 Dec.13th 1955.

34 See AEC 'Expansion of International Activities' PR-855 July 15th 1956.

35 For details of the organization and functioning of its international affairs see Organization for the Administration of the AEC Program for International Cooperation in Peadceful Applications of Atomic Energy in McKinney Report v.3 pp.862-879.

36 Donnelly notes that it was making foreign inspections as late as 1969. See Donnelly (1976)(i) op cit p.51.

37 The changes in DOS Organization for atomic energy matters can be traced through the annual - US Government Organization Manual General Services Administration, Washington DC. But see particularly the years 1961-2, 1964-5, 1970-71, 1972-73, and 1974-75.

38 ibid For DOD

39 Mullenbach op cit p.269.

40 ibid.

41 Donnelly (1976)(i) op cit p.77.

42 See Toll op cit.

43 See Hearings 54 Ammends op cit Part 2 p.603.

44 Quoted from Wit D. 'Some International Aspects of Atomic Power Development' Law and Contemporary Problems, v.21 no.1 1956 pp.148-181.

45 The most significant was in the agreement with the UK concerning discussions of submarine propulsion systems. It became known as the Nautilus episode. See Green and Rosenthal op cit p.95.

46 For background to this legislation see Donnelly, W.H. Indications of Congressional Interest and Concern over Proliferation of the Ability to Make Nuclear Weapons. CRS April 1976 mimeo p.18-19 (hereinafter cited as Donnelly 1976 (ii)). This was passed as PL 93-485 (88 Stat 1460).

47 For a detailed discussion of the development and ramifications of this relationship consult Gowing, M. Independence and Deterrence v.1, Macmillan, London, 1974, Ch.11.

48 The UK had its own enrichment plants at Capenhurst and therefore only took fuel from the US for research.

49 Noted in McKinney op cit v.2 p.421.

50 See Mullenbach op cit p.271

51 These developments are discussed in more detail in International Cooperation in the Peaceful Uses of Atomic Energy Through the Instrument of the Bilateral Agreement for Cooperation AEC Devision of International Affairs, McKinney op cit v.2 pp.421-493.

52 Donnelly (1976)(i) op cit p.62.

53 The limit was initially placed at 6kg but revised in succeeding years. See McKinney op cit v.2 pp.421-493.

54 This is Kratzer's explanation which has some credibility since he held senior positions in both the AEC and DOS. See Kratzer op cit.

55 Liberalization occurred in 1958 and 1959. For details consult McKinney op cit v.2 p.421-493.

56 Quoted in The Foreign Power Assistance Program USAEC McKinney report op cit v.2 p.376-417.

57 Donnelly (1976)(i) op cit p.70.

58 The details are discussed alongside their implications in ibid Ch.V & VI.

59 In the case of Japan, as the subsequent chapter will demonstrate, this had significant implications for the readjustment of plans.

60 McKinney report op cit v.2 pp.386.

61 All of these aspects had quite significant implications for foreign programmes since it pushed them along certain development paths. Moreover, plutonium prices affected the relative economics of nuclear power in foreign settings.

62 This was discussed during the 1955 Hearings on the industry but was not a commitment which was ever followed up. See US Congress JCAE Hearings Development, Growth and State of the Atomic Energy Industry, 84th Congress 1st session, Part I Jan/Feb 1955, USGPO Washington DC, 1955, p.209.

63 Indemnity was a major problem for exporters since unless foreign governments established their own idemnification legislation, US companies would be liable for the consequences of nuclear accidents involving their exports. There was some discussion of extending the Price-Anderson act abroad to cover US exports but this was rejected. For a fuller analysis of this issue see Vogel J. 'International Bilateral Agreements for Co-operation in Atomic Energy,' George Washington Law Review, v25, no 4, April 1957, pp492-507.

64 This curious situation whereby the US was quite willing to transfer reprocessing technology, which bore significant proliferation risks, but not enrichment technology, is easily explained. Although both were proliferation risks, the latter, if openly transferred, would have eroded the US monopoly on enriched uranium fuel supplies and thus the basis of US leverage over wayward states.

65 Donnelly (1976)(i) op.cit pl.

66 This is discussed in some detail in USAEC Twenty-Third Semiannual Report of the AEC, January 1958, USGPO, Washington D.C. 1958, ppl93-4.

67 See PL 85-177 (71 stat.45.3)

68 This became effective on August 7 1959

69 Details of the agreement are discussed in Donnelly op.cit (1976)(i), pp58-60 and McKinney, op.cit v2, pp421-493

70 PL 85-846 (72 stat 1084)

71 This will be discussed in more detail in the following section. On the nature of the programme see Donnelly W. H. Commercial Nuclear Power in Europe, USGPO, Washington D.C., 1972, Chapter 8,

Nau, H National Politics and International Technology, John Hopkins, Balt, 1974, Chapter 5.

72 Donnelly (1972) ibid p102

73 ibid p103

74 The Euratom agreement is described in Donnelly (1976) op.cit, Appendix 1, pp52-8. On the nature of the ommissions see USGAO The Nuclear Non-Proliferation Act of 1978 should be selectively modified, Report by the Comptroller General OLG-81-2 May 21, 1981, p97.

75 Donnelly (1976) op.cit p54.

76 For full details see:
US Nuclear Power Export Activities US Energy Research and Development Administration, April 1976, Washington DC, ERDA-1542 v1, pp4-7, 4-8 (hereinafter referred to as ERDA-1542 v1).

77 These are described in Duffy G. and Adams G. Power Politics - The Nuclear Industry and Nuclear Exports, Council on Economic Priorities, New York 1979.

78 McKinney op.cit. v2, p.384.

79 See Scheinman L. 'Security and a Transnational System: The case of Nuclear Energy' in Keohane R. and Nye J.S. (eds) Transnational Relations and World Politics, Harvard University Press, Cambridge, Mass, 1972, p.283.

80 McKinney op.cit. v2, p.380.

81 Vogel op.cit.

82 Mullenbach notes that the McKinney report proposed an international Atomic Power Demonstration Program and that leading industrialists had called for a nuclear Marshall plan or UNatom. See Mullenbach op.cit. pp.301-303.

83 This was particularly the case after Suez in 1956 which demonstrated the vulnerability of Europe to disruptions in energy supply.

84 Although fuel costs were not the major determinant of investment decisions in nuclear power plants the fact was that the capital costs of GCR's were much greater than those of LWR's which tended to focus attention on the comparative fuel costs of both systems. In this respect the fact that the UK could not guarantee fuel supplies, even though natural uranium was cheaper than enriched uranium, was a disadvantage. On costs see: Burn D. The Political Economy of Nuclear Energy IEA London, 1967 ch.2 and also Timm M. 'Some Aspects of Nuclear Fuel Economics; Atomic Energy Review v13, n4, December 1975, pp.695-742.

85 In this see McKinney report v2 op.cit. p.389.

86 The US also had considerable control over natural uranium supplies and in the 1950's and 1960's was able to persuade Canada not to supply France. See Scheinman, op.cit. p.287-8. Baker also notes the way in which the US utilized its enriched uranium monopoly for foreign policy Purposes. See Baker S.J. Commercial Nuclear Power and Nuclear Proliferation, Cornell University Occasional Papers, no.5, May 1975.

87 Baker ibid. p.26.

88 On this point see Nau op.cit. p.138. For the details of the Senn project consult Nehrt L.J. International Marketing of Nuclear Power Plants, University of Indiana Press, Bloomington 1966.

89 For full details of the regulations consult US AEC Export and Import of Materials and Facilities Controlled by the AEC Wash-1163, 1971, (hereinafter referred to as Wash-1163).

90 Testimony of Francis McKune in part 3 p.549-550 of US Congress JCAE Hearings Development, Growth and State of the Atomic Energy Industry, USGPO Washington DC 1055 part 1-3 (hereinafter referred to as 202 Hearings 1955).

91 Announced in US AEC Press Release PR 706.

92 ibid.

93 This was specified in the US Code of Federal Regulations Part 110 1956.

94 Wit op.cit.

95 See Wash-1163 op.cit. and Donnelly W. Exports of Nuclear Materials and the NPT CRS Washington DC May 23rd 1974 (hereinafter Donnelly 1974).

96 Interview with Department of State official.

97 This is discussed in some detail in US Congress Senate Hearings Exports of Nuclear Materials and Technology, July 1974 USGPO Washington DC 1974 pp.6-12 (hereinafter referred to as Hearings Exports 1974).

98 Interview with former State Department and AEC officials.

99 McKinney op.cit. v2, 0412.

100 ibid. p.413.

101 See US Congress JCAE Hearings Development, Growth and State of the Atomic Energy Industry, USGPO Washington DC 1956 (hereinafter referred to as 202 Hearings 1956) p.8.

102 This is discussed in some detail in Dawson F.G. Nuclear Power-Development and Management of a Technolocy University of Washington Press, Seattle pp.102-122.

103 Quoted in ibid. p.105.

104 Mullenbach op.cit. p.299.

105 McKinney v2, op.cit. p.336.

106 ibid. p.339. The AEC's initiative with the Export-Import Bank to provide financing for all nuclear export projects was announced on October 16th 1956. See US AEC 'Statement by Lewis L.Strauss, Chairman, US AEC, and Samuel C. Waugh, President and Chairman, Export-Import Bank of Washington', PR no.909, Washington DC.

107 McKinney ibid. p.339.

108 ibid.

109 ibid. p.342.

110 ibid. p.345.

111 For details see US AEC 23rd Semiannual report, US GPO Washington DC January 1958 p.191 (hereinafter referred to as AEC Semi-annual report).

112 The Indians obtained their knowledge of reprocessing technology this way. See Yager J. (ed) Energy and US Foreign Policy, Brookings, Washington DC 1974, p.216.

113 AEC Annual report 1958, p.219.

114 McKinney op.cit. p.348.

115 ibid. p.376.

116 This Soviet initiative to share civil nuclear technology with their Eastern bloc neighbours is examined and explained in Modelski G. Atomic Energy in the Soviet Bloc, Melbourne University Press, Melbourne, 1953, pp.124-137.

117 For the background to these developments and progress in the UK nuclear programme at this time see Pocock R.F. Nuclear Power: It's Development in the United Kingdom, Unwin, London 1977 Ch.3.

118 Mullenbach, op.cit. p.292.

119 ibid.

120 ibid.

121 The pressures for international expansion arising from the oligopolistic structure of domestic industries is explained in terms of the need to sustain domestic market shares and relative competitive positions. See Moran T. 'Foreign expansion as an institutional necessity for US Corporate Capitalism', World Politics, v25, no.3, April 1973, pp.369-386.

122 McKinney op.cit. p.426.

123 As Nehrt points out at the time fuel price subsidies were not insignificant since the relative costs (kwh) of both systems were roughly comparable. Nehrt op.cit. p.113.

124 McKinney op.cit. p.409.

125 This is certainly what Burn argued in his comparative assessment of BWR and GCR designs for Dungeness B. See Burn (1967), op.cit. pp.27-30, pp.46-50.

126 US AEC Press Release PR-909, op.cit.

127 McKinney op.cit. v2, p.868.

128 ibid. p.867.

129 ibid. p.349.

130 These are all described in detail in the Annual and Semi-annual reports of the AEC.

131 Nehrt sketches these out in several appendices see Nehrt op.cit. p.260 on.

132 For an excellent history of these linkages, in a much broader context, it is essential to consult Wilkins M. The Maturing of Multinational Enterprise: American Business Abroad from 1914 to 1970, Harvard University Press, Cambridge, Mass. 1974, pp.63-71.

133 Only in Britain and France had the LWR failed to penetrate the domestic market. Yet even in both these countries indigenous technologies had to demonstrate competitiveness with LWR's. Moreover in both countries there was extensive criticism from within and outside official circles of the commitment to GCR technology. In France this finally led in 1969 to its renunciation and by 1981 this was also the case in Britain.

134 McKinney op.cit. p.416.

135 Nau op.cit. p.127.

136 ibid. p.98.

137 The Soviets reacted strongly against the formation of Euratom since they opposed the notion of self-inspection as well as fearing German acquisition of nuclear technology. Moreover their own approaches to the dissemination of nuclear technology were much more restrictive. On these issues see Donnelly 1972, op.cit. p.76.

138 Nau op.cit. p.141.

139 ibid.

140 For a discussion of the success of the ECSC in meeting its initial production plans see Lucas N. Energy and the European Communities, Europa, 1977.

141 Nau op.cit. p.103.

142 See Donnelly 1972, op.cit. p.74, note 177.

143 Nau op.cit. p.74.

144 Quoted in ibid. p.130.

145 See ibid. p.132-3.

146 See Donnelly 1972 op.cit p.101.

147 ibid p.100.

148 It became Public Law 85-846 The Euratom Cooperation Act of 1958.

149 In a letter to the JCAE Chairman of the AEC Strauss noted that:"One of the major purposes of the proposed program would be to provide industry in the US and Europe with important engineering experience and data on capital and operating costs." (Authors emphasis). See letter from Strauss to JCAE 23rd June 1958 reprinted in Senate Report no.2370, August 14th 1958. US Code and Congressional and Administrative News, 85th Congress, 2nd Session 1958, v3.

150 This is quoted in ibid. p.4308.

151 Donnelly op.cit. p.103.

152 US Code and Congressional and Administrative News, op.cit. p.4307.

153 Nau op.cit. p.135.

154 See Donnelly op.cit. p.99 and Naw op.cit. p.134.

155 This is noted in Strauss's letter US Code and Congressional and Administrative News, op.cit. p.4300.

156 Nau op.cit. pp.139-141.

157 ibid. p.135.

158 Quoted in Donnelly 1972, op.cit. p.107.

159 ibid. p.96.

160 The extent of the linkages in the initial period is described in Nehrt op.cit. But for a later snapshot of US corporate penetration consult Nuclear Power in Europe, Foratom 1974 which details all the corporate linkages.

161 Nau op.cit. p.133-4.

162 See Nehrt op.cit. p.119.

163 ibid. p.121.

164 Donnelly 1972, op.cit. p.96.

165 Nau op.cit. p.133.

166 According to Scheinman "While relatively little information about these arrangements is available, it does appear that some ... licensees in different countries have been precluded from merging." See Scheinman, op.cit. p.289.

167 However, interviews with General Electric staff suggested that such prohibitive clauses were not included in GE's nuclear licensing agreements.

168 On this see Nau op.cit. pp.142-5.

169 This is discussed by ibid p.143 and in more detail by Scheinman L. 'Euratom: Nuclear Integration in Europe', International Conciliation No.563 May 1967 pp.39-48 (hereinafter referred to as Scheinman (1967).

170 This was because of the size and nature of the plant which increased construction costs, a significant component of initial capital outlay. On the relative economics of the systems, see Timm op.cit.

171 See Nau op.cit. p.144.

172 ibid. p.145.

173 ibid. p.152

174 For the details of all these various enticements see: AEC Annual Report 1959, op.cit. p.109; McKinney op.cit. v2, p.408; Donnelly 1972 op.cit. p.120-3.

175 Under pressure from the State Department and the AEC Germany classified its enrichment technology research in 1960, Nau op.cit. p.132.

176 See Scheinman, op.cit. p.295 and Nau op.cit. p.131-2.

177 Nau ibid. p.135.

178 See Patterson W. Nuclear Power Penguin, London 1976.

179 Trilateral arrangements whereby the USAEC handed over inspection responsibilities to the IAEA did not come into force until 1963 at the earliest. Interviews with former AEC and State Department officials also confirmed the safeguarding role of the AEC continued until the mid to late 1960's.

180 This is explained by Kratzer who remarks that because of the anticipated difficulty in establishing the IAEA the US used bilateral channels of co-operation to give substance to the atoms for peace programme. However, it seems unlikely, as Kratzer also agrees, that the AEC ever envisaged the Agency as a substantial channel of nuclear supply. See Kratzer M.B. 'Nuclear Cooperation and Non-Proliferation' Atomic Energy Law Journal v17, no.4, 1976, pp.250-288.

181 Scheinman, op.cit. p.283.

182 It was not until the early 1970's that a major debate occured on whether or not plutonium from commercial reactors could be used to manufacture a nuclear weapon. Until then the prevailing opinion in industry and government was that it could not. But a significant debate flared in the 1970's. This was not in any sense settled but most scientific opinion, by the mid-1970's, had come to accept that it was possible. See Lovins A. 'Nuclear weapons and power-reactor plutonium' Nature, no.283, 1980, pp.817-823.

183 This was confirmed by interviews with ex-State Department, ACDA and AEC officials all of whom emphasized that a common assumption which penetrated all their organizations was that commercial nuclear power had little proliferation potential, as long as safeguards were in place. Interviews with various officials.

184 More details can be found in Duffy op. cit.

185 Walker and Lonroth op.cit. p.34.

186 The reasons for this apparent shortfall are explained in US GAO Allocation of Uranium enrichment Services to Fuel Foreign and Domestic Nuclear Reactors ERDA Department of State, Report by the Comptroller General Washington DC March 4th 1975 ID-75-45 Chapter 2 (hereinafter referred to as US GAO ID-75-45).

187 see Nau op.cit. p.151.

188 See US Department of State Report of the Advisory Committee on US Policy Towards the International Atomic Energy Agency May 19th 1962 (hereinafter referred to as the Smyth Report). The publication of the report was followed by JCAE hearings during which the proposed changes in US policy were reviewed in detail. See US Congress JCAE Hearings United States Policy Toward the International Atomic Energy Agency 87th Congress 2nd session 1962 US GPO Washington DC (hereinafter referred to as Smyth Report Hearings 1962).

189 As the report concluded "We believe that various circumstances now combine to give the Agency considerable promise of future usefulness". See Smyth Report op.cit. p.1.

190 The report recommended that '... activities now being conducted under existing bilateral agreements should be transferred to Agency auspices wherever practical.' ibid. p.2.

191 Kratzer notes that the report invigorated US policy towards the Agency and a determined effort to trilateralize cooperation agreements was initiated. See Kratzer op.cit...

192 Interview with State Department official.

193 ibid.

194 Interview with ACDA official.

195 See Baker op.cit. p.12.

196 Scheinman op.cit. p.283.

197 See Smyth report Hearings 1962 op.cit. p.20.

198 This is noted by Scheinman op.cit. p.290 and Baker op.cit. p.22. Nuclear exports, although small in revenue terms (approaching $225m in 1970) were expected to grow tremendously to a level greater than aerospace exports, then the highest high technology export earner. See US AEC The Nuclear Industry 1971 Washington DC 1971 Wash 1174-71 (hereinafter referred to as Wash 1174-71) pp.6-8.

199 These figures are taken from US GAO US Financial Assistance in the Development of Foreign Nuclear Energy Programs Report by the Comptroller General Washington DC May 23rd 1975 ID-75-63 (hereinafter referred to as ID-75-63) pp.23-4.

200 ibid. p.22.

201 ibid. p.23.

202 ibid. p. 22.

203 Figures calculated from ibid p.22-3.

204 See Duffy op.cit. p.58.

205 Figures calculated from ID-75-63 po.cit. pp.14-6.

206 These included Japan, Brazil, Spain, India, Pakistan and Yugoslavia.

207 Details can be found in ID-75-63 po.cit. p.12.

208 Scheinman op.cit. p.289.

209 The evidence for this is also that in the 1970s when the Europeans began to construct their enrichment facilities the JCAE sought to increase enrichment prices on the basis that they were subsidizing prospective foreign competitors. See Scheinman op.cit. and 'Hosmer warns would be enrichers' Nuclear Engineering International May 1969 p.371.

210 See the discussion in Chapter 3 section 3.2.

211 This was evident from the privatization debate in the US where despite considerable government incentives private industry refused to be committed to any substantial investment in the enrichment sector.

212 Canada was unique in the export market. For an examination of their export activities see Duffy op.cit. and Walker and Lonroth op.cit.

213 The details of such programmes are described in ID-75-63 op.cit. p.18 and further examined in Long. D 'Nuclear Proliferation: Can Congress Act in Time?' International Security v2. 1977 Spring p.58.

214 For an examination of the implications of this see Chapter 5

215 A description of the administrative structures for regulating and promoting nuclear power in most western european states can be found in Nau op.cit. Ch.3.

216 On the strength of this organizational culture in the nuclear industry and its transnational dimension see Camilleri op.cit. pp.9-16, and Ch.7.

217 For instance the engineering standards used were those of the IEEE and the AECs safety standards were almost universal for LWRs.

218 See earlier discussion.

219 Opening remarks of Senator Stevenson in Hearings Exports 1974 op.cit. p.1.

220 ibid.

221 Interviews with former AEC and State Department officials.

222 For a detailed disussion of the regulatory framework see: Nehrt op.cit.; Donnelly 1974 op.cit.; and Wash-1163 op.cit.

223 The other requirement was that the export had to be judged not to be inimical to the common defense and security of the United States. This was largely interpreted to mean there had to be a cooperation agreement in force. See Code of Federal regulations 110, Donnelly op.cit. and Wash-1163 op.cit.

224 Most other states had cooperation agreements with the US.

225 The AEC had inspection rights, the right to approve reprocessing and retransfers of any materials and some say in physical security.

226 Interview with former State Department and AEC official.

227 See Section 57 Atomic Energy Act of 1954 and Code of Federal Regulations 10 CFR 110 Unclassified Activities in Foreign Atomic Energy Programs. Basically the regulations noted that '...any activity which: (i) Constitutes directly or indirectly engaging in the production of special nuclear material in any foreign country other than countries or areas now ...listed ... and (ii) does not involve the communication of restricted data or other classified defence information; and (iii) is not in violation of other provisions of law; will not be inimical to the interests of the US and is authorized by the AEC.' This stood unamended until 1972.

228 See Section 110,10 (b) of ibid.

229 Interviews with former AEC officials.

230 Interview with former AEC official.

231 See Hearings Exports 1974 op.cit.

232 This became a major issue in hearings on various cooperation agreements in 1966. For background and a full discussion of this particular loophole see: US Congress Hearings JCAE International Agreements for

Cooperation 1966 89th Congress 2nd Session January, June, August 1966 US GPO Washington DC 1966 pp.186-191, (hereinafter referred to as Hearings Cooperation Agreements 1966).

233 ibid.

234 See Donnelly (1976 i) op.cit. p.10.

235 Although not to states in the communist bloc since this would contravene the requirements of the Export Control Act and the Cocom guidelines.

236 On this see Wonder op.cit. Ch.1.

237 Interview with former AEC official.

238 On these developments see Donnelly 1974 op.cit. and Hearings Exports 1974 op.cit.

239 See amended Code of Federal Regulations 10 CFR 110 1973.

240 Interview with former AEC official.

241 See Vogel op.cit.

242 The 1970s witnessed considerable opposition to the actions of US multinationals. Congress became particularly active in attempting to curb their activities. There were numerous sets of hearings and a sub-committee, of the Senate Foreign Relations Committee, was established specifically to deal with multinationals. See Barnet R.J. and Muller R.E. Global Reach Simon and Schuster New York 1974.

243 This in fact was AEC policy and in hearings in 1974 the Commission noted that its job was to promote US nuclear industry abroad. Moreover it noted that the US had no controls over corporate licensing arrangements abroad in any field of industrial activity ipso facto they should not be applied in the nuclear energy sector. See Hearings Exports 1974 op.cit. pp.35-36.

244 ibid. pp.29-30.

245 The problems of extraterritorial application of US laws is discussed more fully in: Behrman J.N. National Interests and the Multinational Enterprise: Tensions among the North Atlantic Countries Prentice-Hall N.J. 1970 and Litvak I.A. and Maule C.J. 'Conflict Resolution and Extraterritoriality' Journal of Conflict Resolution v.13. n3. 1969 pp.305-319.

246 The US had tried to prevent US corporations from supplying France with computer equipment for its nuclear weapons programme for example. See Scheinman op.cit.

247 Donnelly 1974 op.cit.

248 The broader framework of export control legislation as it applied to nuclear exports is discussed in Hardt John P Export Controls CRS Issue Brief IB75003 February 10th 1975.

249 Interviews with former AEC and State Department officials.

250 There were problems for instance over dual use items which could have both a nuclear and non-nuclear role, e.g. computer equipment. See Hearings Exports 1974 op.cit. p.34-37.

251 Interviews with former AEC and State Department officials.

252 No exports of reprocessing technology were ever made, however. The regulations and procedures are discussed in Wash-1163 op.cit. and Donnelly 1974 op.cit. and see 'Statement of Facts on Nuclear Export Licensing' prepared by the GAO February 1976 reprinted pp 882-889 in US Congress Hearings Export Reorganization Act of 1976 94th Congress 2nd Session january and March 1976 US GPO Washington DC 1976 (hereinafter referred to as Hearings Export Reorganization 1976).

253 Interviews with former AEC and State Department officials.

254 ibid

255 In fact it was largely done by telephone. Interviews with former AEC and State Department officials.

256 See Hearings Exports 1974 op.cit. p.114 especially. Interviews with former AEC and State Department officials.

257 ibid

258 In fact once the assistance came to an end in the 1970s US industry found it could not complete with foreign industry in the export market. See Walker and Lonroth op.cit. Ch.1.

259 A complete overhaul of the administration of export control was made in 1975 following the public and internal debate of 1974. However, the reforms were largely precipitated by the abolition of the AEC and its replacement with the NRC and ERDA. Interviews with various State, NRC, AEC officials and representatives of industry.

260 For an evaluation of developments in 1974 and the impact of the Indian test see: Donnelly W.H. 'Congress and Nuclear Safeguards' Paper prepared for an AIF Workshop October 23rd 1974 (mimeo), (hereinafter referred to as Donnnelly 1974 (ii).)

261 ibid.

262 For details of the Indian test and the source of the materials see: Kapur A. India's Nuclear Option, Praeger New York 1976.

263 See Donnelly 1974 (ii) op.cit.

264 ibid. p.7-8.

265 See the comments of Senator Stevenson in his opening remarks to the 1974 hearings. See Hearings Exports 1974 op.cit. p.1-2.

266 There were three reports all highly critical of existing practice and calling for considerable reforms. The reports were: US GAO Improvements Needed in the Program for the Protection of Special Nuclear Material November 7th 1973 B-164105.
US GAO Protecting Special Nuclear Material in Transit: Improvements Made and Existing Problems April 12th 1974 B-164105. US AEC The Threat

of Nuclear Theft and Sabotage - Safeguards Report Reprinted in the Congressional Record April 30th 1974 (hereinafter referred to as the Rosenbaum report after its author).

267 The importance of this Congressional - Executive tussle over the control of foreign policy was an important influence on the developments in this period. See Brenner M.J. Nuclear Power and Non-Proliferation Cambridge University Press Cambridge 1981. Ch.1 pp.242-5.

268 See ibid Ch. 1 & 3.

269 See Donnelly 1974(ii) op.cit. plld/e.

270 See Brenner op.cit. and ibid.

271 ibid.

272 ibid.

273 Changes were made to the regulations concerning technology exports and to the procedures with respect to all nuclear exports, including dual use items.

274 Interview with industry spokesperson.

275 See Walker and Lonroth op.cit. Ch.2.

276 An excellent survey of the competitive position of the US nuclear industry in the mid 1970s is to be found in the Barber report from which these figures were drawn. See p.C-6. LDC Nuclear Power Prospects 1975-1990: Commercial, Economic and Security Implications. A report prepared for ERDA by R.J.Barber Assoc. ERDA-52 Washington DC 1975 (hereinafter referred to as the Barber report).

277 ibid, p.C-5.

278 ibid

279 The US refused to assist the Indians develop a reprocessing capability.It was the proposed sale of reprocessing technology to Japan by French and British firms, with American corporate involvement (AMF and Vitro Corps), that initiated a policy debate about how such sales

were to be safeguarded. See Hearings Cooperation Agreements 1966 op.cit. pp.186-191.

280 AEC Assistant General Manager for International Activities John Hall told the JCAE that the AEC was conducting "A review of exports from the United States ... to assure that important specialized items of equipment specially developed or intended for use in chemical processing plants will be exported only pursuant to agreements including safeguards". ibid. In effect the problem was that if the technology was replicated in Japan in an indigenously constructed facility safeguards would not have to be applied unless US material was processed in that facility or the Japanese government voluntarily placed it under Agency safeguards.

281 As noted previously enrichment technology was gradually declassified from 1971 onwards.

282 see Barber report op.cit. pp.18-19.

283 In fact a positive decision was taken to continue to supply non-NPT signatories on the basis that it was expected that a number of allied states i.e. Germany and Japan might not ratify the treaty. Moreover there was also the commitment to a reliable supplier policy and the belief that cutting off exports to non-NPT parties would encourage indigenous construction of unsafeguarded facilities. Interviews with former AEC and State Department officials.

284 See ERDA-1542 v.1. op.cit. 4-9

285 France, Germany, Belgium, Japan, Italy, India, Argentina, Spain and later Brazil, Taiwan, and South Korea, had plans for either indigenous reprocessing or enrichment facilities.

286 The changes in world market conditions and the competitive position of the US nuclear industry is discussed in Walker and Lonroth op.cit. 2 & 3.

287 See Barber report op.cit.

288 The case of the German-Brazalian deal is instructive here for it was won against American competition. See Lowrance W.W. 'Nuclear Futures for Sale: To Brazil from West Germany' International Security v.1. n.2. Fall 1976 pp.147-166.

289 On this see Camilleri op.cit. pp.244-248.

290 Baker op.cit. p.26.

291 See Smith D. 'What Price Commercial Enrichment?' Nuclear Engineering International July 1974 and Baker op.cit. p.23. The AEC could meet projected demand into the eighties only if plutonium recycle were authorized. According to Barber the critical year would be 1983 when demand would begin to outstrip supply. Barber report op.cit. p.C-5.

292 For the background on these ventures see Camilleri pp.197-200.

293 See Smith op.cit.

294 Baker op.cit. p.23.

295 Scheinman op.cit. p.299.

296 In fact the Sierra Club had taken the AEC to court in 1974 and won its case that the Commission provide an environmental impact statement on its nuclear export programme. Environmental groups were resorting to legal action, as they had done with respect to the domestic regulation of nuclear power, to impose environmental restrictions on nuclear exports and to gain the right to intervene in decisions on export matters. See Rubin L. 'Whether the NRC should be required to file an EIS' CRS March 25th 1975 (mimeo) and Testimony of Eldon Greenberg pp.225-337 in Hearings Export Reorganization 1976 op.cit.

297 This was the argument put forward by the AIF & industry.

298 On the politics of the Agency's formation see:
Bechhoefer B. G. & Stein E. 'Atoms for Peace: The New International Atomic Energy Agency', Michigan Law Review, v.55 April 1957, no.6, pp.747-798 and Bechhoefer B. G. 'Negotiating the Statute of the

International Atomic Energy Agency', International Organization, v.13 1959, pp.38-59.

299 Smyth Report op.cit.pl.

300 ibid

301 ibid, p.5.

302 ibid, p.2.

303 ibid.

304 This can be seen in the debates surrounding the IAEA Participation Act see Donnelly, 1972, op.cit. p.51-2.

305 Hearings Smyth Report, 1962, op.cit. p.20.

306 ibid, p.16.

307 The details are covered in Schiff, op.cit. p.100.

308 Smyth Report op.cit., p.2.

309 ibid, p.7.

310 In fact the US had been involved in discussions with Japan since 1961 following its request to have safeguards responsibilities transferred to the Agency. See 'Breakthrough for International Safeguards', IAEA Bulletin, V.6, no.1, January 1964, p.13.

311 Baker paraphrases Dulles's arguement before the JCAE that the IAEA was essential since sovereign nations would not long tolerate inspections by the US. Baker op.cit. p.13.

312 Hearings Smyth Report, 1963, op.cit., p.14.

313 ibid.

314 ibid, p.20.

315 US AEC 'US, Japan and IAEA Sign Agreement to Give Agency Responsibility for Nuclear Safeguards', F-189, Sept. 23rd 1963.

316 Except for the Euratom agreement which was policed by Euratoms own inspectorate. This was to be a source of friction between the US and

Euratom countries in the negotiations over the NPT since the US desired a universal system of safeguards. See Donnelly 1972, op.cit. ppl50-152.

317 The US contribution to the Agency in this period is discussed in: US GAO Role of the International Atomic Energy Agency in Safeguarding Nuclear Material, July 3, 1975, ID-75-65 (Hereinafter referred to as ID-75-65) pp.2-3.

318 For an examination of US policy towards the Agency, from which these figures have been taken, consult: Donnelly, W. H., Nuclear Weapons Proliferation and the International Atomic Energy Agency, Report prepared by the CRS US GPO Washington DC, March 1976 (Hereinafter referred to as Donnelly 1976) p.61.

319 See ID-75-65 op.cit. p.3.

320 ibid. p.24.

321 ibid.

322 See Schiff op.cit.ch.4.

323 On these see ID-75-65 op.cit. ch.4.

324 See Donnelly 1976 op.cit. p.92-3.

325 The report recommended that: "The United States Government should reaffirm...by continuing action its vigorous support of the ... Agency especially because of its critical role in the carrying out of the provisions of the Treaty on the Non-Proliferation of Nuclear Weapons." Quoted in Donelly, ibid. p.92.

326 Donnelly notes that the report '...anticipated a substantial role for the Agency to serve as expert, objective, international advisor and arbiter on matters involving the use of nuclear energy and trade in nuclear materials.' ibid.p.95.

327 see ibid.

328 For the details of safeguards evolution and negotiation see Schiff op.cit. ch.3.

329 See Willrich and Taylor T.B., Nuclear Theft: Risks and Safeguards Ballinger, Boston, Mass., 1974, p.188.

330 See Kratzer, op.cit.

331 See Crowson, D. L. 'US Safeguards Overview' in Althoff G. ed. Preventing Nuclear Theft: Guidelines for Industry and Government, Praeger, New York, 1971, p.34.

332 For instance the Lumb report in 1967 clearly fed into later discussions about NPT safeguards.

333 See the Rosenbaum report op.cit. and ID-75-65 op.cit.

334 Schiff op.cit. p.102.

335 Except for the problem of Euratom, although the US did attempt to pressure it into accepting some arrangement with the Agency. See Pendley, R. and Scheinman, L. 'International Safeguarding as Institutionalized Collective Behaviour', International Organization, v.29, Summer 1975, pp.585-616 and Donnelly 1972, op.cit., p.139-140, 151.

336 On this offer see ibid and Bader, W. B. The United States and the Spread of Nuclear Weapons, Pegasus, New York, 1968, pp.120-121.

337 Baker, op.cit. p.13.

338 See Kratzer op.cit.

339 The GAO pointed out the merits of Agency safeguards in terms of their legtitimacy, uniformity, cost and credibility. See ID-75-65, p.7.

340 ibid

341 See Smyth report op.cit. Also interviews with ACDA officials.

342 Quoted in Baker op.cit. p.13

343 See Camilleri op.cit. pp72-3.

344 Ibid p.73.

345 Bader, op.cit., pp.120-121.

346 For the background to and history of the NPT see Epstein, W. The Last Chance, Free Press, New York, 1976, Chs 4 and 5.

347 See Smith, R. K. 'Explaining the Non-Proliferation Regime', International Organization, v.41, no.2, Spring 1987, pp.253-282.

348 On this military cooperation see Simpson, J. The Independent Nuclear State, MacMillan, London, 1981.

349 Bader, op.cit. p.100.

350 The development and the demise of the MLF policy is analysed in great detail in Steinbruner J., The Cybernetic Theory of Decision, Princetown University Press, Princeton, 1974.

351 See Bader, op.cit. pp.46-9.

352 Ibid, p.48.

353 Ibid, p.49-50.

354 Ibid, pp.64-5.

355 Ibid, p.59.

356 Interviews with former AEC and State Department officials.

357 For a thorough discussion of the problems created by Euratom safeguards and commercial interests see: Jensen, L. Return from the Nuclear Brink, Lexington, New York, 1974 and Donnelly, 1972, ch.11.

358 See Donnelly ibid, pp.139-140, 150-152.

359 Ibid, p.138. The President also offered to put the Nuclear Fuel Services reprocessing plant at West Valley under safeguards, see Nuclear Engineering International, June, 1966, p.424.

360 See Baker, op.cit. p.29-30.

361 Ibid, p.32.

362 Interviews with former AEC and State Department officials.

363 Schiff, op.cit., p.80.

364 See Smith, op.cit., p.269. Camilleri agrees noting that America's relative decline led to a "...destabalising [sic] transition from the politics of **hegemony** to the politics of **imperial riivalry.**" See Camilleri, op.cit. p.289.

365 See Kratzer op.cit.

366 See Donnelly 1972 op.cit. p.156.

367 This was the conclusion of the Barber report op. cit. pp.xv-xvii.

368 Baker op.cit. p.30.

369 See Bader op.cit. pp.64-5 for the early emphasis on political motivations and Willrich and Taylor op.cit. Ch.2 and 3, on the gradual shift to technological capabilities as a crucial indicator of potential proliferation problems.

370 See Wonder op.cit.

371 See Kratzer who notes that "... the US has pursued ... from the outset of the cooperation programe, a policy of seeking agreement among nuclear suppliers on the need to ensure that these supply arrangements do not foster proliferation." Kratzer op.cit.

372 See Hearings International Agreements 1966 op.cit. pp.186-191.

373 For example, there was no requirement for non-NPT parties to impose safeguards on their exports.

374 See Schiff op.cit. p.142.

375 See the Barber report op.cit.

376 The details of the negotations and the list are covered in Schiff op.cit. pp.142-3.

377 See ID-75-65 op.cit. p.30.

378 On the emergence and politics of the NSG see: Mandelbaum M. 'A Nuclear Exporters Cartel' New Scientist, January 1977, pp.42-50; and Baker S.J. 'Monopoly or Cartel?' Foreign Policy no.23. Summer 1976 pp.201-220.

379 On this see Lowrance op.cit.

380 As Schiff notes 'The NSG was thus successful at reaching agreement on safeguards to be required with nuclear exports.' Schiff op.cit. p.144.

381 Many perceived US actions as commercially motivated. See Gall N. 'Atoms for Brazil' Foreign Policy, No.23. 1976 pp.155-200.

382 For an excellent discussion of these issues see Wonder op.cit.

383 This is discussed in Gallucci R.L. Fission in Atlantic Politics: Non-Proliferation, Nuclear Energy and the Europeans, Draft 1978 (mimeo), pp.11-14.

384 See the comments of Hosmer (chair of the JCAE) in Nuclear Engineering International May 1969 p.379 and also Wonder op.cit. ch.1.

385 This is noted in Wash-1174 1971 op.cit. p.33 and Nuclear Engineering International December 1970.

386 See Wash-1174 1971 ibid.

387 For a comprehensive examination of the relationship between US foreign and domestic policy on this issue consult Wonder op.cit. Ch.2.

388 Gallucci op.cit. p.14.

389 Wonder op.cit. Ch.3.

390 For the Japanese testimony see US Congress JCAE Hearings Future Structure of the Uranium Enrichment Industry Part 2 Phase 2 - Industry witnesses 93rd Congress 1st Session October 1973 USGPO Washington DC 1973 (hereinafter cited as Hearings Enrichment 1973), pp.249-252.

391 See Wonder op.cit. Ch.4.

392 ibid. also ch.3.

393 Gallucci op.cit. p.15.

394 The details of these developments are discussed in ID-75-45 op.cit. Ch.2

395 ibid p.7.

396 See Smith 1974 op.cit.

397 Ikle's speech is reprinted in the Department of State Bulletin October 21st 1974 pp.543-547.

398 Schiff notes that discussions within ACDA had been going on for some time. See Schiff op.cit. p.148.

399 For the details on this consult Schiff ibid. pp.148-150.

400 This is reflected in Brenners examination of US policy in this period. See Brenner op.cit. Ch.2.

401 In a major address to the UN in September 1974 Kissinger raised the issue of proliferation by noting that 'heretofore the United States and of other countries have widely supplied nuclear fuels and other nuclear materials in order to promote the use of nuclear energy for peaceful purposes. This policy cannot continue if it leads to the proliferation of nuclear explosives. Sales of these materials can no longer be treated by anyone as a purely commercial competitive exercise. The world community therefore must work urgently toward a system of effective international safeguards ... The United States is prepared to join with others in a comprehensive effort.' The whole speech is reprinted in The Department of State Bulletin v.71, October 14th 1974 pp.498-504.

402 See IAEA Regional Nuclear Fuel Cycle Centres: IAEA Study Project September 1975 75-6977.

403 See Donnelly 1974 (ii) op.cit.

Chapter Five - The Politics of American-Japanese Civil Nuclear Relations: 1954-1974

Writing about the nature of the contemporary world economy Wallerstein makes the rather sweeping, but nonetheless profound, statement that '... national (sic) states are not societies that have separate,parallel histories, but are parts of a whole.' (1) Even the most cursory examination of the evolution of the Japanese civil nuclear power programme could not resist the conclusion that Wallerstein's generalization is an apt description of the modern world. For, as this chapter hopes to demonstrate, the history and politics of Japan's civil nuclear power programme is to an unprecedented degree inseparable from developments in the foreign and domestic nuclear policies of its dominant nuclear partner across the Pacific, the United States.

From the initiation of the Atoms for Peace programme to the commercialization of nuclear power in Japan, technological and commercial dependence upon the United States, and its nuclear industry, has been one of the most powerful forces shaping the character and orientation of the nation's foreign and domestic nuclear policies. This is not to discount the equally significant role of domestic political and industrial factors, nor should it be taken to imply that the evolution of Japan's nuclear policies can be explained solely as if they were contingent upon its nuclear relationship with the United States. As the chapter will seek to clarify the relationship has been a complex and dynamic one; it has exhibited elements of both conflict and co-operation; and it has reflected a constant, underlying struggle between the constraints imposed upon Japan's autonomy by its dependent position and its desire for greater self-determination in nuclear matters. Nor has it been simply Japan's bilateral nuclear relationship with the United States which framed its

nuclear development. Its integration into the gradually evolving international nuclear non-proliferation regime, sponsored and promoted by the United States, also has had significant ramifications for its domestic and foreign atomic policies.

This chapter seeks to explore three particular aspects of Japan's location in the international nuclear order. It will examine how far the evolution of the domestic structure of promotion and control of the civil atom in Japan has been shaped by external forces. This will embrace the issue of the complex interface between Japan's development of civil nuclear power and dependence upon American nuclear technology and fuel supplies. Intimately connected with this is a second area of enquiry: an investigation of some of the identifiable ramifications for Japanese domestic and foreign atomic policy arising from the structure and character of bilateral nuclear co-operation with the United States. Finally, the chapter will seek to explain the nature of the challenges to Japan's autonomy, and its progressive engagement with the international nuclear non-proliferation regime.

In investigating these particular issues the chapter is organized into four major sections. The first describes rather briefly Japanese domestic political and administrative arrangements in the nuclear sector, patterns of nuclear policy making, and the development of its nuclear power programme. This is followed by an examination of the structure and mechanisms of bilateral co-operation with the United States. Emerging out of this is an analysis of the ramifications of bilateral co-operation with the United States. A penultimate section deals with the interconnections between the evolution of the international nuclear non-proliferation regime and the orientation of Japan's foreign and domestic nuclear policies. The chapter is concluded by an overview which focuses upon some of the significant conceptual issues raised by the nature of nuclear co-operation between the United States and Japan.

5.1 The Domestic Structure of Nuclear Power Development in Japan

Japan's extreme dependence on imported energy has been a constant consideration in the state's promotion of nuclear power as a strategic energy source. Though at times the state's commitment to nuclear power may have suffered from a temporary lack of enthusiasm it is undoubtedly the case that both historically, and in comparative terms, that commitment has been (and remains) unquestionably stronger than in any other Western nation, apart perhaps from France. From the very earliest days of its development, nuclear power has been conceived by successive governments as a technological solution to the nation's acute energy predicament and therefore essential to its long term economic security as a primarily export manufacturing economy. Consequently, it seems sensible to commence by sketching out the rationale behind the state's attachment to nuclear power before progressing to a more substantial exploration of the organization and development of Japan's commercial nuclear power programme.

5.1.1 Japan's Energy Dependence 1954–1974

In the immediate post-war period up to the early 1970s the Japanese economy experienced phenomenal economic expansion. Levels of economic growth exceeded 11% per annum and only slowed in the period following the oil crisis in 1973.(2) Exports grew dramatically too and Japan's share of world trade increased from 1.5% in 1957 to over 6% in 1977.(3) But the very success of 'Japan inc.', as Kahn referred to it, also revealed its extraordinary vulnerability. For the export led growth, on which its economic vitality depended, was contingent upon the availability of cheap and secure supplies of energy, in particular, oil. Since there were negligible supplies of indigenous energy resources Japan's dependence on energy imports increased with every increment of industrial expansion. (See Table 5-1). Its vulnerability to external disruption in energy supplies therefore increased dramatically over the period 1945 to 1974. And in 1973

Table 5-1 Energy Import Dependence

(Million tonnes coal equivalent)

	1955	1960	1965	1970
Total Energy Consumption	65.8	108.6	174.6	332.4
Imports				
Coal	2.9	8.3	17.1	50.3
Oil	9.5	35.2	92.3	221.4
Gas	-	-	-	1.7
Total Imports	12.4	43.5	109.4	273.4
Import Dependence %	18.8	40.0	62.7	82.3

Source: Adapted from Table 2 in Surrey J. 'Japan's uncertain energy prospects' Energy Policy V2. No.3 September 1974 p.216.

the worst possible scenario became reality: an oil embargo coupled with a three-fold increase in the price of oil.

Economic planners in the powerful Ministry of International Trade and Industry (MITI) were, from the 1950s, well acquainted with the nation's increasingly problematic energy predicament. Indeed it was reluctantly accepted that a lack of indigenous energy resources combined with an economic strategy which required "... a high energy economy capable of processing and then reselling imported raw materials" would necessarily entail a high level of dependence on energy imports. (4) With virtually no oil reserves and relatively small, but also extremely expensive coal reserves, there were few options open to them other than to accede to increased energy imports. (5) Throughout the late 1950s and 1960s the economy therefore became increasingly reliant upon relatively cheap supplies of oil, almost solely from the Middle East. (See Tables 5-2 and 5-3). This despite the fact that the Suez crisis in 1956 had alerted the the planners to the need for diversity in supply arrangements.

Whilst total energy consumption grew rapidly in the period 1945-74, electricity consumption grew somewhat faster averaging an almost 12% per annum increase in the years 1960-72. (6) This was largely because the structure of the economy, which was geared to high energy consumption industries such as steel and chemicals, demanded it. Although there was ample scope for developing the nation's hydroelectric resources it was recognized in the 1950s that these would never be sufficient to keep pace with predicted electricity demand. (7) Consequently, whilst an extensive investment was made during this early period in constructing hydroelectric stations, planners in MITI sought alternative means of electricity generation. With relatively cheap oil available the utilities, with government assistance, invested massively in oil burning power stations. But even so electricity was far from cheap, in fact at 10 mills/kwh (in the 1960s) it was almost double the cost in the United States and 50% more than

Table 5-2

Increasing Dependence upon Oil 1955-1970

(All figures are %)

	1955	1960	1965	1970
Primary Fuels				
Oil	20.5	35.0	56.4	68.3
Coal	69.9	57.3	36.9	26.9
Hydro & Nucl.	9.1	6.8	5.1	3.2
Nat. Gas	0.3	0.9	1.5	1.6

Source: Adapted from Table 3 in Surrey J. 'Japan's Uncertain Energy prospects' Energy Policy V1 September 1974 p.217.

Table 5-3

Japan's Dependence on Middle East Oil 1966 and 1972

(Millions of kl)

	1966	1972
Total Oil Imports	104.16	243.85
Total from the Middle East	93.72	196.86
Middle East as a % of Imports	90.0	80.7

Source: Adapted from Table 4 in Surrey J. op.cit. p.217

the European average. (8) Nor did dependence upon oil for electricity generation alleviate the problem of security of supply. Only nuclear power seemed to offer a solution to the twin problems of security of supply and cost; it appeared to the planners in MITI as an efficient technological fix to the nation's energy predicament. As Wit remarked in 1956, reflecting the prevailing ethos within the state bureaucracy: "Japan's future character ... may well depend upon the early feasibility for her of atomic power." (9)

This early attachment to nuclear power was reinforced by official projections of massive growth in energy demand. Indeed in the 1950s official surveys pointed to energy shortages and insufficient electricity generating capacity by the early 1970s. (10) Since the lead times in investing in generating plant were of the order of 5–8 years, projections of future energy demand, however inaccurate they turned out to be, played a vital role in shaping official perceptions of the nation's energy predicament and actual policy decisions. What is common to the projections of the 1950s through to the 1970s, apart from a tendency to over-estimation, is the emphasis upon secular exponential growth and an increasing gap between total demand and indigenous energy production. Predictions of an expanding energy 'gap' did much to mold industrial and official attitudes to nuclear power. Nuclear power was very quickly regarded as a necessity not a matter of choice. Even though the planners in MITI recognized that nuclear power could not replace oil as the nation's main energy source they believed it offered a more secure, relatively cheaper, and more environmentally acceptable form of electricity generation. (11) Moreover, the Ministry of Finance saw nuclear power as one means of reducing the enormous foreign exchange costs of high oil imports, which by 1972 swallowed $5.7 billion of the nation's dollar earnings and accounted for over 24% of total imports. (12)

Given the lack of indigenous energy resources and projections of expanding energy demand Japan embarked upon an ambitous nuclear programme in 1957. (13) Whilst these plans were somewhat tempered in the early 1960s, by the availability of cheap oil and other factors, the state's commitment to nuclear power was not diminished. Successive government plans in 1961, 1967 and 1972 sought (and achieved) a strategic and expanding role for nuclear power in the energy sector. Moreover the oil crisis of 1973 acted to reinforce and confirm the strategic importance of nuclear power in the nation's energy plans. Indeed the nuclear policies of successive governments were vindicated and given added legitimacy by the actions of OPEC. Investment in nuclear power increased and by 1979 Japan ranked second in the world next to the United States in terms of nuclear power generation.(14) In just two decades Japan had been transformed from a nation with a clearly defined nuclear power programme but virtually no indigenous civil nuclear capability to fulfil it, into a nation which could boast considerable technological and commercial autonomy in the nuclear business. The obvious question is how was this transformation achieved?

5.1.2 The Structure of Policy Making in the Atomic Energy Sector

Contrary to much popular opinion Japan's research into harnessing the atom's power pre-dated the second world war. Nor is it widely appreciated that, throughout the war, the physics laboratories of the country's major universities were devoted exclusively to basic research into the manufacture of atomic weapons. (15) The allied occupation led to the termination of this research and instead scientific effort was re-orientated to studying the consequences of radiation exposture, in the aftermath of the bombings at Hiroshima and Nagasaki. When, in the early 1950s, the politicians came to evaluate the potential for civil nuclear power development they were able therefore to draw upon a considerable fund of indigenous scientific advice. Indeed, just as in the United States, the

scientists came to play a significant role in the creation of the administrative framework for the development and control of the civil atom.

When President Eisenhower launched his Atoms for Peace initiative in December 1953, Japan had not long regained its sovereign status. (16) Moreover, the newly 'democratized' system of government, established by the 1947 constitution, was effectively still in its infancy. (17) This greatly complicated and frustrated the initial task of establishing an administrative framework for the domestic control and development of the atom. This task was made more difficult by the experience of Hiroshima and Nagasaki, which more than anything else shaped public attitudes to the atom, making the question of atomic energy a highly emotive and highly controversial issue. In addition, the politicians were acutely aware that the outside world, particularly the Americans, had to be convinced that any atomic research in Japan was under firm civilian and democratic control. As in the United States, but perhaps even more so in Japan, the process of establishing a legitimate structure for the control and development of the atom was dominated by domestic and foreign policy considerations.

Even before the Atoms for Peace initiative the Japan Science Council, which had been established in 1949, began studies on the organization of atomic research and development. (18) The Council, which was a body representing scientific and academic opinion, concluded that "... research should be confined to peaceful uses only and be conducted democratically, independently and without secrecy." (19) These principles later came to inform the political debate about the proper organization of atomic energy development. The JSC's interest in atomic energy also persuaded the Diet (the national Parliament) to provide a special fund in the 1954 science budget for reactor development studies.(20) This was somewhat premature since there was then still no organization to carry out this research. Nonetheless this political activity created a very receptive environment for the American atoms for peace initiative. Within a month of President

Eisenhower's address to the United Nations politicians, industrialists, and scientists were busily engaged in formulating plans for the organization of an atomic energy programme.

In May 1954 the 'Preparatory Council for the Peaceful Uses of Atomic Energy' was established within the Cabinet to progress nuclear development studies. (21) But bureaucratic infighting within the executive, concerning control of the programme and the extent of government financial support, made progress torturously slow. However, the pace of decision making was somewhat quickened by growing political pressure from the Keidanren (The Federation of Economic Organizations - a body which represented the most powerful industrialists) the Diet, and the JSC for decisive government action. A public relations campaign was mounted throughout 1954 and 1955 largely under the sponsorship of the Keidanren Committee on the Peaceful Uses of Atomic Energy which was given much support by American corporate interests. (22) Following extensive consultation and negotiation between the bureaucracy, the Keidanren, the JSC, and the major opposition parties a bill was introduced into the Diet in the autumn of 1955 by the Chairman of the newly created Joint Committee on Atomic Energy. (23) But the failure of government and the JCAE to agree on some of the proposed clauses in the bill led to renewed discussions. A new 'compromise' bill was reintroduced on December 15th 1955 and was finally approved on December 18th. (24) It became effective on new Year's Day, 1956.

In analysing this early period in Japan's nuclear history Huff asserts that: 'From its beginning in 1955 the atomic energy program has been shaped to a much greater extent by administrative, budegetary, and foreign policy considerations than it has by technology in a strict sense.' (25) This is perhaps nowhere as evident as in the decision making with respect to the domestic organization and control of the atom. For although the nature of the technology imposed certain constraints upon the ultimate form that that framework of control could take the intensely political nature of the

process by which the Atomic Energy Basic Law came into being suggests that politics, rather than technology per se, had the upper hand in fashioning the final product. One of the most obvious manifestations of this is the unique (at the time only Germany had a similar requirement) legal limitation placed upon atomic research and development, restricting it solely to peaceful purposes, and the requirement that there be no secrecy surrounding the atomic energy programme; legal requirements which were later to create difficulties for co-operation with the US government and nuclear industry. (26) It is also manifest in the very organizational structure of development and control of the atom which directly reflects the particular form of the relationship between state and society in Japan. For example, the emphasis upon state control, direction and ownership contrasts markedly with the emphasis upon private enterprise in the 1954 Atomic Energy Act in the United States. Such differences, and also important similarities, will become clearer with a brief examination of both the general structure of control and development of atomic energy, as well as the key institutions established by the basic atomic energy law.

(i) The Administrative Structure

There are several government agencies (see figure 5-1) with responsibility for different aspects of nuclear power but the most salient is the Atomic Energy Commission.

The Atomic Energy Commission (JAEC)

The JAEC was established under the basic atomic energy law to "... plan, deliberate and decide on the matters related to the research, development and utilization of atomic energy." (27) Largely because of the political sensitivity of nuclear research and development the JAEC was located at the hub of governmental power, in the Prime Minister's office. The intention was that the Commission, whose Commissioners are appointed by the Prime Minister, should establish the broad framework of atomic energy policies but would essentially be a deliberative rather than executive body.

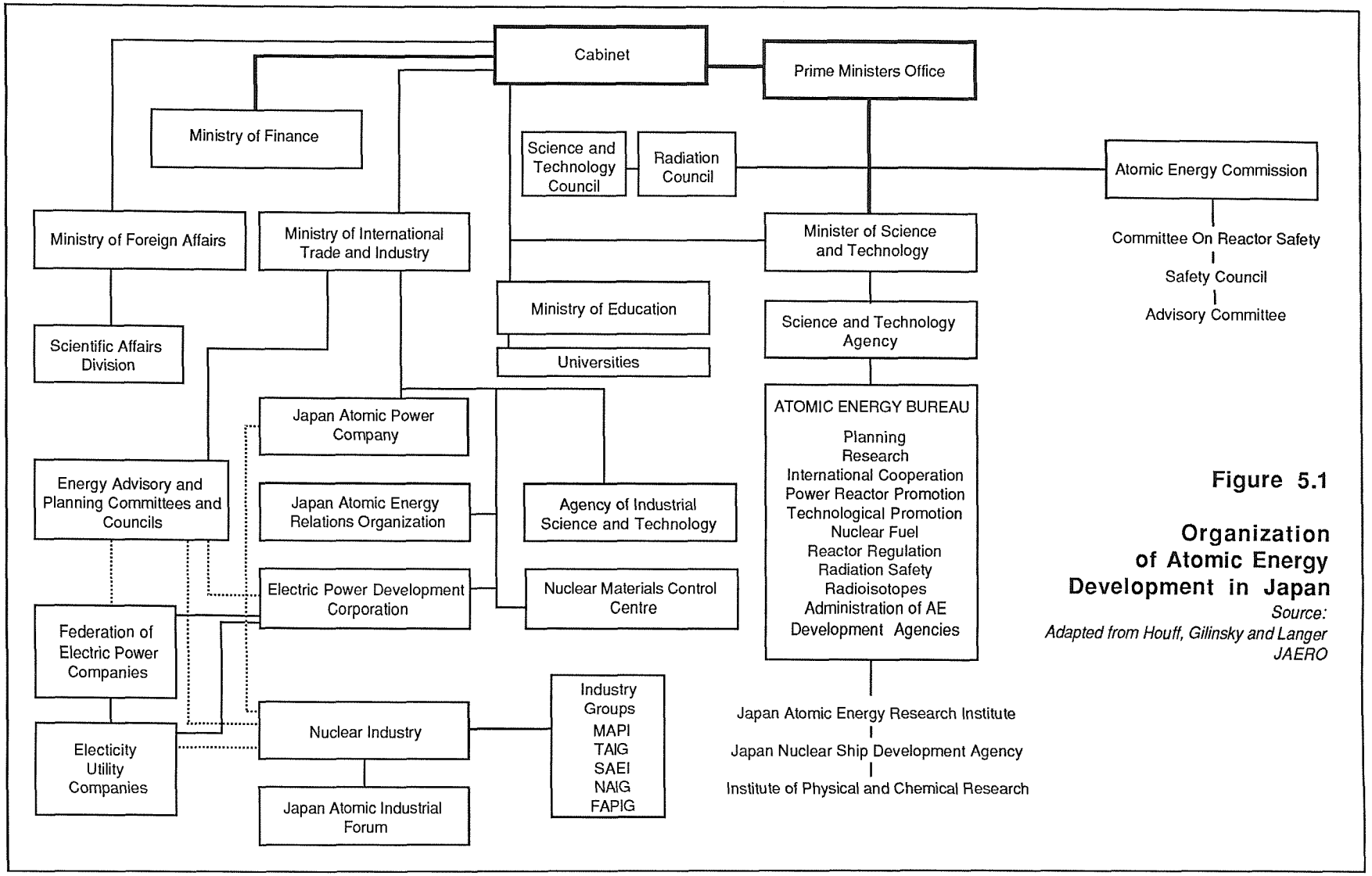


Figure 5.1

Organization of Atomic Energy Development in Japan

Source:
Adapted from Houff, Gilinsky and Langer
JAERO

Nonetheless it has a central role in the policy making process since it provides direct advice to the Prime Minister who is obliged to "... pay due consideration to it." (28) Given that the system of government is basically a parliamentary one (similar to that in the United Kingdom) formal access to the Prime Minister, who wields considerable power, gives the JAEC a privileged position in the hierarchy of administrative power. However, its quasi-independent status (which was a result of a political compromise between the bureaucracy which desired a purely advisory role for it and the Diet which desired a much more indepndent institution similar to the US AEC) limits its scope for autonomous action particularly since it is dependent on other government bodies for co-ordinating, administering and controlling the nuclear programme.(29)

To assist it in fulfilling its statutory role the JAEC, over the years, has spawned a range of advisory committees and councils. (see table 5-4). These have brought together experts from industry, government and academia to formulate policy on a range of technical issues. Such an ad hoc system has allowed the JAEC to draw upon the scientific and technological resources of the nuclear industry, thereby strengthening its position in bureaucratic struggles over particular policy issues. Moreover, the Commission itself has tended to be a representative body, its membership being deliberately chosen to bring together representatives of the major organized interests from industry, labour and science. (30) This is largely done to ensure that policies are formulated on the basis of consensus amongst the key organized interests in the nuclear sector.

The Atomic Energy Bureau (AEB) of the Science and Technology Agency (STA)

In the drive for post-war reconstruction the government recognized the strategic importance of science and technology. Consequently, it established the Science and Technology Agency, in March 1956, to co-ordinate and develop national policies with respect to promoting the industrial exploitation of science and technology. It was therefore quite

natural that when it was established a decision was taken to transfer the Atomic Energy Bureau, then located in the Prime Minister's office, to the STA. (31) (See figure 5-1).

The Atomic Energy Bureau of the STA plays a pivotal role in the formulation and administration of atomic energy policy. Not only does it act as the administrative arm of the JAEC, in essence its secretariat, but also it co-ordinates "... long range plans and research programs, compiling the research budget, and supervising national laboratories." (32) Moreover, it has formal links with the JAEC since the Minister of State for Science and Technology (a post with Cabinet rank) is also the commission's Chairman. (33) The AEB is the administrative nexus of the entire atomic energy programme.

The Ministry of International Trade and Industry (MITI)

Although the basic atomic energy law did not give MITI a formal role in determining atomic energy policy, in practice its jurisdiction over industrial and energy policy has accorded it a prominent role. It has responsibility for government policy with respect to the many joint public-private ventures in the energy sector, such as the Japan Atomic Power Company (see below) and Electric Power Development Company (see below). In addition through its various advisory committees and councils, which cover all aspects of energy and industrial policy and planning, it has a profound influence on the nuclear programme, from broad plans to specific projects. MITI is also one of the most powerful government departments since not only do most of its top officials 'retire' to the '...top echelons of every major corporation in Japan', including those in the electric and nuclear power industries but also many sit in the Diet.(34) It has a practice too of exporting officials to other departments by which means Chalmer s argues it has come to domina te the STA and AEB.(35) Finally, since it has an extensive menu of controls and

discretionary tools of intervention it has enormous potential influence, which it exercises, over the nuclear power industry.

The Ministry of Finance (MOF)

With jurisdiction over the state's budget the MOF has always had a significant role in shaping atomic energy policy. Through its budgetary powers and its responsibility for policy on foreign direct investment the MOF has come to have significant influence in determining the pace and character of the nuclear programme.

The Foreign Affairs Ministry (Gaimusho)

Gaimusho does not have a major role in the formulation of atomic energy policy except on those issues which have implications for Japan's foreign policy and diplomatic relations with other states. It does, however, have sole responsibility for relations with the IAEA and formally for the negotiation of cooperation agreements, treaties and similar inter-governmental arrangements. In practice policy with respect to bilateral cooperation with the US is largely dealt with by the International Cooperation section of the AEB. And foreign atomic policy is formulated and implemented jointly with the AEB since Gaimusho itself does not have the necessary 'in-house' expertise.

(ii) Public and Quasi-Public Corporations

The atomic energy law established several quasi-government corporations for developing the commercial atom.

The Japan Atomic Energy Research Institute (JAERI)

Established in May 1956 the JAERI is responsible for nuclear research and development in all areas of the civil programme. Following an intense political debate concerning the degree of autonomy to be accorded to it the JAERI was established as a wholly publically owned company but with control over its own personnel and budget. (36) Its major research institute is located in Tokai-mura.

The Japan Atomic Power Development Company (JAPCO)

JAPCO is a quasi-public corporation, the result of a fierce battle between private industry, allied with the private electric utility companies,and the government. The conflict was over the question of public or private development of nuclear power. A compromise was reached with the formation of JAPCO which has 80% private and 20% public capital, the governments share being controlled by the Electric Power Development Company (a public utility company). (37) JAPCO was established to import and operate the nation's first commercial power reactors.

The Power Reactor and Nuclear Fuel Corporation (PNC)

The PNC was formed in October 1967 to develop advanced reactor concepts and to develop nuclear fuel cycle technologies, such as reprocessing and enrichment.(38) It is a wholly owned government corporation administered by the AEB.(See figure 5-1).

The Electric Power Development Company (EPDC)

The EPDC was established in September 1952 to construct thermal power generating stations, largely hydro-electric, and supply the electricity to the nine privately owned electric utilities.(39) Through its relationship with JAPCO, and influence on investment in generating plant, it has acquired a significant role in the atomic energy policy making process. Its major shareholder is the government (74%) with the nine utility companies owning 26%.

(iii) Private Industry and Organized Interests

There are several major groups and organized interests in the private sector which are involved directly or indirectly in the formulation of atomic energy policy or are responsible for the development of commercial nuclear power.

The Japan Atomic Industrial Forum (JAIF)

Industry's enthusiasm for the rapid exploitation of nuclear energy in Japan led the Keidanren to establish the Atomic Energy Utilization Council, in

April 1955, to promote the development of a national nuclear programme. This body played an important role in the early deliberations on the atomic energy basic law. At one of its first meetings the JAEC therefore proposed the establishment of a more permanent industry organization modelled upon the US AIF.(40) In March 1956 the JAIF was incorporated with every assistance from the state. As the JAIF's own promotional literature states its major purpose is to:

> ...coordinate the views of industrial circles and makes (sic) representation to the Government, exchanges information with all related organizations in Japan and overseas, promotes the acceptance of nuclear power among the public..(41)

Because it represents the nuclear industry it has a prominent role in all areas of atomic energy policy making. Its officials sit on all the key consultative committees and councils established by the major administrative organs, the JAEC, AEB, and MITI.

The Federation of Electric Power Companies (FEPC)

Established in the early 1950's the FEPC is the main organization representing the interests of the nine private electric utility companies. Although it only has a minor role in the determination of atomic policy, its activities, at particular times, have been crucial to the outcome of policy debates.

The Electric Utility Companies

The electric utility companies are almost unique in Japan since they have successfully fought off attempts to establish state control, in both the pre-war and early post-war periods.(42) Collectively they have enormous political influence in the shaping of energy policy, but more specifically in determining investment in commercial nuclear power plants. This gives them considerable influence in the determination of the overall nuclear programme. All nine utility companies are privately owned and operate on a regional basis.(See Table 5-4)

The Nuclear Industry Consortia

There are five major industrial consortia in Japan, each of which has ties

Table 5-4

The Major Power Companies

(A) The Nine Private Electric Utility Companies

HOKKAIDO Electric Power Company

TOHOKU Electric Power Company

CHUBU Electric Power Company

HOKURIKU Electric Power Company

KANSAI Electric Power Company

CHUGOKO Electric Power Company

SHIKOKU Electric Power Company

KYUSHU Electric Power Company

TOKYO Electric Power Company

(B) Quasi-Public Utilities

Electric Power Development Company

JAPCO

Table 5-5

Projections of Nuclear Power Capacity

Date of JAEC	Projection in Gwe to:						
Projection	1962	1965	1970	1975	1980	1985	1990
1957	.15	.60	-	7	-	-	-
1961	-	1	-	-	6to8.5	-	-
1967	-	-	-	6	15to20	30.40	-
1972	-	-	-	-	43	60	100

Source: 1957, 1961, 1967, and 1972 JAEC Long Term Nuclear Program reports

to foreign licensors or companies. (See Table 5-5) These five industry groups were established in the 1950's and are involved in the construction of commercial nuclear power plants, as well as fuel cycle activities.

The Japan Science Council

Established in 1949 to coordinate scientific and technical advice to the government, the JSC primarily functions as an organized interest group for Japanese scientists. It has had a major influence on certain aspects of atomic energy policy, such as the organization of the nuclear porgramme together with safety and environmental issues, but it is not a dominant force in policy making. This is partly because it is perceived by the bureaucracy as a consistent critic of established policy.

This brief sketch of the main organizations and institutions involved in the nuclear programme gives little indication of the actual processes of policy making. The next, section will therefore peek behind this dry description of the agencies involved in policy making both to reveal some of the key principles underlying the policy making processes and to highlight the structure of power in this particular policy arena.

5.1.3 Policy Making in the Atomic Energy Programme

In the period covered by this study the structure of nuclear policy making remained remarkably resistant to administrative and political change. Although a grand review of organizational matters was undertaken in the late 1960s no significant changes were made in the administrative structure.(43) It was not until 1974 with the growing strength of organized opposition to the nuclear programme, that administrative reforms were introduced. These could hardly be labelled major structural reforms since they entailed merely a separation of the promotional and regulatory functions within the AEB.(44) They were not, for instance, as radical as those proposed (at much the same time) in the United States where the AEC was to be abolished and replaced by two new agencies.(45) This is partly

because of the attachment to gradualism in Japanese administrative culture but also because the political system is much less responsive to dissent from official state policy, particularly with respect to nuclear power. Unlike the United States where the very nature of the governmental system granted opponents of nuclear power many arenas within which to persue their interests, in Japan this was not the case. For the Parliamentary system of government; the political reality of rule by one party, the Liberal Democratic Party (LDP); and the interlocking relationships between business, the LDP, and the state bureaucracy make it inordinately difficult, but by no means impossible, for organized opposition to seriously challenge established policy.(46) This largely accounts therefore for the stability and consistency in the nation's foreign and domestic atomic policies. But what other factors shape the policy making process?

Policymaking on atomic energy matters is largely confined to the restricted body of state and private organizations decribed in the previous section. In the public policy making literature it would be labelled as a policy sub-system.(47) The principle characteristics of this sub-system are; the predominance of statism; the strategic role of the bureaucracy; the degree of centralization of decision making; and the 'partnership' between the public and private sectors.(48)

1. Statism

In his comparative analysis of the administration of national nuclear programmes Hodgetts asserts that in Japan state agencies '...dominate the field.' (49) What he means by this is that compared with the United States or even the United Kingdom, the role of the state in nurturing, controlling, planning and promoting the development of commercial nuclear power is one of an 'overlord'. Through its strategic planning the state defines the collective objectives to be achieved and marshals the necessary

resources to that end. With a wide range of interventionary mechanisms at its disposal, together with a corporate sector dependent upon it to establish a successful climate for a profitable nuclear industry, the state has usurped a predominant role in determining all aspects of atomic energy policy. This is partly because of the unique nature of the technology, with its implications for public safety and national security, but is perhaps due more to the (historically conditioned) highly interventionist role of the state in the Japanese economy: a role much extended and reinforced in the drive for post-war economic reconstruction.(50)

2. The Bureaucracy

If the state is, in comparative terms, a highly interventionist one this has been accompanied by the accretion of considerable power by the bureaucracy. It is the bureaucrats in the STA, MITI and the MOF who determine the critical parameters within which policy is formulated. Chalmers argues that:

> ... policy originates within a ministry, is coordinated by the bureaucrats themselves, ratified at the ministerial and Cabinet levels, given the stamp of approval by the LDP, and, if necessary, enacted into law by the Diet.(51)

Functional specialization, technical knowledge and expertise, combined with the ability to control access to the decision making arena and the formal decision makers, gives the bureaucracy extensive control over both the formulation of the policy agenda and the policy process itself.(52) Moreover since the bureaucracy is responsible for the coordination and implementation of policy its pivotal role in the decision making process is doubly reinforced. Elected politicians, whether Ministers but more particularly members of Diet, therefore sometimes have little more than a symbolic or formal role to play in the determination of many policy questions. And agencies like the AEC, which are dependent upon the bureaucrats for administrative assistance and information, can often be marginalized.

3. Centralization

Although the number of agencies and organizations involved in the policy making process tends to give the appearance of a large, complex, unwieldy system, in fact it is highly centralized and coordinated. Coordination is achieved partly through a vast sprawling network of advisory committees which link together horizontally all the key agencies and major organized interests. Since there is a conscious effort to have overlapping membership on these committees, such as for example the Minister of the STA also being the Chairman of the AEC, coordination is enhanced.(53) However, this emphasis upon advisory committees also facilitates and reinforces the bureaucratic centralization which exists. For the fragmentation in decision making which it induces can provide the larger and more powerful agencies, like the AEB and MITI (with the personnel and resources to staff and monitor this myriad of committees) with the opportunity to orchestrate and orientate the decision making process to their desired ends. And, as Huff suggests, the existance of so many advisory committees gives the appearance of consultation thereby indirectly helping to legitimize the actual centralization of decision making.(54)

4. The State - Industry 'Partnership'

Whilst the history of the atomic energy programme is replete with conflict between industry and the bureaucracy on specific issues, this has never detracted from the basic strategic consensus which exists on the need for a cooperative 'partnership'.(55) Government and politicians recognize that they are dependent on business for implementing national plans and programmes as well as generating the wealth, employment and technological prowess which is vital to national economic growth and power. Equally, industry recognizes that it is totally reliant on government for support and assistance to ensure the profitable, commercial exploitation of nuclear energy. The state-industry 'partnership' is therefore one of the most

salient features on the policy making landscape. However, the question of which is the dominant partner in this relationship is a problematic one. Some answers are suggested by considering the general pattern of decision making on atomic energy issues.

In Johnson's view public policy '...of all kinds in Japan has been made almost exclusively by the bureaucracy ... persistently into the 1970s.'(56) As a description of where power lies in the atomic energy policy arena it has much credibility. For the dominance of the AEB and MITI in determining successive national nuclear plans from 1957 to 1972 is well documented.(57) However, most studies of atomic energy policy making also acknowledge the extensive influence of the corporate sector which is effectively coopted into the corridors of power.(58) This is certainly the case when one examines crucial policy decisions, such as for instance the initial strategy for developing commercial nuclear power and the decisions concerning the organizational structure of the nuclear programme.

On both these issues the state came to historic compromises with private industry. Rather than public development of nuclear power it accepted, as evidenced by the creation of JAPCO, a predominant role for private capital but only under state direction. And although initially opposed to a development strategy requiring the rapid importation of foreign nuclear technology the AEC quickly acceded to the pressures from the JAIF and the consortia for complete dependence upon foreign, effectively American, technology.(59) Business wields extensive power in the political system and the atomic energy sector is no exception.(60) But it would be absurd to conclude that the state bureaucracy is merely an agent for private capital. For the bureaucracy has its own interests to persue, is often concerned with longer range strategic planning, and has to be seen to act in the public interest in a way that private industry does not. It can and does therefore operate quite autonomously from the wishes of corporate capital. Thus private ownership of nuclear fuels was not

granted until the mid 1960s, even though the nuclear consortia continuously pressed for it from 1956.(61) And in 1974 government was not averse to imposing, against furious opposition from the utilities, a 'pollution' tax on electricity generation to placate environmental opposition to nuclear power.(62)

Policy making in Japan has been described as being 'corporatist' in nature.(63) This implies a strong, dominant state but one which is reliant upon the cooperation of major organized interests such as business, professional or technical groups, in order to achieve collective ends, the public interest.(64) In return for their cooperation the state provides these organized interests with priveleged access to the policy making process and a voice in actual decision making. Whilst corporatism also implies state planning, regulation and direction this is achieved largely, but not exclusively, through the mutual consent of the interests involved. Policy making, according to this corporatist view, therefore involves a blurring of the public - private distinction and a system of closed bargaining and accommodation between the politicians, bureaucracy and the major organized interests in society. It is this corporatist description of the general public policy making process in Japan which is echoed in both Huff's and Gallinni's analyses of decision making in the atomic energy programme.(65)

Both Huff and Gallinni in their respective studies of aspects of atomic energy policy making in Japan, stress the close association between the bureaucracy, industry, scientists and national political leadership in the policy process.(66) These relationships are institutionalized in the myriad of formal and informal consultative committees spawned by each of the major government agencies. As both Huff and Gallinni suggest it is not so much technical knowledge that gives access to these decision making fora, although that is important, rather much more critical is the requirement to ensure that all the key organized interests are represented

in the decision making process so that a durable and effective consensus on policy can be reached.[67] Thus Huff concludes that '...scientists have had a generally limited impact on the policy process'[68] and Gallinni emphasizes that nuclear safeguards policy, for example, is determined solely by a committee which draws its membership 'from all organizations involved with safeguards' not just those with the necessary technical expertise.[69] Policy making on atomic energy issues is therefore largely a product of consultation, bargaining, and accommodation between government and the representatives of those organized interests which are central to the successful achievement of established nuclear plans.

Studies of the actual processes by which public policy decisions are reached in Japan suggest that they are in some respects unique.[70] According to Gallini within the atomic energy policy community, as in other issue areas, there is a fundamental attachment to a process of consensus-building. [71] There is a tendency to avoid confrontation and conflict and to use the consultative process between government and organized interests to define points of divergence so that they can be appraised and bargains struck. [72] Where conflicts of interests do occur these are resolved either by compromise or accommodation, such as occured with respect to the creation of JAPCO in 1957. But compromise and accommodation can often mean little more than acquiescence of the weaker to the demands of the more powerful. And as Gallinni incisively argues consensus - building can only occur '... when there is fundamental agreement among the participants that the policy or action under contemplation is necessary and desirable' such that '...inclusion of those in total opposition to a given policy or action being considered could destroy the entire process of consensus-building.' [73] For this reason opponents of nuclear power, who became increasingly vocal in the early 1970s, could not be incorporated successfully into the existing structures of nuclear policy making and were forced to explore alternative means to

achieve their goals.[74] Thus, the delicate, consensus-oriented character of the process of decision making reinforces the closed nature of the policy arena. This will become more apparent as this chapter unfolds.

5.1.4 The Development of a Commercial Nuclear Power Industry 1955-1974

From the earliest days of the atomic energy programme there was enormous enthusiasm both within government and industry for the rapid development of commercial nuclear power. In the 1950s nuclear technology symbolized modernity and industrial progress; it was described with poetic vision, at the UN Conference on the Peaceful Uses of Atomic Energy in 1955, as "'a new Prometheus 'bearing' a gift richer by far than the gift of Promethean fire.'" [76] Many officials and industrialists believed that unless Japan embraced this new technology, and caught up with the Americans and British,the long-term consequences for the country's international competitive position would be disastrous, condemning it to a position of technological dependence. [77] With hindsight such sentiments appear somewhat naive but it has to be recalled that at the time Japan was effectively a 'developing' nation, only recently launched on the trajectory of post war industrial reconstruction. Moreover nuclear power offered a partial alleviation of the projected escalation in its dependence on foreign energy sources. In this context the rapturous welcome given to the new technology by government and industry is readily explained. So too is the rapidity with which the technology was exploited.

(i) The Development of a Commercial Power Reactor Industry

Huff is quite correct in asserting that: "Japan's reactor development began in the mid-1950s as a consequence of a political decision on the part of the US to encourage civil reactor development in what was then referred to as the 'Free World'." [78] Japan made immediate use of the American initiative signing a bilateral co-operation agreement for research with the US on 14th November 1955, even before the basic atomic energy law was

ratified by the Diet. Within two years a clearly defined plan, entitled the Long Term Plan for Atomic Power Reactor Development, established the principle objectives which have largely guided the nuclear programme well into the 1970s. (79) The three key principles underlying the programme were: the decision to rely on imported power reactor technology; the commitment to a public-private sector partnership in its development; and the nurturing of an indigenous nuclear research and development capability to promote, in the longer term, greater independence in the exploitation of nuclear technology. Although the plan was criticised by MITI, the JAIF and FEPC for not endorsing the LWR as the main line of development and also for being "over ambitious" nonetheless these basic principles were accepted by all. (80)

Explicit in the plan was a simple vision of the future:

> ... it called at least for (sic) the initial stage for construction of nuclear power capacity based solely on natural uranium concept (that is, more specifically, British advanced Calder Hall type) and looked toward PU burning fast breeder as the ultimate goal.(81)

Consequently in mid 1958 JAPCO asked for tenders for the first GCR plant and in April 1959 signed a letter of intent with the British GEC for the construction of a 150 Mwe Magnox reactor. (82) The final contract was signed on 22nd December 1959. (83) In the meantime proponents of the LWR had ensured a revision to the 1957 plan requiring JAPCO to purchase a LWR so that a comparison between the two systems could be made. Co-operation with the US and the major US reactor vendors was thereby initiated. And in early 1959 the JAERI announced the purchase of a 12.5 Mwe BWR from US General Electric, as part of its R and D programme to explore the viability of LWRs. (84)

As some predicted the 1957 programme proved over ambitous and somewhat misguided. Consequently a policy review was undertaken in 1960 to assess the future direction of the programme. Earlier projections of installed capacity were revised downwards. (See Table 5-5). The new plan called for

greater reliance on foreign technology and 'measures to be taken by the government to foster atomic industries (sic)'. (85) These measures included financial subsidies and subsidies to promote domestic technology. (86) Additional government assistance was very much welcomed since the industry was beginning to recognise that '... as things stand now atomic power development cannot be sufficiently financed on a profit making basis by private concerns.' (87) Moreover such assistance was regarded as essential if the private utility companies were to achieve the task alloted to them in the revised plan. For the programme stated that the utilities were

> ... expected by the government to shoulder the task of installing the total 1000 megawatt capacity (called for in the plan) at their own risk and on their own responsibility.(88)

However, the whole programme was in some disarray since the GCR was well behind schedule and no commercial size LWR had been ordered let alone constructed. Despite this several utilities announced their intention to purchase US LWR reactors in the near future.

In 1963 the situation was dramatically transformed by the (American utility) Jersey Light and Central's decision to purchase a LWR. This signalled the beginnings of commercial nuclear power and confirmed what many had argued that the LWR should be the mainstay of Japan's nuclear programme. JAPCO therefore hastened its purchase of the LWR, for which tender had been invited in May 1963.(89) The nation's first indigenously constructed research reactor came on stream and later in 1963 JAERI's 12.5 Mwe BWR power demonstration reactor became the first to generate electricity in Japan. The pace of nuclear development quickened under the urgings of MITI which recommended that the utilities quickly 'introduced overseas power reactors of proven types (i.e. BWR's and PWR's).' (90) By 1966 it was clear that the future nuclear programme was to be solely reliant on US LWR technology, for not only had JAPCO signed a contract with GE for the purchase of a 320 Mwe BWR but also two private utility

companies, TEPCO and KEPCO, had signed contracts with GE and Westinghouse respectively for the construction of commercial LWR's. This signalled the beginnings of the first cycle of commercial LWR orders. (See Table 5-6). A happy note too was struck when, two years later than scheduled, the nation's first power reactor, JAPCO's 150 Mwe GCR at Tokai-Mura, generated its first commercial electricity in July 1966.

Both GE and Westinghouse had penetrated the Japanese nuclear industry in the late 1950s and early 1960s by negotiating licensing agreements with several of the major consortia. (See Table 5-7). This co-operation was extended and nurtured in the succeeding years such that by 1967 they were also involved in joint ventures in the nuclear fuel cycle business. Given their dominance of the world reactor market their close association with the Japanese consortia did much to ensure the rapidity with which commercial LWR's were adopted by the Japanese utilities in the mid to late 1960s. Indeed so rapid was the pace of development that in 1967 a new long term plan was unveiled by the JAEC.(91)

In September 1966 the changing outlook for nuclear power led the AEC to convene a 137 man committee to revise the existing long term atomic energy plan.(92) Reacting to the inherent conservatism of the 1961 plan the JAEC proposed a massively expanded programme but one which was also geared to increasing self-sufficiency both in the construction of power reactors and in fuel cycle services.(93) The plan called for the construction of 6 GWe of nuclear generating capacity by 1975, 15-20GWe by 1980 and 30-40Gwe by 1985. The expectation was that nuclear plant would supply 27% of the nation's electricity needs by the mid 1980s.(94) The plan was hailed as a major breakthrough for nuclear power in Japan; it symbolized that commercial nuclear power was coming of age. Murata, head of the Mitsubishi Atomic Power Industries remarked at the time: 'This is really a big programme, considering that it will be persued solely for peaceful purposes' and went

on to compare it, somewhat undiplomatically, in scale with the Manhattan project.(95)

By 1970 commercial nuclear power had arrived. Remarking on the health of the nuclear industry Imai noted that:

> Today Japan finds herself on the verge of a booming nuclear industry. By 1985, according to one official estimate, one fourth of her ever expanding electric power demand will be supplied by nuclear fuel, the volume of industrial activities and the associated technology and economic development are expected to soar accordingly.(96)

There was a further boom in nuclear orders as a new cycle of investment was initiated. (See Table 5-6) By 1973 the domestic nuclear industry was highly developed and although still dependent upon US technology and corporate license agreements was gradually expanding its indigenous technological and commercial capabilities.(97) (See Table 5-8). Larger and more efficient nuclear plants were being constructed to the latest American designs. (See Table 5-9) Imai's, and the industry's, optimism was reflected too in the revisions to the 1967 long range programme in 1972. This new programme projected an even greater role for nuclear power in meeting the nation's electricity needs. (See Table 5-5) However, delays in the construction programme and growing political opposition to nuclear power swiftly eroded the buoyant outlook for the industry.(98) The oil crisis compounded these difficulties by placing a brake on rising electricity demand and thereby creating incredible uncertainty over future nuclear plans. This, combined with intensifying environmental opposition to nuclear energy, reinforced by the drift of developments in the US, led, in the mid 1970s, to a temporary halt in orders for new nuclear plants. Almost three decades after the inauguration of the basic atomic energy law the enthusiasm for commercial nuclear power had begun to wane for the first time.

(ii) Towards an Independent Nuclear Fuel Cycle Capability.

It was not until the mid 1960s that government and industry began to concentrate seriously upon implementing a coherent strategy for the nuclear

Table 5-6

Nuclear Power Plant Order 1966 - 1975

Year	Number of Nuclear Plants Ordered
1966	3
1967	0
1968	2
1969	1
1970	2
1971	4
1972	4
1973	3
1974	1
1975	2

Source: Nuclear Engineering International 'Survey of Japan 1979'

Table 5 - 7

The Five Nuclear Consortia

Name	Acronym	Date Organized	Principal Companies	Number of Companies 1957	Number of Companies 1969	Foreign Licensors
Mitsubishi Atomic Power Industries (Mitsubishi Group)	MAPI	10-11-55	Mistubishi	20	25	Westinghouse
Tokyo Atomic Industrial Group (Tokyo Group)	TAIG	3-26-56	Hitachi Marubini-Iida Fuji Bank Sanwa Bank Showa Denko K.K.	27	27	General Electric
Sumitomo Atomic Energy Industries (Sumitomo Group)	SAEI	4-15-56	Sumitomo Matsushita	14	39	
Nippon Atomic Industry Group (Mistui Group)	NAIG	6-8-56	Mitsui Tokyo Shibaura Ishikawajima-Harima Japan Steel	30	36	General Electric
First Atomic Power Industry Group (Dai-ichi Group)	FAPIG	8-23-56	Dai-ichi Bank Fuji Electric Kawasaki Group Furukawa Group	25	23	

Source: Atoms in Japan, Vol. I (May, 1957), 19-22; Vol. IX (January, 1965), 10-14; and Nuclear Engineering International, Vol. XIV (May, 1969), facing p. 404.

Table 5 - 8

Indigenous Nuclear Industrial Capabilities

Owner Name	Plant Name	Ratio (%)	Main Contractor Name	Manufacturer Name		
				Reactor System	Pressure Vessel	Fuel Assembly
Japan Atomic Power Co.	Tokai	35	GEC	GEC	Fuji Elec.	UKAEA
"	Tsuruga	55	GE	GE	B&W/Hitachi	GE
Tokyo Electric Power Co.	Fukushima I-1	56	GE	GE	GE	GE
"	" I-2	53	GE/Toshiba	GE/Toshiba	Toshiba/IHI	GE
"	" I-3	91	Toshiba	Toshiba	IHI	JNF
Chubu Electric Power Co.	Hamaoka-1	90	Toshiba	Toshiba/IHI	IHI	JNF
Kansai Electric Power Co.	Mihama-1	58	WE	WE/MHI	CE	WE
"	" "-2	72	MAPI	MHI/WE	MHI	WE
"	Takahama-1	61	WE	WE/MHI	MHI	WE
"	" -2	90	Mitsubishi Corp.	MHI/WE	MHI	MUF
Chugoku Electric Power Co.	Shimane	93	Hitachi	Hitachi	Hitachi (Bab. Hitachi)	JNF
Kyushu Electric Power Co.	Genkai-1	87	MHI	MHI/Mitsubishi Corp. MAPI	MHI	MNF

Note: Domestic Ratio = $\frac{\text{Total Price of Equipments Procured by Japanese Makers}}{\text{Total Price of Equipments}} \times 100$

Source: JAEC Annual Report 1976 AEC Tokyo 1977

fuel cycle. The falling price of uranium and the diverse sources of supply, together with the ready availability of enriched uranium supplies from the United States, had induced a degree of complacency about fuel supply matters. However, with the adoption of the LWR by the utilities the problem of future supply arrangements became increasingly salient. Fuel cycle policy developed an urgency from 1967 onwards and became a central issue in the government's long term planning.

A major transformation in nuclear fuel supply policy occured during 1966 and 1967. After years of pressure from industry, private ownership of nuclear fuels was finally sanctioned in October 1966, to take effect in 1968. (99) This opened up the nuclear fuel business to private enterprise and enticed the corporate sector into various nuclear fuel related ventures. Industry's role in the fuel cycle business was strengthened by assistance from MITI which, in 1967, was given the task of achieving greater security and diversity in nuclear fuel supply arrangements. MITI sought to promote more private investment in the exploration and mining of uranium abroad; joint ventures with the major foreign uranium mining companies were encouraged; and the development of an indigenous nuclear fuel manufacturing capability.(100) By the early 1970s the major atomic consortia were involved in scores of international joint ventures in the uranium mining and processing industry.(101) And in a unique set of arrangements both GE and Westinghouse established joint ventures with their respective licensees, Hitachi/Toshiba and Mitsubishi, for the manufacture of BWR and PWR fuel respectively. However,the most politically sensitive and some argued the most important issue was that of enriched uranium supply.

One of the recommendations of the 1961 long range programme was the '... aim of realizing the home production of enriched uranium ... in the latter half of the second 10 year period' i.e. the 1970s. (102) Research into uranium enrichment technologies had begun in 1959, not out of concern

Table 5 - 9

Nuclear Plants to 1973

Electric Utility	Plant	Capacity (MWe)	Type	Construction	Commercial operation	Contractor(s)
IN OPERATION:						
JAPCO	Tokai -1	166	GCR	1960	1967	GEC (UK)
	Tsuruga	357	BWR	1966	1970	GE (USA)
Kansai	Mihama -1	340	PWR	1966	1970	Westinghouse (USA)
	-2	500	PWR	1968	1972	Mitsubishi
Tokyo	Fukushima-1	460	BWR	1966	1971	GE (USA)
Total	5 Units	1823				
UNDER CONSTRUCTION:						
Tokyo	Fukushima-2	784	BWR	1968	1973	GE(USA)/Toshiba
	-3	784	BWR	1970	1974	Toshiba
	-4	784	BWR	1971	1975	Hitachi
	-5	784	BWR	1971	1976	Toshiba
	-6	1100	BWR	1972	1976	GE(USA)/Toshiba
Kansai	Takahama -1	826	PWR	1969	1974	Westinghouse (USA)
	-2	826	PWR	1970	1975	Mitsubishi
	Mihama -3	826	PWR	1972	1976	Mitsubishi
	Ohi -1	1175	PWR	1972	1976	Westinghouse (USA)
	-2	1175	PWR	1972	1977	Westinghouse (USA)
Chubu	Hamaoka -1	540	BWR	1970	1974	Toshiba
Tohoku	Onagawa	524	BWR	1971	1975	Toshiba
Chugoku	Shimane	460	BWR	1969	1973	Hitachi
Shikoku	Ikata	566	PWR	1972	1977	Mitsubishi
Kyushu	Genkai	599	PWR	1970	1975	Mitsubishi
JAPCO	Tokai -2	1100	BWR	1972	1976	GE(USA)/Hitachi
Total	16 Units	12 813				

Source: Nuclear Engineering International

'Survey of Japan' 1973

with dependence on the US but in order to develop an indigenous technological capability in this vital area. (103) Some assistance was given by the US AEC in the unclassified aspects of the technology (since it was still classified in the US until 1971). But in March 1967 the US AEC terminated this co-operation, as part of its attempt to prevent the emergence of a threat to its fuel supply monopoly. (104) This provoked strong reactions within the Japanese nuclear community since there was growing unease with the situation of total dependence upon the US for fuel supplies. The 1967 long term plan therefore made the acquisition of an independent enrichment capability a priority. It recommended that:

> ... as demand for enriched uranium will increase on a global basis from now, Japan should make complete preparations for enriching uranium at home in the future.(105)

The AEC established a special Nuclear Fuel Consultative Council to oversee the development of enrichment technology which was to be a priority project for the newly established PNC.

Despite protests from the US AEC the enrichment project progressed quite successfully, and in April 1972 the JAEC sanctioned the construction of a pilot project, using centrifugetechnology, to be followed later by a commercial enrichment facility. (106) In the meantime the US AEC, in an attempt to forestall the spread of such independent capabilities, had (as in the last chapter described) initiated international discussions on the prospects for a multinational enrichment venture. Concerned particularly by developments in Japan the US proposed, shortly after the historic summit in August 1972 between President Nixon and Prime Minister Tanaka, a joint enrichment venture with the Japanese nuclear industry. (107) But such co-operation failed to emerge since changes in US enrichment contracting policy in 1973 (discussed in the previous chapter) reinforced Japan's desire for an independent capability and indeed heightened the search for alternative sources of supply. Independent development of centrifuge

enrichment technology therefore proceeded apace and the pilot plant began operation in 1976.

Unlike enrichment technology, plans for the development of a reprocessing capability were established well before the first power reactor had generated electricity. In 1959 a special government - industry committee was established formed to formulate a plan for the construction of an indigenous reprocessing plant. (108) Since it was assumed that FBR's, and the recycling of plutonium back into power reactors would occur by the early 1970s the requirement for a reprocessing capability was therefore perceived as having some degree of urgency. Consequently, in June 1962 tenders for the construction of a commercial reprocessing facility were requested and in 1964 plant designs drawn up. (109) Pressure from industry to establish a reprocessing capability underlay the haste with which the programme was progressed. For as industry recognized, in the early period of power reactor commercialization it was largely the practice of 'plutonium credit" which "made nuclear power projects attractive.' (110) (The accounting practice being that a monetary value was placed on the plutonium produced in a reactor and credited against costs thereby artifically reducing total generating costs.) Plutonium too was required for R & D into the FBR. Since it was predicted in 1967 that Japan would have accumulated (in spent fuel) some 1000kg of plutonium by 1970, pressure heightened to proceed apace with the reprocessing plant. Industry also regarded reprocessing as essential being a long term solution to the nuclear waste problem. However, construction of the plant, which was the responsibility of the PNC, was delayed by contractual difficulties and did not finally commence until 1971. (111) By 1976 the Tokai-Mura reprocessing facility was completed and ready to process its first batch of fuel.

(iii) Atomic Research and Development

A division of labour exists in the prosecution of atomic R & D. The JAERI concentrates upon pure research whilst the PNC concentrates upon

development of advanced reactor concepts and, as noted above, fuel cycle technology. JAERI operates several research reactors and, since the early 1960s, has been involved in research into reactor safety and efficiency. As a result it has come to play an important role in the determination of national safety standards. PNC, on the other hand, has two central projects: the construction and evaluation of the JOYO and MONJU experimental and prototype FBR's, both initiated in the late 1960s; and the evaluation of plutonium recycle in its prototype FUGEN (HWR) reactor. (112) In addition PNC, as noted above, has been responsible for the development of indigenous reprocessing and enrichment capabilities.

As this brief survey indicates the incestous relationship between government and industry has been responsible for the creation of a sophisticated nuclear infrastructure in Japan. But, as will become clear from the remainder of this chapter, the evolution of both the nuclear industry and the nuclear programme has been shaped almost as much by the consequences of reliance upon the United States, as the main source of nuclear technology and nuclear fuel.

5.2 The architecture of nuclear cooperation: the civil nuclear relationship with the United States

Commenting upon the pattern of nuclear cooperation between the United States and Japan, one study suggested that it is almost unique since it:

> ...has, for both partners, been amongst the most intense of any cooperation programs, and has entailed major technological, political, and economic benefits for both.(113)

Japan has been America's largest single foreign customer for the supply of nuclear technology and enrichment services. Equally, it has received the most financial, technical and commercial assistance of any country with which the USAEC and the American nuclear industry has cooperated. In at least these respects the relationship is somewhat unique. But the intense character of this nuclear cooperation is in some degree attributable to the

nature of the 'special relationship' which developed between the two countries in the post war period.

Since the defeat of Japan in 1945 the country has been reliant upon the United States for its military security, and until the early 1960s for its economic recovery.(114) Following the outbreak of the Korean war the country regained its sovereignty and at the same time entered into a security treaty with the United States.(115) For its part the US considered Japan to be of vital strategic significance in the Pacific and so sought to assist its economic and political reconstruction in every conceivable way. The cultivation of strong political, economic and security ties with Japan was essential to the American policy of containing the expansion of Soviet influence in the East.(116)

It was against this strategic and political background that cooperation with respect to atomic energy matters initially developed. Such cooperation, though politically sensitive, was conceived by the US as a vital ingredient in cementing the alliance with Japan as well as ensuring the latter's long term energy security which was so crucial to its economic prosperity. Nuclear cooperation therefore offered American foreign policy makers a significant mechanism through which they could 'lock' Japan more firmly into the post-war international capitalist order whilst simultaneously contributing to its economic prosperity. As Lester comments:

> American efforts in the nuclear field, as in others, were motivated by the belief that Japan's economic growth would be a basis for domestic political stability and strong political and economic ties with the Western world.(117)

5.2.1 The Evolving structure of bilateral nuclear cooperation

Writing in 1957, just after publication of the JAEC's long term development programme, Seiki concluded that:

> ...it is impossible, starting at this late stage, to hope to do without foreign assistance ... cooperation with Great Britain and the USA is in fact the only one (course) open to her (Japan).(118)

With the drive for economic reconstruction the pressure on domestic resources meant that totally indigenous development of nuclear power, even if it was possible (which many like Seiki doubted), could not hope to be achieved within a decent time interval. Consequently there was no option other than to import the technology and to risk dependence upon either the US or Britain as the only potential nuclear suppliers. Cooperation in this early period of nuclear development was therefore largely a one way process in which the technology was transferred from those who had it to those, like Japan who did not; it was not in any sense a relationship between technological equals. To facilitate this technology transfer bilateral cooperation agreements (as discussed in the previous chapter) established the framework within which such transfers occurred. In doing so they also institutionalized a structural relationship of dependency between the technology importing nation and the exporter. In the case of Japan this is evident from even the most cursory examination of its nuclear relationship with the US.

Although Japan entered into nuclear cooperation agreements with a number of countries it is its relationship with the United States which has dominated its nuclear history. The reasons for this are simple. In the 1950s there were only two potential suppliers of power reactor technology: the US and the UK. It was therefore quite natural for it to cultivate cooperative relations with both countries. However, the early experience of a rather difficult and disappointing cooperative relationship with Britain, compounded by the disastrous problems which plagued construction of the first imported power reactor, a British designed GCR, prompted the intensification of cooperative ties with the US.(119) By the early 1960s cooperation with the UK was dwindling, except in certain aspects of nuclear R & D, whilst that with the US had expanded massively. Given the latter's unrivalled position in the world nuclear industry it very quickly established itself as Japan's preeminent nuclear supplier.

Civil nuclear cooperation between Japan and the US was governed, as with all such cooperation, through the institution of the bilateral agreement. This provided a legal framework (which the previous chapter discussed in considerable detail) for regulating transfers of nuclear technology and materials between the cooperating governments or their agents to verify that these were not used for miltiary purposes. Since the bulk of nuclear transactions between both countries was carried out largely between privately owned American corporations and their respective counterparts in the Japanese nuclear industry, the cooperation agreements provided a crucial (although not necessarily efficient) mechanism for governing this private transnational activity. Moreover because Japan was the United States most important cooperating party the substantive requirements of the US-Japan bilateral agreement tended to set the pattern for all other cooperation agreements.(120) Thus in 1963 when it was mutually agreed to assign safeguarding responsibilities to the IAEA, the US-Japan agreement became the 'model' for all other bilaterals to emulate.

Initially, cooperation was limited to nuclear research. In November 1955 the first agreement for cooperation between the US and Japan came into force, one month before the Diet enacted the basic atomic energy law.(121) It had taken considerably longer than expected to negotiate since there was still residual domestic opposition from the JSC and opposition parties in the Diet to the strategy of relying solely on the importation of foreign technology, particularly if it implied dependence on the United States.(122) There was a prevalent belief, amongst opponents of the agreement, that the US intended to use it as a channel to assist US corporations in capturing the Japanese nuclear market. This perception had been generated by the fact that the US-Turkish agreement had contained a clause which appeared to give the US nuclear industry (as it was then) first refusal on any power reactors to be constructed in the future.(123) Nothing could have done more to unite the industrialists in the nascent

nuclear sector with the opponents of the agreement. The result was protracted negotiations during which the USAEC made several important compromises on the form of the agreement, including dropping the above proposed clause. The whole episode indicated that remarkable degree of domestic political sensitivity which surrounded cooperation with the United States; a factor which was to complicate negotiation of later agreements.

Like all such agreements at that time American assistance was limited purely to the transfer of basic nuclear research data and the provision of nuclear materials for research purposes. (124) But, as the Chairman of the USAEC, Lewis Strauss, noted in a letter to the JCAE

> Japan, if it desired to do so, would be able to engage US companies to construct research reactors, and private industries in the US will be permitted, within the limits of the agreement, to render assistance to Japan.(125)

Through this channel the JAERI was able to purchase its first research reactor and later obtained its second, under the USAEC's research reactor grant scheme. However, this first co-operation agreement secured a quite remarkable modification to Japan's sovereignty. For it required the government to guarantee unhindered access to USAEC officials responsible for verifying that no materials were being utilized for military purposes.(126) This despite the fact that the basic atomic energy law stipulated, as noted earlier, that nuclear technology could be exploited solely for peaceful purposes. In addition the agreement gave the USAEC some influence over the research programme since it imposed limits on the provision of amounts and types of nuclear materials which could be transferred.

To opponents of co-operation with the United States the research agreement institutionalized Japan's dependent position rather than extending the potential for indigenous nuclear development. As the opponents pointed out, American firms had begun discussions with potential

domestic manufacturers as soon as the agreement had come into force thus appearing to confirm what one leading left-wing magazine, rather fancifully suggested, was the true US objective, namely the '... domination of all Japanese industry by American monopoly capitalism through the manipulation of the electric power companies.' (127) Thus when Commissioner Shoriki announced, in early 1956, that the JAEC was considering extending the co-operation agreement to cover power reactors, it unleashed a torrent of domestic criticism. (128)

Opposition to the proposed power agreement centred around its implications for creating greater dependence upon the US, particularly with regard to enriched uranium fuel, together with its potentially distorting effect upon the power reactor programme which at that point was still in its infancy. However, the 1957 long term programme had called for the evaluation of both GCR and LWR technology thus making the signing of a power agreement a necessity. Negotiations ensued between the USAEC and the Japanese Foreign Affairs Ministry, assisted by the AEB, but proved extremely difficult. In particular problems arose over: the limits placed on the amount of enriched uranium which would be supplied; the use to which the plutonium in the spent fuel returned to the US could be put; its proposed time scale; and the issue of safeguards. (129) But these issues were resolved largely to the satisfaction of both parties and the agreement was signed in June 1958, entering into force in the Decemeber. (130)

The new research and power agreement established a much more comprehensive framework of nuclear co-operation than the more limited agreement it superceeded. It also imposed stringent (though by no means unique) conditions upon co-operation granting the USAEC extensive rights and powers over the use and disposition of US technology and materials supplied to Japan. In common with all power agreements at that time, it gave the USAEC the authority to set limits to the amount of fuel supplied; approval rights over the reprocessing of US supplied fuel; the right to

review the design of all facilities in which US supplied fuel was to be used or stored; the right to safeguard inspections; and discretionary authority to decide upon the re-export of US supplied materials and equipment. (131) Moreover, it also required that ownership of nuclear fuel be restricted to the government "... at least until such time as private users in the USA are permitted to acaquire title"; in other words until private ownership was allowed in the US. (132) The implications for national sovereignty of this extensive discretion granted to the USAEC by the agreement were considerable, confirming the conclusion of one study:

> ... that under many of its agreements, the US had rights which allowed it considerable direct control, if not over the policies of its partners, then at least over their programmes and actions. (133)

Indeed the constraints imposed upon the nation's autonomy by this agreement were a major source of concern within the bureaucracy since there still remained residual domestic opposition to it. Why then did the JAEC, the AEB and the Foreign Affairs Ministry accept its final terms?

Four factors shaped the internal deliberations on the agreement. Firstly, there was no option other than to enter into an agreement with the US if LWR technology was going to be imported. Secondly, whilst the agreement did impose certain constraints upon the domestic programme these were no different than those other nations had accepted, except for Euratom which was then regarded as a special case. Moreover, the costs of co-operation had to be weighed against the potential benefits which were projected to be enormous. Thirdly, a number of the more stringent conditions in the agreement were largley superflous at that time since Japan only had a limited nuclear capability; for instance, it had no indigenous reprocessing capability so the question of USAEC approval of repprocessing did not arise immediately. In addition the USAEC appeared to be more concerned with the promotion rather than the control of Japan's

nuclear development. The prevalent assumption in the bureaucracy therefore was that such controls and discretionary authority would be routinely administered, just as in the case of nuclear exports. There were no grounds for believing that the USAEC would exercise its discretionary authority in any way which might restrict or hamper the full development of Japan's commercial nuclear power or fuel cycle capabilities. Finally, the Americans had acceeded to a number of Japan's demands, such as the provision for trilateral safeguards, a requirement that plutonium returned to the US be used solely for peaceful purposes and a ten year limit on the treaty's duration; all demands which arose partly from the need to placate domestic opposition to the agreement.(134) By acceeding to these demands the USAEC had made the agreement much more acceptable to the general public, so according it greater legitimacy in the domestic political area. Nonetheless for many the agreement continued to symbolize and institutionalize Japan's dependent status in the relationship.

With only one minor amendment in 1963 the agreement remained in force until 1968. By this time the 1967 long range plan had been adopted, greatly expanding the nuclear programme and so requiring the negotiation of a completely new co-operation agreement in 1968. Since the LWR was by then the mainstay of the nuclear power programme it became essential to establish a much longer term agreement, so that fuel supplies would be assured. According to Glen Seaborg, Chairman of the USAEC:

> The primary purpose of the proposed agreement is to provide the framework for assuring the long term supply of enriched uranium fuel required for Japan's nuclear power program. Accordingly, the agreement has a term of 30 years. (135)

There was virtually no domestic opposition to this new agreement with the consequence that the negotiations were expedited rapidly. Moreover, the tremendous advances in the nuclear power programme, together with the growing importance of Japan in the profile of US nuclear exports, had given

the Japanese negotiators additional leverage so that "... it was Japan which most vigorously and effectively negotiated liberalization to its agreement." (136)

This liberization of controls established much greater flexibility in the provision of fuel supplies, both for power reactors and research purposes. (137) Very importantly it also facilitated the implementation of the private ownership of nuclear fuels in Japan by abolishing the requirement (in the previous agreement) that the government hold the title to all nuclear fuels. (138) Alongside this, it authorized the sale of nuclear materials to companies in Japan for processing and fabrication into nuclear fuel; a business which had only begun to develop with the formation of joint ventures between the major American reactor vendors and their Japanese partners. (139) This was a valuable concession since it permitted these new companies to export fabricated fuel to the expanding US market.(140) Conditions for the approval of reprocessing were also relaxed so that it became permissible:

> ... subject only to mutual agreement that safeguards could be effectively applied to the reprocessing facility in question. (141)

Finally, following the transfer of safeguarding responsibilities to the IAEA in 1963, the agreement reaffirmed the Agency's inspection role; a politically significant statement given the JAEC's and JAIF's opposition to the extension of Agency safeguards as proposed by the then recently agreed NPT.(142) All told this new power agreement therefore represented a substantial modification to the framework of bilateral cooperation, although the basic structure of the nuclear relationship remained intact. Whilst many still considered that to be highly unbalanced there was also a recognition that despite this '...the 1968 agreement was worth the cost.'(143)

5.2.2 US Government and corporate assistance to Japan's nuclear industry

Commenting upon the successful partnership between the USAEC and private

industry in promoting, under the Atoms for Peace programme, the widespread dissemination of nuclear technology, a joint Japanese-American study asserted that:

> Perhaps nowhere did this dual policy of government assistance and private sector activity enjoy greater success than in Japan.(144)

Certainly Japan received the largest package of US technical and financial assistance of any single country. And the penetration of the Japanese nuclear industry by the corporate giants of the American nuclear business was particularly extensive, more so perhaps than in either France or Germany.

Addressing the JAIF, in May 1957, the USAEC's Assistant Director for International Affairs outlined the main areas in which the US could provide Japan with direct assistance.(145) These included the provision of: nuclear materials; technology and information; services and equipment; and finance. In each of these areas Japan has received considerable direct and indirect aid from the USAEC. Not only did the USAEC make available mutually agreed quantities of nuclear materials for power and research reactors but also (as the last chapter discussed) these were supplied on an extremely financially attractive basis. But it was not simply nuclear fuel which was no readily supplied.

Under the bilateral cooperation agreement the USAEC transferred massive amounts of scientific and technical information relevant to the civil exploitation of the atom. A complete scientific library of declassified material was donated to Japan in 1954 to encourage the development of nuclear R & D.(146) Scientists from the JAERI and the universities were trained at US facilities and in American techniques covering all aspects of the fuel cycle (except those activities which were classified); scientific exchanges and visits to USAEC facilities and laboratories became commonplace. On intractable technical, legal and administrative questions surrounding the commercial exploitation of nuclear energy, such as for

instance the issue of indemnification, the USAEC office in Tokyo, and experts in Washington, were always available for consultations. Indeed, American experience in surmounting the barriers to commercial exploitation of the atom was used as a prescriptive guide for shaping Japanese technical, legal and administrative structures, as well as practices, in the nuclear sector.

Alongside assisting with these 'softer' aspects of the technology, the USAEC also provided very tangible aid in the form of services and equipment. Through the research reactor programme, as noted earlier, a small reactor was donated to the JAERI in 1957. Reprocessing and waste disposal services were made available with credit being given for the plutonium extracted.(148)

However, for the private utility companies, responsible under the 1960 long term programme for the installation of the nation's first 1000Mwe of nuclear generating capacity, the most critical assistance came in the form of finance. As the Director of JAPCO explained to a joint JAIF-USAIF conference in 1961, the biggest constraint upon the progress of the commercial nuclear power programme was finance.(149) There were two problems: firstly, reconstruction of the economy left only a limited pool of domestic capital available for investment in electric power projects; secondly, the need to expand generating capacity to keep up with demand meant that what little was available was used to construct cheaper thermal power stations, since the capital costs of nuclear stations were prohibitive. Consequently, as JAPCO's Director noted it was '...difficult to finance the programme only with domestic funds.'(150) Since direct government financial aid was limited the industry called for foreign assistance. Speaking to the USAIF annual conference in 1962 Goro Inouye, Chairman of the Chubu Electric Power Company, made an explicit plea to the Americans:

> In the Japanese power industry ... the problem of finance is one of the most pressing problems, and in as much as atomic power plants cost more than conventional thermal ones, we desire that American industry should aid us in this respect as generously as usual.(151)

In fact through the joint agreement between the USAEC and the Export-Import Bank extremely generous levels of finance were made available for atomic power projects in Japan. The first project to benefit from such aid was JAPCO's Tsuruga plant, also the first commercial sized LWR to be constructed in Japan.(152) But the expansion of the commercial nuclear power programme became to a significant degree critically dependent upon American capital.(See Table 5-10) As one study remarked:

> Much of the US composition of Japan's reactor construction was financed by Export-Import bank loans well into the period of growing US trade deficits.(153)

This direct government assistance had enormous benefits for US industry since as:

> ...cooperation at the governmental level was expanded, private sector cooperation was also developed and strengthened. (154)

Initially competition with Britain encouraged the major American reactor vendors to re-activate their commercial connections with the major electro-mechanical groups in Japan.(155) Thus began the corporate penetration of the nascent nuclear energy industry. As noted earlier GE negotiated license agreements with Toshiba (the dominant partner in the NAIG) as well as with Hitachi (the dominant partner in the TAIG) whilst Westinghouse strengthened its longstanding ties with Mitsubishi (dominant partner in MAPI) by signing a PWR licensing agreement. These licensing agreements sparked an intense debate within MITI, and the Foreign Investment Council (which was responsible for approving foreign licenses and investment) since the Ministry of Finance was anxious to restrict the extent of foreign penetration of domestic industry.(156) However, since licensing was the only means by which the Japanese consortia could gain experience with the new technology, the MOF's position was made untenable

TABLE 5-10

EXPORT-IMPORT BANK AND PRIVATE FINANCING
NUCLEAR REACTOR PROJECTS IN JAPAN 1966-74

REACTOR NAME	ITEMS FINANCED REACTOR EQUIPMENT	ITEMS FINANCED FUEL	A EXPORT VALUE (000) $	B EX-IMP LOAN (000) $	PRIVATE FINANCING (000) $	B/A %
TSURUGA (1966)	X	X	40034	32968	6290	82.3
MIHAMA 1 (1967)	X	X	34849	32223	3478	92.4
FUKISHIMA 1 (1967)	X	X	55298	38581	5495	69.7
" 2 (1968)	X	X	70821	58200	10501	82.1
MIHAMA 2 (1969)	X	X	36400	25437	3045	69.8
TSURUGA (1969)		X	14732	6000	6000	40.7
TAKAHAMA 1 (1970)	X	X	58489	30210	30210	51.6
FUKUSHIMA 1 (1970)		X	13710	6170	6170	45.0
MIHAMA 1 (1970)		X	6400	2681	2880	41.8
TSURUGA (1970)	X		5575	2139	2509	38.3
OHI 1 (1971)	X	X	90500	40725	40725	45.0
" 2 (1971)			67200	30240	30240	45.0
TAKAHAMA 2 (1971)	X	X	25300	10895	11383	43.0
FUKUSHIMA 6 (1972)	X	X	115047	51771	40266	44.9
TOKAI 2 (1972)			131391	59126	45987	45.0
TSURUGA (1974)		X	19444	5833	11666	29.9
		Totals	785190	433199	256845	55.17

Source: Adapted from Appendix VI

GAO (1975) US Financial Assistance in the Development of Foreign Nuclear Energy Programs 1D-75-63
Report to the Committee on International Relations

given the strategic importance accorded to the development of an indigenous nuclear power industry. Approval of licensing arrangements was therefore delayed but never refused. Moreover, as the commercial power industry expanded both GE and Westinghouse established (as noted earlier) joint venture companies, with their licensees, in the fuel processing and fabrication business. These broke new ground for until then no direct foreign investment had been permitted in the nuclear energy sector.

American corporate penetration of the nuclear industry was not confined to the major reactor vendors, however. The large multinational engineering and design companies, such as Bechtel and Ebasco, through their associations with GE and Westinghouse, developed strong contractural links with the Japanese nuclear industry. These contractural links for nuclear services extended to all areas of the fuel cycle including enrichment and reprocessing.(158) In virtually every conceivable aspect of commercial nuclear power, the domestic nuclear industry came to rely heavily upon American corporations for technology, services and equipment. Since commercial LWR technology continued to evolve in the US, as new designs and standardization were exploited, the technological, if not commercial, dependence of the Japanese nuclear industry upon the major American corporations continued to endure well into the late 1970s. A recent study of civil nuclear cooperation between both countries concluded that:

> In the 1950s and the 1960s, the Japanese nuclear industry was fully dependent technologically and commercially on the US industry. Even now, with enhanced technological and industrial capacity ... the Japanese nuclear industry still considers itself to be highly dependent on the US. (159)

It was this perception of dependence, reinforced by the American corporate domination of the world nuclear industry, together with the USAEC's monopoly over enriched uranium fuel supplies which, by the early 1970s, began to generate increasing levels of political tension and discord in the

nuclear relationship as Japan sought to establish a greater degree of autonomy.

5.2.3 Managing the Nuclear Relationship

As civil nuclear ties between Japan and the United States evolved this stimulated a remarkable increase in the intensity of interaction between those bureuacrats and corporate officials on each side of the Pacific who were responsible for promoting or regulating the bilateral relationship. A rather select, or self-selected, group of state officials, industry executives, and politicians from both countries developed exceedingly strong and systematic contacts with one another since they shared a common interest in furthering nuclear ties. The professional and commercial bonds between the members of this 'transnational community' were fortified by the existence and cultivation of very intimate communication networks which penetrated and connected the national nuclear policy making sub-systems in both Tokyo and Washington. These networks provided a mechanism for the co-ordination of national policies as well as at times facilitating the formation of transnational and transgovernmental alliances in attempts to influence policy outcomes where the sectional interests of this 'community' were at stake. But however strong the transnational links between the members of this community they could not be insulated entirely from the powerful currents within the broader political alliance between the US and Japan.

Just as the Cold War had sealed the political alliance between the two countries so the dramatic changes in the strategic environment in the 1960s and early 1970s made alliance politics somewhat brittle.(160) The emergence of China as a world power, America's protracted war in Vietnam, and the superpowers mutual pursuit of detente transformed Japan's external political environment and the established policy of total reliance upon the United States came in for increasing domestic criticism. The world of the late 1960s was much more pluralistic than that of the

1940s: Japan's foreign policy interests were therefore rather different than they had been then and no longer coincided automatically with those of the United States; a truth made more evident by the Vietnam war. Moreover the pronouncement of the Nixon doctrine in 1972 shattered many of the political assumptions upon which the post war alliance with the US had been based. This turbulent external environment found a resonance too in growing anti-americanism in domestic politics, fueled by the controversies over the revision of the security treaty in 1960 and the return of Okinawa in the early 1970s. (161) International and domestic forces therefore propelled Japan towards a more independent foreign policy orientation, one which reflected its changing strategic predicament.

Underlying this drift towards greater autonomy was a confidence born of economic success which, by the late 1960s, placed Japan near the top of the international economic league table. Like Germany, Japan was fast becoming an economic giant whilst remaining a political pygmy. But unlike Germany, its economic success depended critically upon access to foreign raw materials and foreign markets so that it was extremely vulnerable to any disruptions to the smooth running of the international economic order. These economic vulnerabilities therefore became a much more dominant consideration in the framing of foreign policy. (162) Greater emphasis was placed upon diversity in trade and commercial relations to minimize the potential for economic disruption; a strategic decision which had enormous consequences for nuclear co-operation with the US. Foreign policy therefore gradually shifted to service the political requirements of this new strategy.

Economic success also brought Japan into conflict with its closest ally. Throughout the 1960s America's growing trade deficit with Japan generated considerable friction between both governments; trade issues became a major source of conflict and tension.(163) When, in 1971, the Nixon administration unilaterally imposed import restrictions on foreign

goods with the aim of reducing the balance of payments deficit, Japan was perhaps the worst affected amongst all the industrialized states. This unilateral action did much to confirm the view that, with US hegemony being gradually eroded, Japan could no longer depend upon America to maintain a stable, liberal international economic order; an order which was vital to the nation's economic prosperity. This combined with the announcement of the Nixon doctrine undermined Japan's confidence in its alliance with the US fermenting a crisis in the relationship. This crisis was temporarily resolved at the successful Nixon-Tanaka summit in 1972; a summit which spent much of the time reaffirming the alliance as a central pillar in the foreign policies of both states. But America's impotence in the face of the oil crisis, in the following year, rekindled latent concerns within the governing party, the LDP, both about the real value of the alliance and the wisdom of allowing it to dominate completely the orientation of Japan's foreign policy.

Whilst cooperation in nuclear energy matters between the two countries continued, even increased, throughout the 1960s and early 1970s, it could not be totally insulated from the turbulence and tension in the alliance relationship. From the US point of view nuclear cooperation with Japan became increasingly important largely for economic reasons, to help redress the trade deficit; its strategic and political rationale, so much emphasized in the early days, now took very much second place since Japan was fast becoming the US nuclear industry's biggest and fastest growing market. But this change in the USAEC's and State department's perceptions of the value attached to such nuclear cooperation coincided, indeed collided, with Japan's reevaluation of the whole alliance relationship. Its quest for autonomy and reduced dependence upon the US impacted directly upon the nuclear relationship, threatening to undermine the structures of nuclear cooperation which had evolved over the years.

Conflict and tensions in the nuclear relationship were not new to those government and corporate officials who made up that rather elite transnational community responsible for nuclear cooperation. Indeed they had developed their own mechanisms for regulating and governing the nuclear relationship, as well as for promoting and protecting common interests. Although formally cooperation was administered through the Foreign Affairs Ministry and the State Department in practice it was the functional agencies and specialists who dealt with most issues. The intergovernmental level of cooperation was therefore reinforced by the existence of strong, transgovernmental networks of officials drawn from the AEB, MITI, USAEC, and USACDA. On all the major issues, such as fuel supply questions or the negotiation of cooperation agreements, these officials dominated the proceedings. They communicated regularly with one another and on all significant policy issues were in constant contact.(164) The USAEC, for instance, maintained its own direct contacts with the AEB and JAEC, through a special office in Tokyo. As one interviewee commented:

> The AEC and the nuclear bureaucracy in Japan had very strong contacts and relations. The State department did not take exception to the fact that the AEC wanted such direct communication with the nuclear bureaucracies in other countries.(165)

Moreover, the Tokyo office reported directly to USAEC headquarters in Washington and not through the State Department:

> All AEC offices operated theoretically under the supervision of the Ambassador and kept him informed of events. However [in practice] these offices reported directly to the AEC itself.(166)

These transgovernmental networks not only afforded the possibility of coordinating policies and resolving difficult policy questions without the danger of overt 'politicization' but also facilitated the forging of transgovernmental alliances on important nuclear policy issues.

According to Destler:

> One contributor to maintaining tolerable US-Japanese relations is informal transnational alliances, ongoing relationships based on overlapping interests and mutual support that link particular policy actors in Japan and the United States.

This is certainly the case in the nuclear issue-area for on a number of important issues (such as for example issues of nuclear safety, questions of enriched uranium fuel supply, the transfer of enrichment technology, the financing of nuclear projects, and safeguards policy amongst many others) informal transgovernmental alliances have arisen to effect close collaboration in the achievement of desired policy outcomes. Destler describes such activity in graphic terms:

> At a minimum, such allies take compatible positions in their respective internal political struggles and maintain a general mutual awareness of these positions; at a maximum they strive consciously to strengthen one another's leverage and credibility at home, and conspire actively to put across particular negotiated solutions in the two systems.(168)

Such informal alliances often have involved the private sector too, since corporate power and influence play an important role in shaping policy outcomes in both political systems.

Just as at the governmental level strong transgovernmental networks exist so too at the societal level have strong commercial ties led to the establishment of transnational networks of corporate officials and organized interests. Both the JAIF and the USAIF, for example, have extremely close relations, arranging regular joint conferences, providing advice and assistance to each other and each other's members, and representing their common interests on specific issues to their respective governments. Indeed, at the industrial level the commonality of interests betwen the US and Japanese nuclear sectors is often greater than that at the governmental level.[169] This is partly because there is a shared conception of the industry's technological and commercial requirements. But it is also equally a product of the fact that, at the corporate level, many of those in senior executive positions have been trained in the US.

This is particularly the case with Westinghouse and GE licensees. As one GE official described the relationship:

> Initially, all the Japanese were trained in the US and now most are in senior management positions. Relations with licensees - with Toshiba and Hitachi - is constant flow of personnel mostly in the US for 18 months.(170)

Both GE and Westinghouse also maintain their own offices in Tokyo through which they can cultivate and extend their associations with their licensees, the electric utilities, and the nuclear bureaucracy. Although as one GE official explained, GE is content to allow its '...partners in Japan to deal totally with the Japanese authorities.'(171) Thus, for instance, government approval for GE's licensing arrangements with Toshiba and Hitachi was negotiated entirely between the latter and MITI.(172) This illustrates one way in which these transnational corporate networks are used to promote (in this case) American corporate interests abroad.

Civil nuclear cooperation between the US and Japan has forged strong functional bonds between the bureaucrats and corporate executives whose existance depends, partly or wholly, on expanding, servicing or managing the nuclear relationship. These in turn have established a fertile milieu in which complex transnational and transgovernmental alliances may be cultivated:

> ... on issues where the dominant interests of the actors in the two countries lead them to favour the same general sort of resolution.(173)

This transnational activity, and its ramifications for atomic energy policy in Japan, will be discussed further in the penultimate section of the chapter.

5.2.4 The Structure of Nuclear Cooperation and its Consequences

The bilateral framework erected to govern and facilitate nuclear cooperation between Japan and the US institutionalized a relationship of technological and commercial dependence. According to one study:

> In the nuclear energy field the US-Japan relationship has been historicaly unbalanced, with Japan having adopted US LWR technology and continuing, thus far, to be largely dependent on the US for the bulk of its enriched uranium services.(174)

Of course the nature of the relationship was a dynamic one and, in the early 1970s, Japan sought to break some of the chains of this dependency. However, until then the structure of cooperation very much reflected the interests and requirements of the dominant partner: the US. This had several important consequences.

Perhaps the most important was that it created significant structural and perceptual linkages between the atomic energy policy making sub-systems in Washington and Tokyo; events and developments in one country affected the unfolding of events in the other. This eroded the traditional distinction between foreign and domestic policy. However, the unbalanced nature of the relationship meant that Tokyo was affected much more by developments in Washington than vice versa. This conclusion is echoed by Destler who argues that:

> US policies are far more important to Japan than vice versa; the same US-Japanese issues that are buried (or unrepresented) in the New York Times and the Washington Post make the front page of the Ashai Shimbun ... the words and actions of US policy figures have had far greater impact on Japanese policies than those of Japanese leaders have on America's.(175)

Moreover the structure of cooperation also imposed significant constraints upon the exploitation of nuclear energy in Japan. These constraints were compounded by the nature of US nuclear assistance which actively facilitated and encouraged the corporate penetration of Japan's nascent nuclear industry. Yet the challenges to Japan's autonomy in the nuclear sector, created by its dependent situation, stimulated a powerful domestic counter-reaction which, as noted earlier, was expressed in the early 1970s by '...rising demands for self-determination in the peaceful uses of nuclear energy.'(176) The cooperative relationship was therefore a fluid and complex one. This will become readily apparent as its ramifications are unpackaged in the following section.

5.3 The Ramifications of Bilateral Cooperation

One of the few studies of American-Japanese nuclear cooperation concluded that:

> United States leadership in nuclear energy development has ... been an important ingredient in Japan's ability to launch a major nuclear energy program of its own. (177)

This is undoubtedly somewhat of an understatement for the whole history of Japan's commercial nuclear power development reflects its critical reliance upon imported, American technology. All the key decisions, from the organization of the nuclear programme to the question of safety standards, were subtely shaped or determined by this technological dependence on the US. Technological and commercial links with the US became a kind of transmission belt for indirect, and sometimes direct, US corporate and governmental influence over Japan's commercial nuclear power programme. This section intends to explore the ramifications of the dependent character of nuclear cooperation for the domestic organization and politics of Japan's civil nuclear programme.

5.3.1 The Structure and Administrative Organization of the Domestic Nuclear Programme

According to Huff the:

> ...sudden infusion of atomic energy technology into Japan led to a whole series of reactions in the political system. New organizational structures have been established both in the public and private sectors to set goals, establish priorities and allocate resources. Because of the scope of the new research and development programe, the government's role as an economic promoter and regulator has greatly expanded.(178)

Whilst, as discussed earlier, these new organizational structures were shaped very much by domestic political forces and a political culture which prescribed the state a primary role in the economic sphere, the necessity for reliance upon imported technology stamped its own specific requirements upon these new structures. Nor was industry immune from these external influences, for licensing arrangements with American corporations largely conditioned the competitive structure of the doemstic nuclear industry.

From the very initial days of nuclear cooperation the USAEC and the major American nuclear corporations became quite deeply involved in shaping the nation's nuclear power programme; an entanglement which had profound consequences for both the organization and the character of the nation's civil nuclear development.

One of the most controversial issues in the formative period of Japan's nuclear development was the question of whether the state or private industry should take sole responsibility for demonstrating the commercial potential of atomic energy. Although there was a consensus on the need for a partnership in the exploitation of the atom, the practical question of how the initial importation and construction of power reactors was to be organized and managed was the source (as noted earlier) of a prolonged political struggle between the state and private industry. This struggle lasted for well over a year and was not resolved until the autumn of 1957. So fundamental was it to the whole future of the commercial exploitation of nuclear power that it invited the indirect participation of the major American reactor vendors; at stake was their future prospects in the Japanese market.

There were two major factions involved in this controversy. On the one hand MITI, MOF, the JAERI, the EPDC, and the scientists on the JAEC, were adament that government control of commercial reactor development, through a publicly owned company which would import and construct the nation's first commercial power reactors, was essential.(179) On the other hand, the nine private electric utility companies, the JAIF, the five nuclear consortia, industrialists on the JAEC, and leading politicians in the LDP, favoured private development of nuclear power. They therefore proposed that a new privately owned company be established to import and construct the first power reactor.(180) This was immediately opposed by the atomic energy bureaucracy.

Both MITI and JAERI perceived the private development of nuclear power as a direct threat to their immediate bureaucratic interests and the long term viability of an indigenous nuclear industry. For, along with the MOF, they believed that private development would require a massive and costly (particularly of extremely scarce foreign exchange reserves) programme of technology imports.(181) Since the private sector had close relations with American industry the concern, expressed by JAEC Commissioner Yukawa, was that this would lead to over-reliance on American technology. It was also a fear which the JSP and JSC vocalized. However, the bureaucracy faced a powerful and determined set of oponents since the private utilities, the JAIF and the nuclear consortia conceived the issue as a matter of principle; it was not an issue on which they were prepared to consider retreat.

Although the USAEC and nuclear industry did not become direct participants in this domestic controversy, they were indirectly implicated in the confrontation between government and the private sector. Firstly, the model for the government's management of the nuclear programme was the USAEC whose main objective was the private development of nuclear power. This was reflected in the whole ideological thrust of the Atoms for Peace programme which Japan had so warmly embraced. Secondly, the major US reactor vendors had very close relations with three of the nuclear consortia and were busily engaged in preliminary discussions on how industrial cooperation might be enhanced. It was clearly in their interests to lend as much support as they could to the utilities and consortia because of their enthusiasm for the LWR. Proponents of public development of the atom, on the other hand, were unified by their attachment to the British GCR. It was therefore vital for the American companies that private control over reactor development be established.

By activating their long-standing commercial links with Mitsubishi and Toshiba, leading companies in two of the atomic consortia, Westinghouse and

GE were able to hint at early discussions on prospective licensing agreements.(182) In the context of the public-private controversy this was an astute political initiative: the prospect of licensing agreements held out the possibility of indigenous manufacture of LWRs in the not too distant future as well as potential sub-contracting arrangements (already being exploited for turbine-generators) in the lucrative US domestic market. One of the political consequences of these corporate initiatives was that they helped undermine the position of those who argued that private control would hinder the development of an indigenous nuclear industry.(183) For the American giants it was a risky strategy since it was clearly of more immediate benefit to GE and Westinghouse to sell reactors, as was the initial British strategy, than to sell the technology adn thus cultivate potential competition. One can only surmise therefore that political considerations were just as significant as immediate commercial benefits in American corporate decisions to contemplate licensing arrangements with their Japanese partners.

Following extensive consultations and mediation by the LDP, a compromise was reached on this controversial issue. JAPCO, a new corporation responsible for the introduction of power reactors, was to be established (in the autumn of 1957) as a joint public-private venture but with private capital retaining control.(184) This was welcome news to the American corporations. In early 1958 a revision was made to the 1957 Long Term Plan, largely it is assumed under pressure from the private utilities, in which greater stress was laid upon the LWR.(185) JAPCO too announced its commitment to the construction of a LWR. In this seminal controversy over public-private development of atomic power the final outcome was unambiguously to the advantage of American corporate interests. But it would be absurd to argue that it had been engineered since direct American influence over the final outcome was extremely limited. However, by shaping some of the parameters of the debate, the American 'presence',

though somewhat latent, undoubtedly played a not insignificant role in its resolution. This American corporate presence commanded far greater influence over the evolving structure of the Japanese nuclear industry.

In 1956 there were five newly established atomic energy consortia in Japan ready to compete for nuclear business; ten years later the five remained but only three were in any serious sense competitors for nuclear contracts. During the intervening years, these three had become closely connected to GE and Westinghouse through the signing of licensing and manufacturing agreements.(186) As a result the competitive structure of the Japanese nuclear industry almost came to replicate that of the US nuclear industry: an oligopoly in which the two giants, Westinghouse and GE, together retained the largest share of the market. This did not arise by accident but rather, as Dunning and others have explained in the context of other industrial sectors, is a predictable consequence of external penetration by multinational corporate capital.(187) By limiting their license and co-manufacturing agreements to their established commercial partners in Japan, the major American multinationals came to reproduce similar market conditions as existed in the US. Since, at the time, there were no major foreign competitors to the US in the LWR business, those consortia not linked to the American giants could not hope to compete on equal terms with the others. Moreover, this situation created surplus capacity in the industry, since there has never been sufficient demand to keep all five consortia in business. In this context the existence of licensing arrangements has imposed powerful constraints upon any MITI attempts to promote the industry's rationalization.(188) For the nature of these agreements make any mergers or contraction in the number of consortia, which involve either Westinghouse or GE licensees, extremely difficult to implement. Such policies would be opposed by both the American licensors and Japanese licensees, whose respective commercial interests and possibly commercial viability would be threatened, and would

undoubtedly provoke a major confrontation between MITI and those very consortia whose cooperation would be essential to the success of such initiatives.(189) As a result MITI has avoided direct intervention to rationalize the nuclear sector.

Through their licensing agreements, Westinghouse and GE not only created the conditions for an oligopoly in the Japanese nuclear industry but also reinforced their technological and commercial hegemony in the Japanese market. Licensing agreements institutionalized the atomic consortia's dependence upon American technology particularly since commercial LWR technology was still rapidly evolving throughout the 1960s and 1970s. Because the atomic energy consortia did not have R & D resources on anything like the scale of their American licensors they were locked into a situation of critical reliance upon them, as each successive LWR design advanced upon the previous one. This technological dependence was evidenced in the predominant share of Japanese nuclear patents held by foreign, mostly American, companies.(190)

In addition licensing agreements also imposed significant commercial constraints upon the licensees. Whilst not preventing them from competing against their licensors in the world market, potential competition in the most lucrative market, the US domestic market, was proscribed.(191) These restrictions were included to protect the commercial interests of the licensors since it was not to their advantage to assist potential competitors to penetrate their own domestic market.(192) In practice the licensees were not concerned by such restrictions since they were much more enamoured by the potential benefits from sub-contracting arrangements with GE and Westinghouse. Such benefits were perceived in the 1960s as being potentially enormous since the latter then dominated the world market. It was this belief which initially made licensing tie ups extremely attractive to the atomic energy consortia. Licensees received substantial financial and commercial benefits from these sub-contracting arrangements, gaining

access to the lucrative American domestic market which would otherwise have remained firmly closed to them.(193) Not only did the benefits of sub-contracting outweigh the costs of some of the more restrictive clauses of the licensing agreements but also it reinforced the commercial dependence of the consortia upon their American partners.

This commercial dependence was heightened by the industrial secrecy and proprietary requirements endorsed in the license agreements. These requirements have been a constant source of irritation, and at times controversy, in Japan since the basic principles of atomic energy development demand openness and democratic control.Since license agreements make it difficult to disclose certain technical information which might be of benefit to potential competitors they pose a political problem for state regulation of the industry. For instance they prohibit public access to technical information which, in the Japanese case, could be essential to judgements about power plant safety. This situation granted Westinghouse and GE enormous latent influence in the regulatory process.(194) Proprietary rights over commercially sensitive technical information thus placed certain external constraints upon the regulatory process. As will be discussed later this had important political ramifications particularly for public confidence in established regulatory structures.

With the commercialization of nuclear power, in the mid 1960s, colloboration between the American reactor vendors and their Japanese licensees looked set to expand into other areas. However, the deepening of commercial ties, particularly in relation to fuel cycle technology, was constrained by Japan's Foreign Investment Council's highly restrictive attitude to foreign investment and foreign licensing agreements, resulting from its desire to prevent foreign control of Japanese industry.(195) Indeed the FIC, which had to approve all licensing agreements, had made the process of approval tortorously slow and bureaucratic. (196) This had led the nuclear industry, through the JAIF, to bring pressure to bear on MITI

and the MOF to make the nuclear industry a special case, thus permitting much more extensive collaboration with foreign companies. This was resisted but a progressive liberalization of controls commenced in the 1960s as a consequence of Japan's increasing integration into the world economy. (197)

In pressing for the relaxation of investment controls over the nuclear industry, the major American corporations acted indirectly through their licensees.(198) They understood only too well that the consortia's commercial and technological dependence upon them would eventually necessitate revisions to FIC's restrictive policies. A major breakthrough occurred in 1967 when the FIC acceeded to increasing political pressure from the nuclear industry and finally relaxed its policy, authorizing the establishment of the very first joint venture in the nuclear sector between Japanese firms and a foreign company. Japan Nuclear Fuel Corporation was incorporated by GE, and its licensees Hitachi and Toshibi. In the context of established policy this was a momentous development since it permitted GE not only a forty per cent share in the new company but also participation in its management. (199) For GE it was in many respects a historic achievement since such ventures were extremely rare in any sector of the Japanese economy, let alone in one which was regarded as so vital to the nation's future prosperity. However, as predicted, the decisive factor in this shift in FIC policy was simply that there was no practical alternative given that the government was committed, by the 1967 long term plan, to the development of an indigenous nuclear fuel cycle capability, whilst equally GE was committed to the notion of a joint venture. (200) As Huff acknowledges: 'MITI was not anxious for an American firm to be a partner in such a sensitive national project. However, General Electric's technical assistance was necessary if this phase of development was to proceed on schedule.' (201) Approval of the JNF venture was quickly followed by the sanctioning of a similar joint venture between Westinghouse

and Mitsubushi. Dependence upon American technology had made it almost impossible for the government to resist the further penetration of the domestic nuclear industry by American corporate capital.

5.3.2 Regulatory Structures and Policies

In his study of the Japanese nuclear power program, Huff suggests that: 'The United States, in part, has been taken as the model for much of the Japanese atomic energy regulatory ... institutional set-up'. (202) Certainly, the administrative structures and policies designed to deal with questions of nuclear safety, indemnity against nuclear accidents, and safeguards implementation, owe a considerable debt to American practices.

Nuclear safety did not become a major political issue in Japan until the early 1970s. Prior to that it was largely dealt with by JAEC experts although Japan was the first country to hold public hearings on the siting of a power reactor. (203) Like the USAEC the JAEC established an expert committee to deal with the safety evaluation of proposed power reactor projects. Moreover, as in the US a system of construction and operating licenses was utilized to ensure that safety requirements were complied with. However, because reactors were initially imported much of the necessary information and experience for making safety judgements was not indigenously available. Consequently, the Japanese authorities had to rely considerably upon their counterparts in the US. This was particularly the case in the early days of nuclear power development. Reactor safety missions were regularly despatched to the US and the latest American safety standards and criteria were the basic source for much of Japan's safety codes. (204)

One very sensitive problem emerged over the question of the public availability of much of the technical information upon which safety judgements were based. The problem arose because of proprietary rights in the licensing agreements between the atomic energy consortia and the

American reactor vendors. These agreements made it difficult to publicize fully all the technical data upon which safety evaluations were based and so limited the potential for either public participation, or more importantly, independent technical validation of official safety policy. As the Director of Japan's Atomic Energy Relations Organization explained:

> Japan has depended to a great extent on technology introduced... from the United States and nuclear technology has been introduced into Japan mainly in the form of proprietary information. Therefore, if all the techniques of nuclear engineering were to be made open to the public there would naturally be great resistance from the companies concerned and this could jeopardize Japan's future ability to introduce foreign technology.(205)

Whilst used as a justification for restricting the degree of public participation in regulatory issues, the explanation is somewhat disengenous since in the early 1970s, the opening up of the American regulatory process to the public (and the intervenors) brought much information into the public domain. Nonetheless, official acquiescence in accepting this state of affairs contributed to the erosion of public confidence in the regulatory process; an issue which is explored further in the next section of the chapter. (206)

The question of safety was also intimately tied to the issues of reactor siting and government indemnity in the case of a nuclear accident. On both these issues the US unwittingly became a party to the domestic policy debates. Reactor siting policy was a highly controversial issue in the early period of the nuclear power programme. Several sites for the first research and power reactors were strongly opposed by local citizens.(207) In the case of JAPCO's first power reactor, the proximity of the proposed Tokai Mura site to the USAF's Mito bombing range provoked a public outcry on the basis that the location of the project courted a disaster. Tokai Mura was also the site of the JAERI complex, which housed research reactors and later a reprocessing facility. In 1959 public hearings were held to calm local fears. The USAF was approached by the Foreign Affairs Ministry and the bombing range issue became a source of

diplomatic friction between the two countries. (208) Since the USAF refused to abandon the Mito range, even it would appear under pressure from the State department, JAPCO and JAERI proceeded with their plans against considerable local and national political opposition. (209) However, the Tokai Mura episode forced MITI and the JAEC to formulate a reactor siting policy which closely resembled that adopted by the USAEC. (210)

Whilst the siting of nuclear facilities generated much public concern very little interest was shown in the indemnification issue, despite the fact that potentially it involved huge implicit state subsidies of the nuclear programme. With the import of research and power reactors in the late 1950s, the government had to confront the difficult problem of liability in the case of a nuclear accident. This was essentially a question about whether the state or private industry should bear the full costs of insuring against such risks, and whether financial limits should be placed upon their liability. Both American and British companies, as well as their governments, demanded adequate legal protection against claims resulting from any nuclear accident which involved nuclear technology or nuclear fuel supplied by them. (211) As a result the JAIF: '...thought it would be desirable to use this as the point of departure for pressing the government to tackle the indemnity problem.' (212) After consultations with the USAIF and American reactor vendors the JAIF, in June 1958, submitted an interim report to the JAEC recommending legislation much along the lines of the recently enacted Price-Anderson act in the US. (213) This was followed, in August 1959, by a more detailed report stressing the need for limits, as in the USA, to private sector liability. (214) This provoked a prolonged debate between, on the hand MITI and the MOF, who refused to contemplate an almost open-ended subsidy to private industry, and on the other hand, the consortia, JAIF, together with the private utilities who, in the case of an accident, demanded government indemnity against potentially crippling financial claims. (215)

Throughout this period, the American experience with indemnity law was a constant reference point in the bureaucratic and political debate. Both directly and indirectly the USAIF, USAEC and the major reactor vendors became entangled in the controversy. When a final compromise was reached and legislation presented to the Diet on March 3 1961, it is probably accurate to claim, as does Nehrt, that the American participants like, '...GE, by setting forth in detail what would be considered "adequate" indemnity, helped to shape the contents of the Japanese law in this area.' (216) Thus indemnity law was not only forced onto the public agenda "from outside" but also came to reflect foreign practice and experience, particularly that in the United States. (217)

This was equally true of the organization of safeguards accounting procedures and practices. Both the initial research, and later the power reactor agreements with the US, required the 'maintenance of records' and 'annual reports' to verify that no nuclear materials were being diverted to military uses. (218) Since the USAEC could inspect such records it was natural that they should be consulted on the proper form which this safeguards accountancy system should take. But in late autumn of 1958, domestic criticism of US inspection rights provoked the AEB and Foreign Affairs Ministry into spurring the IAEA to initiate an acceptable system of international safeguards. (219) In 1963 safeguards responsibilities for bilateral transactions with the US, as discussed in the previous chapter, were taken over by the Agency. (220) This involved further modifications to organizational structures and routines and in the process attracted vociferous criticism from the JAIF and the utilities who were apprehensive about the commercial and economic consequences of Agency safeguards:(221) the latter would have much preferred to have remained under USAEC safeguards. (222) However, the US State Department's and the USAEC's desire to promote the agency's role in safeguarding international nuclear transactions brought them into a tacit allicance with the Foreign Affairs

Ministry and the AEB, who were strongly committed to the internationalization of safeguards; an alliance which would not be deflected from its purpose simply because of the existence of domestic opposition on the part of the Japanese nuclear industry. (223) Domestic opposition was therefore overruled. Despite this international safeguards continued to be a contentious issue between industry and the government well into the 1970s.

5.3.3 The Politics of the Nuclear Power Programme

A number of studies have pointed out that policy making on several of the most fundamental aspects of Japan's civil nuclear power programme has been conditioned heavily by the dependent nature of its nuclear relationship with the United States. (223) On the issues of reactor choice, the size of the nuclear programme, the development of indigenous fuel cycle capabilities, and the question of nuclear safety, reliance upon the US has played a significant role in framing the parameters and the politics of decision making. This section will examine just how far, on each of these issues, policy outcomes were shaped by foreign, as opposed to simply domestic, considerations.

The Politics of Reactor Choice 1956-1966

One of the advantages of reliance on foreign nuclear technology is that in theory it gave Japan the luxury of being able to evaluate com peting reactor technologies, at a time when they were still in the development stage, with a view to commiting the country to that which was judged to be the most commercially attractive in the Japanese context. This was the explicit rationale behind the 1957 long term programme which called for the import of both a GCR and a LWR, so establishing a kind of 'technological duel' between both systems. Accordingly a final decision on which technology to develop was ideally to result from a rigorous, objective technical and commercial evaluation of both systems. But decision making

on issues of such substantive and national importance is rarely informed by the dictates of procedural rationality; the issue of reactor choice was no exception. Indeed well before any effective evaluation of the GCR had occurred, the major private utilities had committed themselves to the LWR. How and why did this occur?

The question of which power reactor technology to develop was as much a political issue as a commercial and technical one. Besides economic and technical considerations such a decision involved delicate political judgements about: its implications for broader alliance relations; the long term industrial and political consequences of dependence either upon American or British technology; the availability of alternative sources of fuel supply; and how effective the chosen technology would be in equipping Japan to compete in the future world market for nuclear power. It was not a choice which simply revolved around which system produced the cheapest electricity but rather embraced a much broader political agenda about what kind of nuclear industry Japan was to cultivate. Officials and industrialists were also consumed by a very powerful sense of national prestige which was articulated in the notion of an atomic 'race' and the expressed determination to 'catch up with' the West in this new technology. (224) Nuclear technology was conceived as essential to the nation's future industrial and technological power base. For all these reasons the choice of which power reactor technology to exploit was profoundly political even if the official lexicon of choice was overwhelmingly technical.

Between 1956 and 1958 the question of which reactor system to import was entwined with the issue of public or private development of nuclear power. As discussed earlier the proponents of public control, such as the EPDC, JAERI and MITI, were committed to the GCR since, at that time, it was regarded as the only 'proven' technology; the JAIf, the utilities and the consortia, who were the main proponents of private development were much

more attached to the LWR, largely it is assumed because of their close links with American industry. Some members of the JAEC, together with the JAERI, MITI and the MOF, feared that dependence upon American technology, which they perceived as a concomitant of private development, would undermine attempts to establish an indigenous nuclear industr y and nuclear R & D infrastructure. (225) The 1957 Long Term programme therefore endorsed the immediate import of a British GCR with a future commitment to the import of a LWR so that the relative merits of both systems could be evaluated. According to Huff:

> The British Calder-Hall type was selected over competitive American models since it had a relatively impressive performance record. Moreover, it used natural uranium fuel which was more readily available than the enriched uranium used in American reactors. Looking to the future, the Calder-Hall was considered more easily manufacturable in Japan ... At the time, the Calder-Hall was seen as simply a temporary expedient to fill in the slack period before a domestic fast breeder reactor could be put to use.(226)

But this initial choice of the GCR came in for heavy criticism.

A rearguard action against this decision was fought by the supporters of the LWR, although as part of the compromise over the establishment of JAPCO even they had agreed earlier to the immediate import of a GCR. (227) It also has to be recalled that in 1957 the British GCR was much more of a proven system than were any of the US LWR designs - a fact which, as chapter 3 discussed, had provoked the US JCAE into devising a crash GCR development programme; a move which did not assist those in Japan arguing for the immediate import of a LWR. Moreover, the consensus style of policy making in the nuclear programme and the politics of the government-industry 'partnership' meant that even though private industry disliked the emphasis given to the GCR in the 1957 plan, it was honour bound to implement it. JAPCO, from its very inception, was therefore locked into the GCR project. Nonetheless the JAIF, the utilities and some of the consortia launched a powerful but diplomatic critique of the 1957 plan requesting that the programme be modified to give much greater

emphasis to the LWR. (228) This was accompanied by a vigorous reactor advertising 'war', as Seiki refers to it, in which the major American and British reactor vendors attempted to persuade government and industry of the technical and commercial merits of their respective systems. (229) But the magnitude and determination of the American advertising campaign far outweighed that of the British. This resulted from the fact that JAPCO's initial choice of the GCR had a:

> ... profound impact on the US nuclear community, both governmental and private. Surprise and disappointment that Japan would place its first nuclear power reactor order outside the US was mixed with a determination on the part of the US government and industry to complete more effectively in future. (230)

Although JAPCO requested tenders for a GCR plant in the autumn of 1958 the 'reactor war' was by no means over. (231) The utilities, those consortia linked to American reactor vendors, and the JAIF continued to press for the import of a LWR. And in 1958 the JAEC's long term programme was modified '...to incorporate a rather significant enriched uranium reactor program'. (232) According to Huff:

> ... there were suggestions that the change was due to political pressure by those electric utility companies which had already signed import contracts on enriched uranium reactors manufactured in the United States.(233)

This would appear a somewhat exaggerated claim since there is no evidence of any contractual agreements. Far more important is the fact that this modification coincided with the negotiations for the first power reactor co-operation agreement with the US. This agreement, combined with the generous types of assistance offered by the USAEC, gave a considerable boost to the competitive edge of the American nuclear industry in its attempts to penetrate the Japanese nuclear market.

A small breakthrough for the LWR occurred in early 1959 when the JAERI announced that it was to purchase a 12.5 Mwe BWR from GE, as the first phase of its power demonstration reactor programme; a programme designed to provide JAERI with R & D experience with LWR systems. (234) The 'drift'

towards the LWR was underway assisted both by the deepening of co-operative ties between the USAEC and the Japanese nuclear bureaucracy as well as the development of closer corporate links between a number of the Japanese consortia and Westinghouse and GE. Further political pressure was brought to bear on JAPC and the JAEC to sanction the import and construction of a LWR, as required by the 1957 plan. But this was resisted since the initial contractual and construction problems encountered with the GCR made it impossible for JAPCO to manage simultaneously two major reactor projects. Nonetheless JAPCO did reaffirm its commitment to a second project which was to be, as laid down in the 1957 plan, a LWR. (235) Despite this, American firms and their Japanese partners continued to press JAPCO to proceed rapidly with this second project. (236) As the decade drew to a close JAPCO, the AEB and the JAEC, were becoming increasingly impatient with the slow pace of progress on the GCR project and more convinced, under the barrage of domestic pressure and the force of international developments, of the wisdom of proceeding with a LWR.

Developments in both Euratom and the US had helped to convince the Japanese authorities of the urgency surrounding an indigenous LWR project. In Europe the joint US-Euratom co-operation programme had led, by 1961, to the award of three major LWR projects to American manufacturers. These contracts were won against stiff competition from French and British designed GCR's thus signalling the denouement of GCR technology. As the previous chapter noted this provoked a fierce 'reactor war' from which the GCR's fortunes never recovered. Moreover in the US, under the power reactor demonstration program, both BWR and PWR systems took strides in their commercial development. Several privately financed ventures were also underway. Indeed by 1960 the LWR was expected to be the mainstay of the domestic nuclear programme, so that even the US JCAE had abandoned its interest in the GCR. With the prospect of falling behind in the nuclear

technology race unless the LWR was quickly developed the JAEC initiated a review of nuclear plans in 1960.

Central to this review was the question of which technological path to commercial nuclear power should now be given priority: the GCR route or the LWR route? Apart from developments abroad two factors in particular were decisive in shifting official opinion to favour the arguments of the domestic proponents of LWR's. Firstly, the technical problems and delays encountered by JAPCO in the early construction of the Tokai Mura GCR provoked the JAIF into commenting that the '...turmoil of introducing the advanced Calder-Hall type power reactor has been a sour juice'. (237) The implication was clear: the experience with British technology was never to be repeated. Secondly, following the recommendations of the Strath committee in 1958 the emphasis placed upon the AGR, as the replacement for the GCR in the British nuclear programme, completely destroyed its commercial prospects in the Japanese market. With some justifiable annoyance, the JAIF, representing the majority of Japanese opinion, commented as early as 1960 that:

> What with ... the recent trend in the UK to switch off to the AGR concept, many, very many have come to be doubtful about the future of the Calder-Hall type power reactor.(238)

As a consequence the LWR became the critical issue in the domestic deliberations over the 1960 long range programme.

On February 20th 1961 JAPCO announced its intention to proceed with its second reactor project, which was to be a US LWR design. (239) Under enormous pressure from the three consortia linked to Westinghouse and GE, as well as the JAIF and the JAPCO board, MITI and the AEB had authorized the company to proceed with a second project. However, two particular problems arose: finance and fuel supply. With respect to finance JAPCO's Director made it clear, at a joint USAIF-JAIF conference in 1961, that:

> We are earnestly expecting that the financial institutions and manufacturers in the US would ... provide assistance and cooperation (financial) in order for us to materialize the next project.(240)

On the American side both the USAEC and the corporations held out the prospect of generous Export--Import Bank financing. On the fuel supply issue, the USAEC was able to confirm fairly liberal long term supply arrangements, reinforced by a 1963 amendment to the fuel supply quota set in the 1958 agreement, thus nullifying any residual Japanese concerns about enriched uranium availability. (241) Regular informal discussions between the USAIF, the JAIF, the USAEC, and the potential reactor vendors, Westinghouse and GE, cleared away any potential obstacles and consolidated the ground for greater industrial and governmental co-operation. (242) In May 1963, following eighteen months of detailed discussions with the Americans, JAPCO called for tenders for the construction at Tsuruga of a 250 Mwe LWR.

JAPCO's decision to construct a LWR confirmed the commercial death of GCR technology in Japan and committed the nation to dependence on American technology. This decision was reinforced by the order, also in 1963, for the privately financed Oyster Creek plant: a 64 Mwe GE BWR. Within a year, before the Tokai Mura GCR was operable and well before construction of the Tsuruga or Oyster Creek plants was completed,three Japanese utilities had announced their intention to purchase LWR's. (243) In 1966 the first commercial orders for LWR's were placed by Tepco and Kansai electric utilities and others, such as Kyushi, announced ambitious nuclear plans based upon the LWR. (244) Nuclear power was now on the verge of commercial viability and the new long term plan published in 1967, confirmed the predominance of the LWR in Japan's nuclear power programme.

In the years immediately following JAPCO's initial decision the USAEC helped the major US corporations consolidate their presence in Japan. Through Export-Import Bank financing vital finance was provided to ensure that the LWR remained commercially attractive to the electric utilities.(245) (See Table 5-10) More directly, with the negotiation of the new long term co-operation agreement in 1968 fuel supply arrangements

were strengthened. And finally, both Westinghouse and GE themselves extended and intensified their ties with their respective consortia so locking the Japanese nuclear industry more firmly into dependence upon American nuclear technology. This is evident from the fact that even in the early 1970's, with the emergence of potential new LWR suppliers such as Germany and France, commercial and technological bonds between the consortia and these American corporate giants were strengthened.(246) One of the unavoidable consequences of this process of consolidation was also that it tied the future course of the Japanese nuclear programme more firmly than ever before to that of the United States. As Lester observed

> An inevitable consequence of the te chnologically derivative nature of the Japanese nuclear program is that nuclear policy and politics in Japan continues to be quite strongly influenced by developments in the US.(247)

State Planning of the Nuclear Programme

Speaking on the subject of US-Japanese nuclear cooperation to a joint JAIF-USAIF conference in 1961 the President of the Nippon Atomic Energy Group, Mr Setok, talked of a:

> ...cooperative relationship between our two industries not in terms of just one or two reactors but in the context of our long term development programme.(248)

This is precisely what transpired. In the process the character of Japan's long term planning and its ability to fulfil these plans was subt ly, and sometimes not so subt ly, conditioned by the very nature of its cooperative relationship with the US. For the nuclear supply arrangements negotiated with the USAEC, and the process of corporate technology transfer, impacted directly upon the nuclear programme in two critical areas: the development of indigenous nuclear capabilities; and the growth and absolute size of the programme. In both of these areas supply arrangements offered inducements to, as well as imposing constraints and enormous uncertainties upon, Japan's nuclear planning establishment, all of which were reflected in the composition of the nuclear programme.

By controlling what technology and materials could or could not be supplied the USAEC secured some influence over Japan's nuclear research activities and the development of indigenous nuclear capabilities. In the initial years of nuclear cooperation the supply of plutonium for JAERI research was tightly restricted so curtailing some of the potential areas of R & D, particularly into advanced reactor concepts. (249) Only with the more liberal supply arrangements of the 1968 agreement did the USAEC make more generous supplies available so enabling the expansion of research activities in key areas such as the FBR and plutonium recycle. (250) Moreover, the lack of interest shown by the USAEC in developing cooperative R & D projects, as it had with Euratom, spurred the JAERI and JAEC into strengthening research links with other countries, specifically Britain, France and Germany. (251) Similar refusals to cooperate in aspects of fuel cycle technology (discussed in greater detail below) also affected plans for the development of indigenous reprocessing and enrichment facilities. (252) The USAEC even made attempts to have the JAEC and JAERI terminate its research into centrifuge enrichment technology. (253) In these ways cooperative arrangements with the US came to have not insignificant ramifications for the achievement of established plans.

One of the key factors which, in the early days, conditioned the potential growth and size of the nuclear programme was the availability of enriched uranium. Since the US had a monopoly over the supply of enriched uranium the ceilings placed upon how much would be made available to Japan, and under what conditions, were critical to the plans of both government and the nuclear industry. In practice the ceilings never really imposed harsh constraints upon the nuclear planners or the actual programme. Instead the close relationship between the nuclear bureaucracies in Washington and Tokoyo created a context in which these ceilings were set by mutual agreement. In effect this gave the USAEC an informal veto or at least a voice in shaping the JAEC's nuclear plans. But, as far as is

known, this was only used explicitly on one occasion which was during the negotiations for the 1958 power reactor agreement.

Scientists at the JAERI, together with the JAEC, initially proposed a rather ambitious R & D programme as part of the 1957 long term plan. However, in negotiating with the USAEC, the ceiling to be placed on enriched uranium supply, discussion turned to the proposed programme. USAEC officials regarded the programme as unrealistic and requested it be cut back, eliminating a number of projects. As Atoms in Japan reported at the time, the USAEC considered the plans so

> ... 'unrealistic' that it is difficult for the USAEC to get this bilateral approved by the US Congressional Joint Committee on Atomic Energy unless the plan turns to be more decisive and practical.(254)

(This, by the way, did much to lend support to the arguments of the JSC, and others, who opposed greater co-operation with the US precisely because they believed it led to US intervention in indigenous nuclear developments.) Yet when the 1958 agreement came up for renewal, once the civil programme had taken off, the reverse was the case. Far from constraining plans the supply arrangements actively courted their expansion.

In his letter to the President requesting approval of the 1968 agreement, Glen Seaborg, Chairman of the USAEC noted that:

> The primary purpose of this agreement is to provide the framework for assuring the long term supply of enriched uranium fuel required for the 13 Japanese power reactor projects identified in the appendix to this agreement.(255)

These new supply arrangements actively encouraged the massive growth in the nuclear programme laid down in the 1967 long term plan. But the new arrangements also made it imperative that any modifications to the plan or the schedule of individual projects, which had implications for fuel supply, be discussed closely with the USAEC. (256) This provided the USAEC with a mechanism for monitoring the progress of the Japanese nuclear programme and integrating this information into its own planning

requirements for the provision of enrichment services. In this sense, by setting the parameters for nuclear plans, it became an informal or latent participant in the JAEC's planning process.

When revisions to the JAEC's 1967 plan were agreed in 1972 the resultant request for a larger ceiling on enriched uranium supplies was sucked into a domestic political tussle in the US over the privitization of the USAEC's enrichment services. Incredible uncertainty was thereby created within the Japanese nuclear bureaucracy over the viability of established plans. Already the terms of enrichment contracts with the USAEC had been unilaterally altered in 1971; new terms wwhich created a nervousness amongst Japanese nuclear planners. (257) This uncertainty was further compounded by the domestic politics of the enrichment issue in the US. Enrichment policy was in a state of flux and this had significant consequences for Japan's nuclear programme since:

> The Japanese need for increased fuel supply commitments coincided with growing concern in the US as to the adequacy of the US enrichment capacity, and debate over whether it should be expanded by private industry or government. In the face of Congressional threats to object to any further foreign commitments, the US administration was reluctant to conclude amendments to any US agreement for cooperation, including that with Japan.(258)

Although an amendment was agreed, after much Japanese lobbying in Washington, the incident convinced the AEB and MITI that the Japanese nuclear programme could not be left hostage to the vagaries of the US domestic politics and so a search for alternative sources of fuel supply commenced.

The Politics of Nuclear Fuel Supply

High dependence upon energy imports has impressed upon '...Japanese utilities that the long term assurance of fuel supply is the most important consideration' in their planning. (259) Consequently security of nuclear fuel supply, from the early days of the nuclear power programme, has always been a key issue. Since the LWR became the mainstay of the programme a determined attempt has been made to encourage the development of indigenous

enrichment, fuel fabrication and reprocessing capabilities so as to reduce future dependence on foreign sources of nuclear fuel supply. In addition the early 1970s witnessed a growing unease with the US as the nation's sole supplier of enriched uranium with the result that the government began to cultivate alternative sources of supply. But policy on all these fuel cycle issues was shaped (even determined) as much by decisions taken in Washington as by the deliberations of government and industry in Tokoyo. On the two critical questions of private ownership of nuclear fuels and enrichment policy, the nuclear relationship with the USA left its own deep imprint on the character of Japanese policies.

(i) Private Ownership of Nuclear Fuels

Although the Basic Atomic Energy law was ambivalent about the question of private ownership of nuclear fuels the JAEC's 1957 plan implied government ownership and control. (260) This was not acceptable to private industry, particularly the utilities, since private ownership of nuclear fuels was seen as central to the development of an indigenous nuclear fuel cycle industry. Like the issue of public or private development of power reactors, the question of nuclear fuel ownership was a primary bone of contention in the struggle between government and industry to establish a mutually acceptable relationship between state control and private initiative in the nuclear sector. On the one hand, the NFC (which later became the PNC) together with MITI and the AEB desired government ownership for reasons of both security and long term energy strategy, whilst on the other hand, the JAIF, the FEPC, and the consortia argued for private ownership on the grounds that it was essential to the future viability of a private nuclear industry private sector.(261) As might be expected the issue was also closely intertwined with the debate about which reactor technology to import. Both the utilities and the JAIF favoured private ownership of nuclear fuels not just for ideological reasons but also because they were the main proponents of the LWR. They conceived the

development of LWR technology and a privately owned enriched uranium fuel fabrication industry as organically related. However, the signing of a co-operation agreement with the US in 1958 temporarily put an end to this particular debate.

As discussed earlier the 1958 agreement required the Japanese government to retain ownership of all US supplied nuclear fuel. (262) Whilst the evidence suggests that this was a purely American inspired requirement (largely because private ownership of nuclear fuel was not allowed in the US) there is no hint that the Japanese negotiators opposed this significant infringement of their national sovereignty. (263) Quite the contrary the AEB and the MITI used it to confirm and justify their desired policy of public ownership. That this is the case is demonstrated by the fact that simultaneously they were negotiating a co-operation agreement with the British which did not contain any prohibition against private ownership. Despite this the JAEC announced on 4th April 1958 that the title to all nuclear fuels would remain with the government until such a time when:

> ... with the settlement and stabilization of both domestic and foreign conditions, private ownership will be considered. (264)

Translated this meant until such a time as private ownership was authorized in the US. In this way the question of ownership of nuclear fuels in Japan became tightly coupled to the domestic politics of nuclear fuel ownership in the US.

Private industry, particularly the JAIF, continued to keep close surveillance on US developments with respect to nuclear fuel ownership. Following reports that the USAEC was reconsidering whether to permit private ownership of US enriched uranium abroad a limited relaxation in Japanese law was effected in 1961, granting private companies the right to own natural uranium. (265) This prompted the JAIF and the EPDC to increase political pressure on the JAEC to extend private ownership to enriched uranium too. But this was resisted since it could not compromise its

relationship with the USAEC which was still considering the issue. However, at a joint USAIF and JAIF conference in 1962 the USAEC emphasized that private ownership was high on its agenda and enabling legislation would soon be forwarded to Congress. (266)

MITI responded quickly to developments in Washington, where hearings on the proposed private ownership legislation were held by the USJCAE in June 1963. By August the Atomic Power Committee of MITI's Industry Rationalization Deliberation Council had convened two meetings to consider the nuclear fuel ownership issue. (267) But the difficult passage of the USAEC's bill through Congress (discussed in chapter 3) delayed MITI from making any public initiatives. Once private ownership was authorized by the US Congress, in August 1964, the politics of the fuel ownership issue in Japan was transformed immediately.

Passage of the private ownership legislation in the US reinforced the arguments of the utilities, JAIF and the consortia linked to the American reactor giants, that MITI, the AEB and the JAEC should now follow the American example and permit private ownership in Japan. (269) Moroever, with the emerging commitment to the LWR the government could not prohibit industry from taking advantage of the new possibilities which might open up for collaboration with American firms as the LWR fuel fabrication business was commercialized. One thing was clear, such colloboration would be made more difficult if nuclear fuel still continued to be under public ownership in Japan. In addition, attachment to the LWR meant that the development of a fuel fabrication capability was now becoming an important strategic objective but one which could only be achieved through the import of US technology. As a result the JAEC and MITI succumbed to organized pressure as well as developments in Washington. Private ownership of nuclear fuels was authorized by the Japanese Cabinet in October 1966 to take effect two years later in 1968. (270) This was timed to coincide with the entry into force of a new co-operation agreement with the US which facilitated the

implementation of this private ownership policy by permitting Japanese firms to own American supplied enriched uranium. (271)

(ii) Enrichment Policy

Writing not long after the 1968 bilateral co-operation agreement with the US took effect, Imai argued that:

> Although the bilateral agreement with the US theoretically assures a supply of enrichment services, uncertainties about this seem to suggest that it would be prudent to have at least a partical capability to meet enrichment needs from domestic sources. It is also a prudent industrial policy. (272)

In fact his comments echoed the tone of the JAEC's 1967 plan which stressed the need for an indigenous enrichment capability. However, what neither the JAEC nor Imai could forsee was just how prescient their arguments turned out to be.

Even prior to the import of a LWR the traditional concern over fuel supply vulnerabilities had led the JAEC to authorize R & D into enrichment technologies. (273) The problem was that with its limited resources it was not really feasible to develop and then evaluate the relative merits of the two main technologies: both diffusion and centrifuge enrichment. Whilst the USAEC provided some assistance, mainly one assumes to monitor Japanese technical developments in this sensitive area, the bulk of US technical knowledge on enrichment remained classified. Thus as Gilinsky and Langer pointed out in their (1967) study of the Japanese nuclear programme:

> Enrichment technology is the only area connected with civilian nuclear power that has remained largely secret and discussions of possible enrichment in Japan immediately raise difficult questions of technical, economic and foreign relations, especially with the United States.(274)

In fact very shortly after the JAEC's 1967 plan was published, calling as it did for greater investment in an indigenous enrichment capability, the USAEC unilaterally withdrew all co-operation with respect to enrichment techniques. (275) On the grounds of its proliferation implications, it sought also to have terminated all R & D in this area but particularly into centrifuge enrichment technology. This occurred too just at the time when

Japanese electric utilities began to embark upon a massive LWR construction programme which was completely dependent upon US enrichment supplies. Both factors strengthened the JAEC's argument for an indigenous capability; the problem was how to achieve it.

A twin strategy was adopted by the JAEC: intensive investment in the development of a domestic enrichment capability; and, following in the footsteps of URENCO (the British - Dutch - German joint centrifuge venture established in 1969) it began to explore the possibilities for a multinational enrichment venture. With respect to the first, as noted earlier, domestic R & D into enrichment technologies had led by 1972 to a decision to embark upon the construction of a prototype centrifuge enrichment plant. Whilst the USAEC endeavoured to restrict this development it was not successful in so doing.(276) With respect to international collaboration progress was complicated by political facators, mainly US domestic politics.

In September 1970 in discussions with State Department officials, the Japanese delegation suggested the possibility of a joint Canadian - US - Australian - Japanese joint enrichment venture.(277) Although receptive to the idea, given (as the last chapter illustrated) the State Department's increased emphasis upon multilateral initiatives in the non-proliferation issue-area, enrichment technology still remained classified thus preventing even initial collaboration. (278) However, the Nixon administrations desire to privatize the USAEC's enrichment services led, as noted in Chapter 4, to the opening up of enrichment technology to private industry and an historic offer to share the technology with allies.(279) This was exactly what the JAEC had desired and they engaged enthusiastically in discussions with the USAEC and private industry groups. Moreover, the JAEC's Enrichment Survey Committee, which had been formed in 1972 to study alternatives for securing future enrichment supplies and consisted of both

representatives of government and industry, lobbied hard in Washington to put the case for a joint US - Japanese enrichment venture.

At the Nixon-Tanaka summit meeting in August 1972 a considerable boost was given to US - Japanese enrichment cooperation since the final communique endorsed the establishment of a joint enrichment venture.(280) Discussions on a joint venture had arisen as part of a broader package in which Japan purchased:

> ...a substantial amount of enriched uranium services well in advance of actual need, which would provide the US immediately with substantial revenue ($320 million) that would otherwise have been earned a number of years later, while also providing Japan with a stockpile ... of enriched uranium.(281)

Within a few months the JAEC's Enrichment Survey Committee had become a participant in the Joint Westinghouse - Union Carbide - Bechtel Uranium Enrichment Associates enrichment venture (discussed in chapter 3) partly financing the study and sharing in the technical evaluation of alternative enrichment technologies. In hearings before the US JCAE in the autumn of 1973 the President of UEA, Jerome Komes, welcomed this Japanese participation:

> The Joint Committee may be aware that, over the past year, we have been discussing the general aspects of uranium enrichment with a key group of industrialists from Japan. This has led to the execution of an agreement whereby the Japanese Enrichment Survey Committee is contributing significantly to the cost of our study. They will participate in the study and will share in the results thereof to the extent permitted by the US laws and regulations of the AEC.(282)

This was the beginning of a transnational alliance which included Japan's FEPC, key utilities, Mitsubushi, UEA and Westinghouse. Their intention was to cultivate the favourable climate in both Washington and Tokyo for multilateral enrichment ventures, in order to acquire much needed government subsidies (both US and Japanese) for their own private enrichment venture. Thus representatives of the FEPC, the major utilities and Mitsubushi appeared before the JCAE at the same hearings in order to impress upon the US Congress the urgent need for a private joint venture.

Addressing the US JCAE, Mr Wada, Chief Executive of the Kansai Electric Power Company (but also representing the FEPC) argued strongly for a joint US-Japanese venture:

> ...at this stage when we should elect to proceed with an international joint venture for securing an enriched uranium supply, we highly evaluate and respect your country as a potential partner because of its actual operational experience of enrichment plants for several decades and also [sic] of its industries technical and economic capabilities. We, therefore, evaluate a United States - Japan joint venture as a very promising step. (283)

Moreover he went further and explained to the USJCAE that Japan would welcome private ownership of any such joint venture:

> Among a number of countries in the world, I believe Japan and the United States share a similar form of enterprise and similar business philosophy...And in this sense, it is very easy for us to understand the US fundamental policy, that is, to promote future enrichment projects by means of private industries.(284)

The irony of this statement was that the JCAE was less enamoured of private ownership of enrichment plants than were the Japanese representatives appearing before it.

Despite such lobbying, and the tacit support of the State Department, the issue of the joint enrichment venture was sucked into the controversy over public-private ownership of enrichment facilities. Progress was halted and even reversed. The USAEC's initiatives to accelerate the pace of private investment in the enrichment business alienated the Japanese authorities. For the unilateral changes made to the terms of enrichment contracts in 1973, followed, in July 1974, by the bombshell of the USAEC's temporary moratorium upon all new enrichment contracts, provoked the JAEC's Enrichment Survey Committee to consider seriously alternative arrangements for future enrichment supplies.(285) Moreover, the UEA increasingly appeared to make little progress since the conflict between the USAEC and the USJCAE over the future structure of the enrichment industry remained deadlocked. Consequently, in 1974, the Japanese authorities signed a contract with EURODIF for future enrichment supplies so signalling to the

US administration '...a concrete political expression of Japanese concern over the reliability of the US nuclear fuel assurances...'.[286] Paralysed by the Watergate crisis the gesture went largely unnoticed in Washington's political arena. Nevertheless, it signified the beginnings of a significant change in the US - Japanese nuclear relationship with Japan striving for greater self-sufficiency and diversifying its sources of nuclear supply.

The Politics of Nuclear Safety

Since the very earliest days of the nuclear programme nuclear safety issues have had much greater public salience in Japan than in the United States. Quite simply, the legacy of Hiroshima and Nagasaki created a very different political climate for the development of commercial nuclear power than in any other Western state. Public concern with the safety of nuclear power plants was voiced as early as the 1950s with the controversy over the siting ofthe nation's first research and power reactors. Largely in response to this demonstration of public anxiety the JAEC instituted transitory public hearings on the safety and siting of the Tokai Mura power reactor pioneering, in the West, the notion of legitimate public participation in what were regarded as arcane technical matters. With the growth of the environmental movement and the growing dependence on US LWR technology public disquiet with the safety aspects of the nuclear programme reached new heights in the late 1960s and early 1970s. But by then the issue of nuclear safety was very much an extension of the safety debate which had engulfed the US nuclear industry as a result of growing domestic opposition to nuclear power.

Environmental groups in Japan had emerged in the early 1960s in reaction to widespread industrial pollution.[287] But it was not until the late 1960s that environmentalist opposition began to have any success in the legislative field. Important legislation was introduced in 1968 and

1969, followed in 1971 by the creation of an Environmental Agency. Moreover, the emergence of the environmentalist movement became a catalyst for much wider dissent and dissatisfaction with the prevailing political consensus in Japanese politics. Support for the ruling LDP continued on a path of steep secular decline and the fragile political coalition upon which it was based was shaken to the core.(288) As a result the LDP was forced to reconsider many of the fundamental assumptions upon which its political legitimacy in the 1950s and early 1960s had been based. Policies were adapted and '...political influence over the bureaucracy increased in response to public criticisms of unpopular official policies or the consequences of earlier policies, such as pollution.' (289) The controversial issue of nuclear power safety was injected from abroad into this already turbulent political situation.

Growing dissent against nuclear power in the US impacted directly upon the Japanese nuclear programme. Because of Japan's dependence on US LWR technology every safety related incident in the US became a weapon in the armoury of those groups, like the environmentalists, the Socialist Party, the JSC and citizens groups, who vigorously opposed the nuclear programme. (290) As one report noted:

> Since Japan's own atomic energy program has relied so heavily on American know-how and designs, the debate over the adequacy of safety measures in the US is bound to exacerbate Japanese misgivings. Atomic power plant siting, therefore, has ... become an emotive and highly politicized issue in Japan. (291)

Politicization of nuclear power plant safety and licensing in the US was like a 'contagion of doubt' sweeping across the Pacific contributing directly to the politicization of the nuclear power programme in Japan. As the US safety standards and regulations underwent dramatic and continuous revisions, to dispell the criticisms of opponents and to prevent the erosion of public confidence in the industry, the unintended consequences for the Japanese nuclear programme were considerable. The USAEC's continuous 'ratcheting up' of safety standards required frequent changes to

Japanese plant designs and construction, thereby dragging the safety question to the forefront of public attention.(292) This in turn created construction and operating delays so contributing to increased costs, providing further ammunition for the opposition which consistently challenged the economic rationality of commercial nuclear power.(293) But the most fateful blow to public confidence in the Japanese nuclear industry came in 1972 with the ECCS hearings in Washington which lasted for well over a year.

As discussed in chapter 3 the ECCS hearings publicized the weaknesses and inadequacies in the USAEC's own safety criteria with the consequence that public confidence in the regulatory system reached a new low ebb. Since daily reports of the ECCS hearings were given prominence in Japan, through the media and opponents of nuclear power, the issue generated an enormous public backlash against commercial nuclear power.(294) Many local citizens' groups or 'residents' movements' (jumin undo) were formed to fight against the siting of nuclear plants in their prefecture or locality.(295) At the national level, the JSP, the Socialist Party, and the Scientists' Association attacked the whole basis of regulaltory and safety procedures.(296) Nuclear safety quickly developed into a major national issue and one which became significant in the 1972 general election. (297)

Opponents of nuclear power in Japan were able to exploit the public availability in the US of the vast quanity of vital technical information on nuclear safety questions which was so crucial to their own campaigns. This promoted the development of strong communication links between US intervenors and their Japanese counterparts. The latter were able to use these links to launch technically sophisticated critiques of the safety of nuclear power plants. In addition they sought the incorporation of American regulatory practices into the Japanese system so that in May 1973, following intense political pressure, the JAEC finally acceeded to the

holding of statutory public hearings on all nuclear power plant projects.(298) This concession provided the opponents of nuclear power with a new arena for challenging the nuclear programme; an arena which was conspicuously utilized.

By the mid 1970s, opposition to nuclear power had blunted public confidence in the nuclear power industry and the governments regulatory mechanisms. The JAEC, because of Japan's dependence on US technology, was placed in a very difficult political situation. The absence of any substantial safety R & D meant that there was little indigenous technical evidence which could be used to legitimize, in the eyes of the public, the JAEC's safety judgements. In reply to its critics therefore the JAEC's '... standard answer is to quote from risk evaluation studies done by the USAEC.' (299) This brought further recriminations since their critics were well briefed, sometimes by their American counterparts, on the inadequacies of all the USAEC's major studies. This opened up to public view the JAEC's major vulnerability as a regulatory agency since critics could charge that the:

> ... safety evaluation branch of the government is not properly qualified, because the most important technical proof of safety is based on tests and experiments abroad about which basic data are [sic] not available in Japan. (300)

Justified or not this was a wounding criticism which struck at the very foundations of public confidence in the nation's nuclear regulatory system. For the JAEC dependence on US technology appeared to bring with it a fundamental challenge to its own legitimacy as an institution responsible for safeguarding the public interest. As a result it sought to procure a greater degree of technological autonomy.

5.3.4 Bilateral Co-operation: some tentative conclusions

This short section has attempted to illustrate some of the ramifications for Japan's nuclear programme and policies, of its bilateral nuclear

relationship with the United States. Although the evidence has been somewhat fragmentary it does suggest that dependence on the US and American corporations had significant consequences for the direction, pace and politics of its civil nuclear power programme. This, as Huff indicates, was not unexpected amongst Japan's ruling elites for:

> While Japan has always welcomed international technology exchange, her leaders have also been alert to the political consequences which can ensue from them.(301)

Yet nuclear co-operation also brought with it the means by which Japan could liberate itself from some of the constraints of its initial technological dependence. The nuclear relationship with the US therefore had a certain dialectical quality to it.

By assisting and promoting the development of Japan's nuclear capabilities US corporations were in the long term creating potential competition in the nuclear marketplace. Thus, as the Japanese nuclear consortia became more technologically advanced so their relationship with their American partners underwent subtle structural changes. By the late 1970s, as Lester points out, the Japanese nuclear industry entered a more balanced partnership with the major American nuclear coporations.(302)

Equally growing sensitivity to the consequences which flowed from commercial and technological dependence on the US stimulated a rather powerful political reaction within the Japanese nuclear bureaucracy. It constantly struggled to establish greater autonomy and independence in the nuclear field, even in the face of opposition from the nuclear industry. This in turn brought it into conflict with US policies, as for example with respect to enrichment policy. Indeed as the evidence here indicates the conflictual side of the nuclear relationship became increasingly evident in the 1970s '... under the stress of changing policies in the United States and rising demands for self-determination' in Japan.(303) Yet, as Imai argued, writing at a time when the strains in the relationship approached breakingpoint, the bonds of nuclear co-operation are so strong that '...

neither side expects to gain very much by not continuing it. (304)

In the final section of this chapter the focus will be adjusted, away from bilateral cooperation, to bring into the foreground the political consequences for Japan of its closer integration, throughout the 1960s and 1970s, into the American inspired international nuclear non-proliferation regime.

5.4 Japan and the Evolving International Nuclear Non-Proliferation Regime

In the last chapter the discussion emphasized how the growing dissemination of nuclear technology together with the prospect of the arrival of commercial nuclear power initiated significant changes in US foreign atomic policy. Where the Atoms for Peace policy had concentrated upon bilateral controls, as a means to ensure that the spread of nuclear technology and materials did not contribute to further nuclear proliferation, the balance in American policy increasingly tilted towards multilateral mechanisms of control. This, as noted previously, was perceived as the most efficacious solution to reconciling American security and commercial objectives in a world in which nuclear power was coming of age. But for Japan this shift in American policy posed an uncomfortable dilemma: on the one hand, the nuclear industry feared that it would impose new constraints upon indigenous nuclear development whilst, on the other hand, the foreign policy establishment and many politicians welcomed such multilateral controls in preference to bilateral controls. In trying to resolve this dilemma Japan came into direct conflict with US policy on a number of issues. Moreover, in seeking to shape this evolving non-proliferation regime to reflect its own interests, Japan was forced to cultivate an increasingly active political role in the international arena.

5.4.1 Japan, the IAEA, and International Safeguards

Since its founding in 1957 Japan has developed a unique relationship with

the IAEA. Japan's preference for multilateral cooperation, as opposed to bilateral cooperation, made it the first state to trigger the Agency's nuclear supply function by requesting, in 1958, the provision of 3 tonnes of natural uranium for research purposes.(305) This in turn required the Agency to formulate its first safeguards policy and Japan became the 'test-bed' for their implementation. Indeed Japan pioneered the application of Agency safeguards with respect to commercial reactors and fuel cycle facilities; during the 1960s 50% of the Agency's safeguards activities involved Japan.(306) It also pioneered, as noted earlier, the transfer of bilateral safeguards to the Agency, so stimulating a major expansion in the latter's role in international nuclear commerce. And the JAIF was one of the first non-governmental organizations to be given consultative status by the IAEA.(307) Thus, in a very practical sense Japan has been one of the Agency's most active supporters.

Underlying this attachment to the Agency was a desire both to expand its supply function, thus reducing the need for Japan to depend upon bilateral cooperation, as well as deeper political motivations. Important amongst the latter was the fact that, as Gallinni argues:

> ...Japanese membership in the IAEA and its acceptance of Agency safeguards afforded the Japanese an opportunity to reassert the peaceful motives underlying Japanese involvement with nuclear research and development and reassure the international comunity that this involvement did not signal a resurgence of militarism in Japan.(308)

There was thus a strong core of support for the Agency within the Foreign Affairs Ministry, particularly the UN Bureau (which was responsible formally for government policy towards the Agency), and the AEB's International Affairs Division which dealt with safeguards policy. However, with the rapid development of the country's nuclear programme in the 1960s the nuclear industry, particularly the utilities together with PNC and JAERI, grew somewhat impatient with what was regarded as the 'intrusive' nature of Agency safeguards. Thus began a somewhat ambivalent stage in Japan's relationship with the Agency.

Although at a general level the commitment to the Agency remained strong, the expansion of international safeguards in the 1960s provoked considerable controversy within the nuclear industry. Since representatives of the utilities and the nuclear industry all but dominated the key safeguards policy making body, the Special Advisory Committee on Safeguards, their criticisms and interests came to be reflected in the drift of Japan's safeguards policy.(309)

One of the initial sources of conflict arose over the transfer of safeguarding responsibilities, with respect to the bilateral cooperation agreement with the US, from the USAEC to the Agency. While the evidence confirms that the request for this transfer came solely from Japan it is curious that it coincided with a major shift in US policy towards the Agency, as evidenced in the Smyth report.(310) It is perhaps not improper to speculate that the change in US policy, from ambivalence to the Agency to the enthusiastic promotion of its safeguards role, was not unconnected with the timing of the Japanese request. Indeed, whilst the Japanese desire for such a transfer had been articulated as early as 1960, it was not requested until 1962, the year in which the Smythe Report was published.(311) In this respect the imminent nature of major changes in US policy was undoubtedly significant in evoking the Japanese request.

However, a number of nuclear industrialists were not particularly enamoured by the transfer of safeguards responsibilities to the Agency. This, they believed, brought new uncertainties and potentially difficult commercial and operational problems. And, as noted earlier, the strong links with the US meant that there were some within the industry who would have much preferred to continue the existing safeguarding arrangements with the USAEC. But this was not possible for two reasons. Firstly, achieving the transfer of safeguards to the Agency, in respect of atomic cooperation with Japan, was vital to the American strategy of abolishing all bilateral safeguarding arrangements with its cooperating parties. Japan was somewhat

of a special case in this resepct. Of all the Western states with which the US cooperated it was one amongst a small number which had both a major commitment to nuclear power and in which Agency safeguards could be applied for all the Euratom countries, for example, were covered by their own safeguards systems.(312) It was therefore important for political and symbolic reasons that a swift, uncomplicated transfer arrangement be negotiated with Japan to entice others to follow suit. Secondly, the AEB and Foreign Affairs Ministry were extremely keen on the transfer arrangement since it would enhance Japan's international 'rehabilitation' and facilitate the consolidation within the Agency of safeguards administration with respect to all of Japan's other bilateral cooperation agreements (for example that with the UK). Consequently, as remarked upon previously, the strong commitment of both the US and Japanese authorities to the transfer arrangement acted as a kind of tacit transgovernmental alliance, helping to counteract the potential influence of those, in both Washington and Tokyo, who sought to oppose it. When the transfer arrangement was finally negotiated it was hailed in Japan as a significant coup for Japanese nuclear diplomcy.(313)

Whereas only a few nuclear industrialists had offered an essentially token challenge to the policy of safeguards transfer, the matter of extending Agency safeguards provoked much more serious and concerted resistance. Although Japan had been instrumental in establishing the Agency's very first safeguards system in 1961 (INFCIRC/26), the extensions to that system proposed in 1964 (INFCIRC/26 Addl), later in 1966 (INFCIRC/66/Rev1) and 1968 (INFCIRC/66Rev2) were opposed forcefully by the JAIF, the utilities and the corporations in the nuclear fuel industry.(314) But even fiercer resistance was mounted against the safeguards requirements of the NPT, delaying Japan's signature of the treaty and later its ratification; delays which brought it into conflict with the US since:

> ...there was a general inability on the part of US officials to understand Japan's strong aversion to the mechanisms of safeguards implementation in view of its strong support for safeguards and non-proliferation in principle.(315)

In each of these cases the industry's opposition to extending the scope of Agency safeguards was based upon two fundamental arguments: the commercial implications; and the operational implications.

In 1963 the JAIF established a Special Committee on Safeguards Systems to investigate the problems which might arise from the application of Agency safeguards in Japan. It researched the potential problems and collated the views of the utilities, the consortia, and others in the industry with the consequence that it became the focal point of industry resistance against the extension of Agency safeguards.(316) What exercised the nuclear consortia, and to a lesser extent, the utilities, was the commercial implications of agency safeguards. The fear was that international inspection could endanger commercial secrecy and lead to the dissemination of indigenous technical advances, so undermining any potential competitive advantages or commercial benefits which might otherwise have accrued to the Japanese nuclear industry.(317) In this regard the JAIF consistently called for an inspections system which did not '...infringe upon ... commercial secrets.' (318) Closely associated with this was the belief that because Japan was subject to Agency safeguards, the development of its nuclear industry and growth of the nuclear programme were severely handicapped in commparison with the American, German or French nuclear industries which were not subject to IAEA inspection.(319) What angered the JAIF and industrialists was the fact that their European allies in Euratom had a system of self-inspection which was perceived as much less onerous. Each proposed extension of Agency safeguards was therefore regarded as a further threat to the commercial integrity and future competitive position of Japan's evolving nuclear industry.

Besides these commercial worries, the JAIF, and the utility companies in particular, viewed with alarm the prospect of frequent inspections by

Agency personnel. What they feared, according to Gallinni, was that frequent inspections '...would interfere significantly with the smooth operation of nuclear facilities, producing costly delays and even shut-downs.' (320) This fear led the JAIF to call for a safeguards system in which the Agency's right to inspection was restricted:

> It should...be given rights to carry out stringent inspection, when, but only when, the IAEA has justifiable suspicion of violence ... There shall be no resident inspection. Normal rights of inspections should not infringe upon commercial operation... (321)

It was this concern which prompted the AEB and the Foreign Affairs Ministry, under pressure from the nuclear industry, to present a joint petition to the Ninth General Meeting of the Agency in 1965, calling for the curtailment of inspections on reactors.(322) This was vociferously opposed by the US and led the Johnson administration, in 1967, to invite the application of Agency safeguards to the American civil power programme.(323)

As the commercial power programme expanded and the frequency of Agency inspections increased (see Table 5-II) to the point where, as noted earlier, fifty per cent of the Agency's efforts were directed at Japan, the JAIF's criticism of safeguards intensified. This, together with the actual experience of Agency inspections, convinced the AEB, the Foreign Affairs Ministry and MITI, of the validity of some of the industry's fundamental criticisms of Agency safeguards. As Gallinni points out:

> The emphasis placed by the Japanese government on the need to refine existing safeguards procedures and improve the implementation of this policy by the Agency can be regarded as an indication of the importance placed by the government on mollifying the grievances of Japan's nuclear industry... (324)

This growing concern with the intrusiveness of safeguards was associated, according to one interviewee, with a widespread belief in official and nuclear industrial circles, that Japan, because of its initial enthusiastic support for the Agency, was being used as a 'guinea-pig' for international safeguards. (325) This made for a very tense relationship between the

Table 5-11 IAEA Safeguards Inspections in Japan 1966-1974

Year	Number of Insepctions	Man-days	Total Facilities
1965	2	14	7
1966	2	6	6
1967	3	20	12
1968	5	27	15
1969	6	84	34
1970	6	246	77
1971	9	324	147
1972	12	274	141
1973	-	272	149
1974	-	317	180

Source: Gallinni and FY 1976 Annual Report of the JAEC JAEC Tokyo 1976

Agency and the Japanese authorities. Furthermore, the concentration of the Agency's inspection efforts on Japan provoked deep resentment within political circles since it appeared to challenge the sincerity of the nations commitment to the peaceful uses of atomic energy which was enshrined somewhat uniquely in its basic atomic energy law. (326)

Events in October 1970 brought Japan's simmering discontent with the Agency to the surface. The catalyst was unscheduled inspections of the Tsuruga BWR plant. These provoked a major confrontation with the Agency since:

> Japanese patience with these unscheduled inspections rapidly wore thin, and at the end of the month senior executives of Japan's electric power industry lodged a strong protest with the Foreign Ministry, MITI, and the STA.'(327)

This incident had a profound impact upon Japanese policy with respect to Agency safeguards. Nor could it have come at a more crucial time since the Agency's Safeguards Committee, which Japan had recently joined, was in the initial stages of formulating the safeguards system to be applied under the NPT. In the light of this it has been suggested by some that the Tsuruga incident was manipulated by the Japanese nuclear industry to influence these discussions in Vienna.(328) Whether true or not it is indisputable that the prospect of NPT safeguards magnified the fears of the Japanese authorities and nuclear industry about the disruptive and intrusive character of international inspection. For NPT safeguards involved:

> The expansion of international safeguards coverage from individual nuclear facilities to the entire flow of nuclear material within a state ... hardly an appealing prospect for Japanese industrialists already alarmed by the image of an increasingly costly and intrusive network of international safeguards blanketing their nuclear facilities.(329)

Resistance to the extension of Agency safeguards became intimately connected with opposition to the NPT. This in turn brought Japan into diplomatic conflict with the United States.

5.4.2 Japan and the NPT

The NPT was the cornerstone of American non-proliferation policy in the 1960s; it was the core of the evolving nuclear non-proliferation regime inspired by US policy makers. But for Japan, the NPT presented a number of difficult political problems since it touched upon the most sensitive aspects of national security and appeared to undermine the nation's international status and prestige, as well as the commercial future of its domestic nuclear industry. Not surprisingly, therefore, it attracted fierce domestic opposition, provoking a highly controversial and confrontational domestic political debate which led to some curious political alliances. Yet even more curious was the proscribed and symbolic character of the debate: for all the participants tacitly accepted that membership of the NPT was a vital final step towards Japan's post war 'rehabilitation' and integrat ion into the Western political community. Nonetheless, the controversy raged for almost eight years, and was not finally resolved until 1976.

According to Huff the '...overall goals set out in the NPT received wide support in Japan.' (330) What was at issue in the domestic debate therefore was not the principles underlying the treaty but rather its approach, and the demands it imposed upon non-nuclear weapons states (NNWS) such as Japan. Since Japan had an espoused non-nuclear defence policy there was no suggestion, unlike with a number of other NNWS, that the question of whether or not to keep open the nuclear weapons option figured prominently in the debate. On the contrary, as Frankel remarked:

> To an outsider, membership of the NPT seems to conform with the major orientations of Japan's foreign and domestic policies, being the logical outcome both of Japan's security ties with the United States and of her non-nuclear policy.(331)

What then fuelled the domestic controversy over NPT membership? Essentially, there were four key aspects to the debate: the NPT's implications for Japan's security; its political ramifications: its

potential restrictions upon the commercial nuclear power programme; and the problem of safeguards.

(i) National Security

Many right wing members of the LDP opposed the NPT because they perceived it did little to enhance Japan's security. The fundamental guarantee of Japan's security, they argued, lay in the alliance with the US and specifically in the Security Treaty. But growing uncertainties about the US guarantee created some uneasiness with increased reliance on its ally, which is precisely what NPT membeship implied.(332) Both the right wing of the LDP, which desired the strengthening of the security treaty and the JSP which wanted to weaken it, used the debate over the NPT to resurrect the whole question of security relations with the US.

Since China was not expected to joint the treaty, yet presented an emerging strategic threat to Japan, membership of the NPT, opponents suggested, might actually undermine the nation's long term security. UN security guarantees in this context were dismissed as being worthless largely because, as the JSP argued, the extension of the US nuclear umbrella to Japan complicated its situation making such guarantees irrelevant. Additionally, Chinese membership of the UN Security Council undermined Japan's confidence in any UN security guarantees.(333) To its opponents therefore:

> The Nonproliferation Treaty gave Japan little in the way of added security except in the general sense that the world is presumed to be a safer place now that the treaty has gone into effect.(334)

This rather pessimistic evaluation of the treaty's security implications was not shared by the proponents of the treaty in the Foreign Affairs Ministry and the dominant factions in the LDP. Great stress was placed upon the government's confidence in the US nuclear umbrella as well as prospective security benefits to be gained from the NPT as a first crucial step towards nuclear disarmament.(335) This latter, because of widespread public support for nuclear disarmament combined with an influential peace

movement, generated much political support for the government's position. Moreover, some of the arguments of the LDP's right wing alarmed many in Japan since their opposition to the NPT appeared to imply a rejection of Japan's long-standing non-nuclear policy.(336) This reinforced the fragile hegemony of the NPT's proponents in the argument about its security implications.

(ii) Political Considerations

Perhaps the most powerful catalyst in strengthening and uniting the many disparate forces against the treaty was its institutionalization of the inequality between the nuclear weapon states (NWS) and the NNWS.(337) Domestically, proponents of the NPT could not possibly defend the treaty's classification of Japan:

> ... among the nuclear have-nots, a second class category of states, out of bearing with Japan's increasing economic strength and international status...(338)

This was an emotive issue and it visibly strengthened political opposition to the NPT. But it was not an issue which was decisive in determining public reaction to the treaty largely because it appeared an inevitable consequence of the prevailing structure of power in the world; there was an element of resignation to the realities of international politics. Whilst all the political parties, and even the government, were united, as in all other NNWS, in their declarations of contempt for this aspect of the treaty it did not fundamentally affect the politics of the NPT issue. Certainly the government argued that whilst the regime:

> ...proposed by the Treaty was by no means one which the Japanese could be expected to consider ideal ... on rational calculation, the balance of advantages and disadvantages between becoming a party to the Treaty and staying out seemed to be very heavily in favour of joining.(339)

(iii) Commercial Ramifications

It was concern about the treaty's implications for the continued growth and development of the nuclear power industry which, together with the matter of safeguards arrangements, proved to be a major obstacle to the

development of a domestic consensus on the treaty. The intimate relationship between the nuclear industry, the nuclear bureaucracy, and the LDP, awarded the industry's objections to the treaty a salient position on the government's agenda. The JAIF, together with the AEB, MITI, and the JAEC were deeply worried by a number of provisions in the treaty.

What was uppermost in the industry's mind was that the treaty could be used to constrain indigenous nuclear development in Japan. In particular, it was felt that a rigid interpretation of the treaty might restrict or even prevent certain types of nuclear R & D.(340) Moreover, there was a strong conviction that the treaty institutionalized certain commercial advantages for the NWS. Imai makes the point that the huge military nuclear R & D expenditures of the NWS were not restricted by the treaty thus allowing them to subsidize their commercial nuclear development; a subsidy which could be (and has been) turned to their commercial advantage.(341) He used the example of uranium enrichment technology to highlight the commercial advantages accruing to the NWS by virtue of the fact that the technology was originally developed for military purposes and paid for by the state. Such subsidies, particularly in nuclear R & D, make it difficult for Japan, or any NNWS, to compete with the NWS on equal terms. In this respect, it is argued, the NPT condemns the NNWS like Japan to a permanent situation of 'catching up' with the nuclear industries in the NWS. Imai makes this point forcefully:

> The NPT in a sense puts into writing the advantages of the NWS. It is important that there is some form of guarantee that these advantages will not be employed for industrial or trade gains by the NWS. (342)

Along with the majority of NNWS there also deep anxiety about the potential restrictions upon nuclear technology transfer which might flow from accession to the NPT. Whilst proponents of the treaty highlighted Article IV, which was a broad commitment by the NWS to assist the NNWS in the peaceful exploitation of nuclear technology, the JAIF was not convinced that this would guarantee full and unrestricted transfers of all nuclear

technology and materials. The AEB and the Foreign Affairs Ministry, on behalf of the nuclear industry, therefore sought assurances from the US government that acceptance of the NPT would not hinder the free flow of American nuclear technology to Japan. In reply the USAEC's and State Department's:

> ... promises to continue the broad technological exchange program that had grown up between the two countries along with assurances that Japan would benefit from the technological spin-off of the vast American military research and development program

ameliorated many of the AEB's and JAIF's fears.(343) However, the uncertainty about how the NPT's requirements would be implemented and the unwillingness of the NWS to provide any specific guarantees about supply policy:

> ...reinforced a feeling of lingering uneasiness among Japanese nuclear industrialists concerned with promoting the development of their industry and preserving a competitive position in international trade. (344)

(iv) International Safeguards

Reference has been made already to the growing resistance within Japan to the enforcement of Agency safeguards. The substantive reasons behind this have been rehearsed above and the emphasis here is upon how it affected the debate over the NPT. There can be little argument that, at least with respect to the question of Japan's ratification of the treaty, the fundamental impediment was safeguards.(345) The nuclear industry, the AEB, and the Foreign Affairs Ministry were exercised by two issues: equality of treatment with Euratom; and the intrusiveness of existing safeguards mechanisms. Once these issues had been resolved to the satisfaction of the nuclear industry its opposition to the NPT dissolved. But the more determined opponents of the NPT, in the LDP, and within the government, cultivated this resistance to safeguards as part of a broader political strategy to encourage suport for their cause. As a result both the inevitable signing and ratification of the treaty, as explained below,

were considerably delayed causing a heightening of tension in Japan's relationship with the US.

(v) The Debate over NPT Accession and Ratification

There were essentially two phases in the domestic political debate over the NPT: the first phase (from 1967 to 1970) concerned Japan's accession to the treaty; the second phase (from 1970 to 1976), its ratification. In each phase the issue of safeguards played a quite distinctive role but varied in terms of its impact upon the final policy outcome. Whilst the first phase involved a wide-ranging debate, covering the fundamental question of whether Japan should or should not accede to the treaty, the second phase was somewhat more circumscribed, focusing largely upon how some of the feared consequences of membership might be mitigated before the treaty was ratified by the Diet. In both cases domestic politics as well as international diplomacy shaped the actual outcomes.

According to Huff, the political controversy with regard to Japan's signing of the NPT was in '...large part ... a question of timing.'(346) There was a reluctant acceptance, particularly amongst opponents of the treaty, that although a number of its terms were unacceptable, politically it would be impossible for Japan not to accede to the NPT. Not only would such a refusal have undermined the whole thrust of its post-war foreign policy, based as it was on a determination to achieve 'respectability' and full acceptance within the Western alliance, but also it would have been totally at odds with its own non-nuclear policy. Additionally, it would have irreperably damaged its alliance relaitonship with the US (a fact which many of the domestic opponents of the NPT would have welcomed); a relationship upon which Japan depended for its security. If, therefore, accession to the treaty was inevitable, why then was the debate so prolonged? The answer lies in both the constraints of NPT diplomacy and characteristics and dynamics of Japanese politics.

From the late 1960s domestic disquiet within the nuclear bureaucracy and the nuclear industry about the NPT forced the Foreign Affairs Ministry to take a much more active and visible role in NPT diplomacy. This was a difficult task since on many issues it placed Japan on the opposing side of the argument to the US, and its other Western allies. Nevertheless, during the NPT negotiations (from 1965 to 1968), attempts were made, sometimes successfully, to influence the final terms of the treaty. This involved 'back-channel' diplomacy as well as efforts aimed at mobilizing joint policy action amongst those major NNWS (including West Germany, Italy, Sweden, India and Switzerland) with strong reservations about the treaty.(347) Together with West Germany, joint approaches were even made to the US. But once the treaty was signed by the major powers on July 1st 1968, Japanese diplomacy focused upon the possibilities of cooperative action amongst the NNWS to alleviate some of the consequences of NPT membership. Consequently, Japan's accession to the NPT was delayed initially whilst it participated in the Conference of NNWS in Geneva during September 1968.

As Huff notes the '...Japanese were most disappointed in the results of the conference' and as a result put off signing the treaty.(348) For well over a year the domestic controversy, over the question of accession, continued to rage. Various justifications for the postponement were given including the invasion of Czechoslovakia and the delays in West German accession. But whatever the official justifications the underlying cause of delay was the government's search for a domestic consensus on the NPT. As explained earlier in the chapter, the character and style of Japanese policy making places enormous stress upon consensus politics. According to Destler:

> To [the] Japanese, maximum effort should be made to involve and accommodate a potentially dissident minority in the process of decision making; something decided by a majority and imposed without such an effort at accommodation is viewed as arbitrary amd overbearing.(349)

Consequently, the form which the decision making process takes becomes equally, if not more, important than the substance:

> Respect for form includes efforts to assure that all relevant actors are properly consulted. It can also include adoption of a principle important to certain policy actors ... but with adjustments in its practical application that result in an actual outcome at variance with their preferences ... attention to form gives potential dissidents a face-saving way out: they have a chance to participate in the decision; they win acceptance of their principle.(350)

On an issue as controversial as that of the NPT the emphasis upon form became crucially important. This was particularly so since the treaty, as already discussed, ellicited opposition from powerful organized interests from both within and outside the government. In addition, the knowledge that, because of external political constraints, the final outcome of the debate was essentially preordained meant that attention to form became even more vital that normal. As a result the domestic controversy dragged on from 1968 to 1970 as the proponents of the treaty within the government adopted a slow process of consensus-building. This proved extremely difficult, largely because the concerns of the JAIF, the right-wing of the LDP, and the JSP, were essentially contradictory.(351) But the political fragmentation of the opposition also helped to strengthen the hand of the treaty's proponents. With growing alarm at the delay, the Foreign Affairs Ministry and the AEB sought to achieve a compromise lest the failure to sign the treaty by the Spring of 1970 jeopardized Japan's participation in the special safeguards committee whose task was to design a revised safeguards system as required under Article 3 of the treaty. In January 1970 the political deadlock was broken when the LDP announced its support for signing the treaty and shortly thereafter in February, the Cabinet too, finally decided in favour of accession.(352) But as the Foreign Minister stated at the time:

> We do not mean that it is quite desirable for Japan to sign this treaty now. We think, however, that it is wiser for Japan to sign the Treaty than not to do so, when all things are taken into consideration.(353)

In fact, the Cabinet's decision to accede to the treaty was qualified by a compromise agreed with its opponents, that the government would:

> ... withold ratification pending satisfaction that the safeguards to be applied under the treaty would be acceptable.

No sooner had the controversy over signing the NPT receeded when the debate over the treaty's ratification commenced.

Even though the government signed the NPT on February 3rd 1970 it was still '... viewed as unsatisfactory by nearly everyone.'(355) Within government and industry the greatest reservations concerned the application of NPT safeguards. Almost a third of the government's statement on its accession to the NPT was devoted to the question of safeguards.(356) It was clear that, the combined pressure of the JAIF, the AEB, and MITI was not going to permit the Foreign Ministry's enthusiasm for the treaty to override the potential damage which might be inflicted upon the Japanese nuclear programme by a new safeguards system. Consequently, the government adopted a major role in the Safeguards Committee's deliberations upon NPT safeguards. Gallinni confirms this noting that:

> ... Japanese concern with the problem of NPT safeguards has been expressed in a number of ways, one of the most notable of which was the consistency and intensity of Japanese involvement in the proceedings of the Safeguards Committee which convened in Vienna in the spring of 1970.(357)

Thus the political question of Japan's ratification of the NPT therefore came to depend almost entirely upon whether a new safeguards system could be devised which was acceptable to both the international community and Japan's nuclear industry.

Through intense diplomatic activity within and outside the Safeguards Committee, Japan was able to forge influential political coalitions on key safeguards issues. Its unique and extensive experience of Agency safeguards contributed to its diplomatic persuasiveness. By May 1971 a new model agreement for safeguards under the NPT was approved by the Safeguards

Committee. Included in the model agreement was Article 7, arguably the most crucial of all its terms, which was:

> ...hailed as an achievement of Japanese diplomacy, and was envisioned in both industrial and government circles as a significant means of minimizing the objectionable aspects of safeguards implementation.(358)

Article 7 allayed most of the fears emanating from the Japanese nuclear industry and nuclear bureaucracy concerning the extension of Agency safeguards under the NPT to cover every aspect of Japan's nuclear activities. As a result, following this diplomatic success, preliminary negotiations between the Agency and the Japanese government for the application of NPT safeguards in Japan were concluded in November 1973 to the satisfaction of both parties.(359) In Gallinni's view this had profound consequences for the debate over ratification:

> In November 1973 ... the Foreign Ministry and the STA announced substantive agreement with the IAEA regarding implementation of NPT safeguards, thus ostensibly fulfilling one of the preconditions defined by the Japanese government as essential to ultimate Japanese ratification of the NPT. (360)

Tentative agreement between the AEB and the Agency, with regard to the application of NPT safeguards in Japan, removed a major obstacle to ratification of the treaty. The agreement signified (the much sought) equality of treatment with Euratom countries and guaranteed a much less intrusive system of inspection.(361) This together with Euratom's decision to enter into a safeguards agreement with the Agency, and the anticipated safeguards agreements between the Agency and the US and UK, removed several key impediments to the realization of a domestic consensus on ratification. Opposition to ratification from the JAIF and the AEB evaporated and on December 11th 1973 the Prime Minister announced government preparations for the submission of the NPT to the Diet for its formal ratification.(362) However, as Frankel explains, ratification was further delayed by the peculiarities of Japanese party politics:

> ... there was still a time-lag in a parallel shift to a full support for ratification in the opposition parties which had opposed the signature of the Treaty, as well as in the press. Against its initial wishes, the Government was thrown back on a debate mainly about the basic orientations of Japan's foreign policy and was forced to steer between the Scylla of offending the right-wing critics and the Charybdis of offending those on the left.(363)

This resulted in the government's reluctance to forward the treaty to the Diet for ratifiction until it could guarantee a smooth passage.(364) Ratification was to take a further two and one half years; a delay which increasingly aggravated the American foreign policy establishment.

5.4.3 US-Japanese Relations and the NPT

Throughout the years of Japan's domestic controversy with regard to the NPT US foreign policy makers became more and more frustrated with the government's apparent inability to expedite the process of NPT accession and ratification. From the American perspective Japan's reluctance to sign and then later ratify the treaty weakened the evolving non-proliferation regime. Specifically, it made persuading those other states who had not acceeded to the treaty much more difficult, particularly when their objections mirrored those of the Japanese. There was, however, a reluctance amongst American officials to become involved, at least publically, in Japan's domestic politics since on such a sensitive issue '...they fully realized that American pressures could easily become counter-productive.'(365) This realization led to much 'behind the scenes' communication, through the transgovernmental networks which connected the nuclear policy making communities in Washington and Tokyo. Through these networks the US provided what assistance it could, as well as signalling their displeasure with the direction being taken by Japanese policy. This was particularly the case with respect to Japan's statements and proposals on safeguards matters.

On a number of occasions Japan found itself in open disagreement with the US. When in 1965 and later in 1967 the AEB and Ministry of Foreign

Affairs proposed the abolition of safeguards on reactors during a joint USACDA-AEB conference in Tokyo in 1967, the US made clear its objections to such proposals and sought some concertation of views on safeguards questions.(366) Nor did the US take kindly to Japan's attempts, in the IAEA Safeguards Committee, to liberalize Agency safeguards, though they did support its proposal of Article 7.(367) But the protracted delay over ratification caused intense anger in Washington. State Department and ACDA officials could not understand why, after the safeguards question had been resolved in 1973, the government did not move to have the treaty ratified. This increasing frustration boiled over and according to Baker:

> ... in 1973 and 1974 the United States intensified its efforts to convince the Japanese government to ratify the NPT as part of its larger political objectives in Asia. One of the arguments used by American spokesmen was that it might be impossible for the United States to continue to supply the Japanese nuclear industry with enriched uranium fuels if the Japanese government failed to ratify the NPT.(368)

This, it is argued, sealed the nuclear industry's change of mind with regard to ratification and moved the debate forward. According to Frankel:

> in the private persuasion process, the argument that the ratification was a sine quo non for a [sic] continued cooperation with the United States was said to have played a significant role.(369)

American influence and American interests, though perhaps less visible than on many other issues, certainly helped to shape the political dynamics of the domestic debate in Japan over the NPT. Particularly with respect to Japan's accession to the treaty in 1970 the pressure emanating from Washington must have been a significant influence upon the government's decision to separate out the question of signing the treaty from its ratification. For the government, and the nuclear industry, were only too aware of the fact that Japan was reliant upon the US both for its military security and the supply of nuclear technology, equipment, and fuel. This relationship of dependence compelled the Japanese authorities and nuclear industrialists to anticipate American reactions to their statements and initiatives in the domestic policy debate over accession and ratification.

In this sense American interests were internalized in the debate and direct US involvement or intervention was unnecessary; the major policy actors in Japan were already keenly attuned to the priorities and aspirations of US policy makers. Thus as Frankel notes above, (and interviews confirmed this) the need to sustain a cooperative relationship with the US became an important weapon in the government's hands within the context of the many private, internal bureaucratic and political struggles over accession and ratification.(370) The significance of the NPT issue to its proponents on both sides of the Pacific also created fertile circumstances for the development of transgovernmental and transnational alliances.

Whilst there is no conclusive evidence that such alliances were of paramount political importance in determining policy outcomes on the NPT issue, there is sufficient hard evidence to suggest that some tacit coordination of policy, between Washington and Tokyo, did occur with the object of influencing the direction of the debate on accession and ratification in Japan. American initiatives in 1967, with respect to opening US civil nuclear facilities to Agency inspection, were clearly designed to counteract JAIF opposition to the extension of safeguards. Huff, for instance, relates how:

> JAIF members were invited to view an inspection process at the Yankee Atomic Power Station at Rowe, Massachusetts, and reportedly commented on the 'non-intrusive' nature of the inspection.(371)

And Frankel too implies that some coordination of official statements and policy initiatives was undertaken between the policy makers in Washington and Tokyo in order to progress the debate over ratification.(372)

Although the Japanese government had not ratified the NPT by 1974 (the historical boundary to this study) the outcome of the debate was regarded as inevitable. In the wake of the Indian test in 1974, and the resultant reform of US non-proliferation policy, the question of ratification, like that of accession, became simply one of timing.

The political controversy over the signing and ratification of the NPT had profound political consequences: to many observers it suggested the beginnings of a radical change in the nuclear relationship between Japan and the United States.(373) For it brought the two states into open disagreement on a number of very important non-proliferation issues. Together with the conflict over enriched uranium supply, the 1970s began to signal a considerable divergence of interests between Japan and the US in the nuclear issue-area. Alongside this, the NPT debate had forced Japan to take a much more active diplomatic role in the international non-proliferation regime; it sought new alignments and tacit alliances in order to ensure that its own interests and requirements were reflected in the evolving rules and procedures of the regime (e.g. Article 7 of the model safeguards agreement). Finally, the developing awareness that its interests were not always consonant with those of the US, combined with its initial diplomatic success in shaping the character of NPT safeguards, reinforced Japan's drive for greater autonomy in the nuclear arena. The domestic debate over the NPT therefore came to have significant implications for the future character of US-Japanese civil nuclear cooperation.

5.5 US-Japan Civil Nuclear Cooperation: Some Concluding Observations

In the two decades since the initiation of its nuclear cooperation with the United States, Japan progressed from a situation of total dependence upon American technology and nuclear fuel to a situation in which it had acquired substantial technological autonomy. But just as it attempted to exercise that autonomy it found that changes in US policy sought to constrain its actions even more so than in the past. For, in the wake of the Indian nuclear explosion, proliferation concerns had become a major political issue in the United States with the consequence that American foreign atomic policy, as the last chapter described, became preoccupied

with strategies for controlling nuclear development abroad. This brought Japan into direct confrontation with the United States since the latter attempted to utilize the panoply of controls and discretionary authority granted to it under the bilateral cooperation agreement in order to prevent those developments which did not accord with its non-proliferation objectives. As a result, throughout the latter half of the 1970s, the nuclear relationship between both countries deteriorated, provoking growing disillusionment and disenchantment in Japan with the nature of the US-Japan alliance. Nuclear technology became a source of conflict between the two states as their respective policy objectives and interests diverged.

For Japan the structure of its nuclear relationship with the United States became an increasing liability in, and constraint upon, its attempts to expand the domestic nuclear programme in the mid to late 1970s. As US policy drifted back towards a pre-Atoms for Peace strategy of denial, Japan found its nuclear plans increasingly vulnerable to potential disruption by the US. Under the bilateral cooperation agreement requests for permission to carry out certain nuclear related activities, such as reprocessing, which previously would have been dealt with routinely by the USAEC, were now elevated into matters of high policy because of their implications for the coherence of the new US non-proliferation strategy. Somewhat ironically, just as Japan was attaining greater technological and commercial independence from the US in the nuclear energy business, progress in key areas of its atomic energy programme became contingent upon the domestic and bureaucratic politics of US non-proliferation policy. This was not a happy situation but it was one which, as this chapter has shown, was not entirely unfamiliar to Japanese policy makers and nuclear industrialists.

At various points in this chapter the discussion has emphasized how the framework of bilateral cooperation with the US has conditioned and constrained nuclear developments in Japan. On a range of important policy

issues, such as the private ownership of nuclear fuel, the size of the nuclear programme, nuclear safety questions and many others, decision making in Japan has been tied to developments in the US. Dependence upon the US as its dominant nuclear supplier and US corporate penetration of the Japanese nuclear industry created a high level of inter-dependence and perceptual linkage between the actions of decision makers, as well as events, in Washington and Tokyo. But as the discussion here has shown Japan's dependence upon the US brought with it an extraordinary high degree of sensitivity and vulnerability to American policy and actions. Moreover, as the debate over the NPT demonstrated, such dependence brought about a very keen awareness amongst policy makers and nuclear industrialists in Japan of the preferences and aspirations of US policy makers. As a result the US rarely had to resort to crude diplomatic or political intervention in Japan's internal bureaucratic and domestic policy debates to ensure that its interests were taken into account. It would be crass, however, to argue that the nature of nuclear cooperation with the US merely condemned Japan to a position of subservience. The fact is that whilst cooperation undoubtedly imposed constraints upon Japan's nuclear development, equally it enabled it also to lay the technological and industrial foundations for greater autonomy in the future. Cooperation therefore pulled in contradictory directions.

Throughout this chapter many examples have been given of how the process of cooperation assisted and encouraged Japan's drive for greater autonomy in nuclear matters. Although initially completely reliant upon US nuclear technology the indigenous nuclear industry very quickly absorbed American techniques. By the early 1970s Japan had built up a sophisticated nuclear infrastructure and an impressive industrial base for the manufacture of nuclear power plants. Its indigenous nuclear industrial capability was maturing and its nuclear consortia developed a more equal partnership with their American licensors. Moreover, investment in

indigenous enrichment and reprocessing facilities, combined with the availability of alternative sources of nuclear fuel supply, increased the potential scope for greater autonomy in the exploitation of nuclear energy.

The acquisition of these technological and industrial capabilities was also accompanied by a strengthening, within the nuclear bureaucracy, of the commitment to reducing dependence upon the US. Various episodes in the nuclear relationship confirmed the initial aspirations of the JAEC, first articulated in its 1961 long term programme, to pursue a strategy of nuclear development which promoted Japan's eventual commercial and technological independence. Problems with respect to fuel supply arrangements in particular became a primary motivation underlying this strategy. Dependence thus provoked a powerful reaction on behalf of the state to adopt policies which sought to mitigate or prevent its worst consequences.

Finally, what is also interesting is the way in which Japan's integration into the evolving non-proliferation regime was instrumental in its struggle to achieve its aspirations to greater autonomy. Both the issue of safeguards and the NPT forced Japan into a proactive diplomatic role. Moreover it exploited this new arena of multilateral diplomacy, as discussed earlier, in a quite successful attempt to ensure that the rules and procedures of this maturing regime reflected its own national interests.

The various snapshots of the US-Japan nuclear relationship presented in this chapter tend to confirm that whilst, over most of the period covered by this study, Japan was almost entirely dependent upon the US for the expansion of its nuclear programme and the development of its nuclear industry this did not guarantee harmonious or frictionless relations. Rather the relationship was much more complex than the simple label of dependence would suggest; it was laden with contradictory impulses and pressures. This raises interesting questions about the strengths and

limitations of the theoretical perspectives introduced in chapter one and to which the focus returns in the following, concluding chapter.

Chapter Five Footnotes

1 This is taken from Wallerstein's essay 'The rise and future demise of the world captialist system' in Wallerstein I. The Capitalist World-Economy Cambridge University Press, Cambridge 1979 p.53.

2 See Ward R.E. Japans Political System 2nd Edition Prentice-Hull NYC 1978 p.32.

3 These figures are taken from Kosaka M. 'The International Economic Policy of Japan' in Scalapino R.A. ed. The Foreign Policy of Modern Japan Univ. of California Press, Lodon, 1977 p.207.

4 See Wit, D. 'The United States and Japanese Atomic Power Development' World Politics V8 No.4 July 1956 pp.515-533.

5 Wit notes that maximum coal production was 55 million tonnes p.a. but projected demand for 1970 was 61-65 m.t. Reserves were put at only 200 m.t. In fact in the early 1960s the government rationalized the coal industry closing down many expensive pits. See ibid.

6 These figures are taken from Imai R. 'The Political Outlook for Nuclear Power in Japan' Atlantic Community Quarterly V13 Summer 1975 pp.226-243.

7 In fact Wit notes the reports in 1957 of predicted energy shortages by 1975. See Wit op cit.

8. This figure is quoted in Gilinsky V. & Langer P. The Japanese Civilian Nuclear Program Rand Memorandum RM-5366-PR Rand Corporation Santa Monica August 1967 p.6. Of course the relatively high cost of electrical power in Japan also meant that it would be an ideal place for the US nuclear industry to demonstrate the economic viability of nuclear power.

9 Wit op cit.

10 A MITI survey in 1957 predicted a shortage in electricity generating capacity in the 1970s. See Atoms in Japan V1 No.2 'Outlook for Nuclear power generation in Japan as Investigated by 3 Governmental Organs'.

11 See Gilinsky and Langer op cit p.5. It is important to understand that in the late 1960s and early 1970s thermal power stations were seen as the major source of environmental pollution. Moreover air pollution in Japan was a major political issue in the early 1970s.

12 These figures are taken from Imai (1975) op cit.

13 For details of the 1957 plan and its political and bureaucratic origins see Seiki W. 'The Road to Atomic Power' Japan Quarterly V5 October 1958 pp.418-425.

14 This is acclaimed in Kodoma K. 'How the government is ensuring there is adequate nuclear power available' Nuclear Engineering International, V24 No.293 December 1979 p.54.

15 For details and background on these early developments see: Shapley D. 'Nuclear Weapons History: Japan's Wartime Bomb Projects Revealed' Science V199 13th January 1978 pp.152-157.

16 Under the post war Settlement Treaty of San Francisco 8th September 1951 Japan regained its sovereignty on April 28th, 1952 when the US military occupation ended. See: Ward, op.cit. pp.186-7.

17 On the development of the constitution and the US role see ibid pp.19-24.

18 On the background and details of these early developments see: Imai R. 'Japan and the Nuclear Age' Bulletin of the Atomic Scientists V26 June 1970 pp.35-39 and
Huff, R. Political Decision-Making in the Japanese Civilian Atomic Energy Program Ph.D Dissertation George Washington University 1973 p.35.

19 Imai ibid

20 See ibid and Huff op cit p.34.

21 These details are discussed in Huff op cit p.35.

22 The role of the US in this formative period is discussed in ibid pp.157-8 and Likawa I.S. 'The Present Status of the Peaceful Uses of Atomic Energy in Japan' in Peaceful Uses of Atomic Energy - Proceedings of a Conference Co-sponsored by the JAIF and AIF Japan Atomic Industrial Forum Tokyo 1957

23 See Huff op cit pp.35-6

24 On the Diet debate and final approval see ibid pp.36-8

25 ibid p.61

26 Article 2 of the Basic Atomic Energy Law states that: 'The research, development and utilization of atomic energy shall be limited to peaceful purposes and performed independently under democratic management; the results therefrom shall be made public to contribute to international cooperation.' Atomic Energy Basic Law Law No.186 December 19th 1955 JAEC Tokyo 1956.

27 Law for the Establishment of the Atomic Energy Commission Law No.288, December 19th 1955 JAEC Tokyo 1956 see Chapter 2 Article 5

28 ibid Article 3

29 On this point see Huff op cit pp.40-1 and Hodgetts J.E. Administering the Atom for Peace Atherton Press NYC 1964 p.60

30 See Hodgetts ibid p.60

31 This is explained in Summary of Japan's Atomic Energy Development Japan Atomic Energy Relations Organization Tokyo 1977 p.1 (Hereinafter referred to as JAERO)

32 Huff op cit p.42

33 See the summary in JAERO op cit p.4

34 Johnson C. 'MITI and Japanese International Economic Policy' in Scalapino R. op.cit. p.258.

35 This is explained in Johnson C. Japan's Public Policy Companies American Enterprise Institute for Public Policy Research, Washington DC 1978. Ch.6.

36 For details see Huff op cit p.43

37 See Atoms in Japan V1 No.3 1957

38 This is detailed in JAERO op cit p.30

39 On the background to this consult Chalmers (1978) op cit

40 This is discussed in Huff op cit p.54

41 Japan Atomic Industrial Forum Inc. 1978 Tokyo 1978 p.1

42 The history and politics of private ownership of the electric utility industry is described in Chalmers (1978) op cit.

43 See Huff op cit p.52

44 This is examined in more detail by Gallinni L. Implementation of International Safeguards in the Japanese Context Ph.D Dissertation University of Michigan 1975 p.163.

45 See the earlier discussion in chapter 3 of this work.

46 For a useful introduction to the character of these relationships and the nature of policy making in Japan consult Ward op cit.

47 On the systems approach in the public policy literature see Jenkins W.I. Policy Analysis Martin Robertson, London 1978 Ch.1.

48 These characteristics are drawn from Huff op cit, Gallinni op cit and Ward op cit.

49 Hodgetts op cit p.21

50 See Chalmers (1978) op cit p.62

51 See Chalmers (1977) op cit p.245

52 This administrative dominance of the atomic energy policy process is confirmed by Huff op cit p.32.

53 A practice which developed when the AEB was established in the STA. See Hodgetts op cit p.163

54 See Huff op cit p.31

55 On the nature of the government - industry relationship see ibid p.55 and Gallinni op cit p.155

56 Johnson (1977) op cit p.245

57 Consult Huff op cit Ch.3; and also Gilinsky and Langer op cit.

58 This is confirmed throughout the studies of Huff ibid and Gallinni op cit.

59 This is discussed later in the chapter but see Huff ibid ch.2.

60 ibid. See Ward op.cit Ch.6.

61 The background to private ownership legislation is discussed later in the chapter but see Huff op.cit. ch.4.

62 A special tax was levied on electricity generation from October 1974. The proceeds from the tax are redistributed to local public organizations in areas adjacent to the sites of nuclear power plants to improve public amenities. See Kodoma op.cit.

63 For a useful discussion of the nature of corporatism and its implications for policy making see Ham C & Hill M, The Policy Process in the Modern Capitalist State, Harvester Press, Brighton 1984 pp36-42.

64 The public interest, in corporatist work, is largely defined in terms of assisting the processes of capital accumulation. See Wolfe A, The Limits of Legitimacy, Free Press NY 1977.

65 See Gallinni op.cit. and Huff op.cit.

66 See Gallinni p.154 and Huff Chapter 2.

67 This becomes clear from both Huff and Gallinni's studies. See Huff Chs 2 and 3, and Gallinni pp.188-193.

68 Huff ibid p.395.

69 Gallinni op.cit pp.188-189.

70 On this see Ward op.cit. Ch.5,9,11 and Destler I.M. et.al. Managing an Alliance Brookings Institute, Washinton DC 1976, Chp.3.

71 This is confirmed in the atomic energy sphere by Gallinni op.cit. p.190.

72 An extremely lucid account and explanation of the impact of political and cultural factors on the policy process is given in Destler op.cit. pp.111-114.

73 Gallinni op.cit. p.192.

74 Environmental opposition was not totally unsuccessful since it forced the government to take greater heed of safety and environmental aspects of nuclear power generation. However, the impact of the oil crisis in 1973 reinforced the case for nuclear power and opposition was to some extent bought off by the electricity tax alluded to above. Opponents of nuclear power continued to be largely excluded from the policy process and sought alternative methods of pressing their case e.g. the courts. See Surrey, J 'Opposition to Nuclear Power: a Review of International Experience' Energy Policy, vol.3 December 1976, pp.302-304.

75 See Huff op.cit. p.34.

76 This is quoted in Cammilleri J The State and Nuclear Power Wheatsheaf, Brighton 1984, pp.12-13.

77 See Huff op.cit. pp.36-7.

78 ibid p.61.

79 On this 1957 plan see Atoms in Japan v2, no.1. 1957 and also Seiki op.cit.

80 Atoms in Japan v.1. no.6 June 1957

81 Atoms in Japan v.4. no.8 August 1960 p.1.

82 The history of this initial contract is covered in Atoms in Japan v.2. no.9 1958, v.3. no.4 1959 and v.3. no.11 1959.

83 See Atoms in Japan v.4. no.1. January 1960.

84 For the details of this contract see Atoms in Japan v.3. no.3. March 1959.

85 Long Range Program on the Development and Utilization of Atomic Energy JAEC Tokyo 1961 p.129.

86 These subsidies included tax measures, low interest loans, subsidies for domestic technology, and assistance with foreign capital. See ibid and Atoms in Japan v.5. no.1. January 1961, p.1.

87 Atoms in Japan v.6. no.5 May 1962

88 Atoms in Japan v.5. no.11. November 1961, p.5.

89 Details of this contract can be found in Atoms in Japan v.7.. no.5. May 1963 p.16 and Atoms in Japan v.7. no.9. September 1963.

90 Atoms in Japan v.8. no.3. 1964.

91 The 1967 plan is discussed in detail in Murata H, 'Nuclear Energy : the Next Ten Years' New Scientist Japanese Supplement v. 36 November 16th 1967 pp.3-4.

92 See Huff op.cit. p.78.

93 On the details of the programme see Gilinsky and Langer op.cit. and Huff ibid. pp.77-79.

94 Figures taken from Murata op.cit.

95 ibid.

96 Imai (1970) op.cit.

97 See 'Survey of Japan' Nuclear Engineering International, v.18. no.206. July 1973.

98 On the causes of delays and their implications see Surrey op.cit. and Imai (1975) op.cit.

99 This is described in Huff op.cit. p.78.

100 For the details of these fuel cycle plans consult Gilinsky and Langer op.cit. pp.19-20 and ibid pp.103-105.

101 See Nuclear Engineering International 1973 op.cit.

102 Long Range Program 1961, op.cit. p.25.

103 Atoms in Japan v.3. no.1. January 1959

104 See Huff op.cit. p.112.

105 Quoted in Atoms in Japan v.11. no.4. April 1957 pp.9-12.

106 For details see Huff op.cit. p.114 and Nuclear Engineering International 1973 op.cit.

107 In fact, according to Huff, the joint venture had been proposed initially by the Japanese to the Americans in 1970. See Huff op.cit. p.115.

108 On this consult Atoms in Japan v.3. no. 6. June 1959.

109 Developments on the reprocessing plant can be traced in Atoms in Japan v.6. no.7. July 1962 and v.8. no.1. January 1964, pp.10-14.

110 Atoms in Japan v.7. no. 12. December 1963.

111 For all the details consult Huff op.cit. p.108--109.

112 The background and the progress on these reactor projects is covered in ibid, pp.120-123, Gilinsky and Langer op.cit pp.31-35, and JAERO op.cit. pp.20-38.

113 Future US-Japanese Nuclear Energy Relations Report of the Working Group, Rockefeller Foundation, New York 1979 p.77 (hereinafter referred to as Report of the Working Group).

114 On the nature and development of the US-Japan relationship consult Destler op.cit. Ch.1 and 2.

115 On these details see Ward op.cit. p.19-21.

116 The development of the Cold War in Asia and the role of Japan in US policy is described in Iriye A The Cold War in Asia Prentice Hall NYC 1974 Ch.4.

117 See Lester R K 'US-Japanese Nuclear Relations:Structural Change and Political Strain' Asian Survey v.22. 1982 pp.417-433.

118 Seiki op.cit.

119 On this see Huff op.cit. Ch.5.

120 See the discussion in Report of the Working Group op.cit. p.85.

121 See Agreement for Cooperation Concerning Civil Uses of Atomic Energy Between the Government and USA and the Government of Japan June 21st 1955 (hereinafter referred to as the 1955 Research agreement).

122 This is discussed in Huff op.cit. p.130.

123 see ibid p.131.

124 In the letter transmitting the agreement to the US JCAE, Chairman of the US AEC Strauss noted that the agreement would '...restrict Japan in determining the choice of reactor to be constructed to a research reactor.' See Letter from Strauss in US Congress JCAE Proposed Agreements for Cooperation 1955 US GPO Washington DC 1955.

125 ibid.

126 Consult 1955 Research agreement op.cit. Articles 7 and 8.

127 This is quoted in Wit op.cit.

128 On this see Huff.op.cit. p.135.

129 The JAEC was concerned that the agreement would constrain Japan's nuclear developments and that domestic opposition to cooperation with the US had to be mollified. Thus it sought a time limit on cooperation as well as the very important stipulation that the plutonium from any spent fuel returned to the US could only be used for peaceful purposes. The US desired that the latter be agreed unofficially but because of the strength of domestic political commitment on this issue the Japanese desired it to be written into the actual agreement. See Atoms in Japan v.2. no.5. May 1958 and ibid p.135-136.

130 As to how they were actually resolved consult the 1955 Research agreement op.cit.

131 See Articles 7,9,10 of Agreement for Cooperation between the Government of the USA and the Government of Japan Concerning the Civil Uses of Atomic Energy (Power and Research) June 16th 1958 US GPO Washington DC 1958 TIAS 4133 (hereinafter referred to as the 1958 power agreement).

132 This is contained in Article 7(d) ibid.

133 Report of the Working Group op.cit. p.106.

134 See Huff op.cit. p.136.

135 See 'Letter from the Chairman of the AEC, Glen Seaborg, Transmitting the Agreement to the JCAE' May 16th 1968 reprinted in the Congressional Record S6363 May 24th 1968.

136 Report of the Working Group op.cit. p.85.

137 Consult Article 7 of Agreement for Cooperation Between the Government of the USA and the Government of Japan Concerning the Civil Uses of Atomic Energy June 1968 US GPO Washington DC 1968 (hereinafter referred to as the 1968 agreement).

138 ibid Article 6.

139 ibid Article 7(c).

140 The agreement allowed: 'US Commission may also transfer to the Government of Japan or to authorized persons under its jurisdiction... special nuclear material for the performance in Japan of coversion or fabrication services ... and for subsequent return to the USA or ... to another ...' Article 7(c) ibid. As Donnelly notes, at the time, this was a unique concession. See p.61b in Donnelly W.D. United States Agreements for Cooperation in Atomic Energy A Report prepared for the Committee on Government Operations US Senate US GPO Washington DC 1976.

141 Report of the Working Group op.cit. p.85.

142 On this opposition see Gallinni op.cit. Ch.4.

143 This is quoted in Huff op.cit. p.138.

144 Report of the Working Group op.cit. p.79.

145 For the details of USAEC assistance being offered see Edwards R 'US Atoms for Peace Program' in Peaceful Uses of Atomic Energy 1957 Conference op.cit.

146 See US AEC Press Release no.578 November 12th 1954.

147 According to the USAEC up to 1959 260 Japanese scientists were trained in the US and USAEC facilities had hosted over 880 Japanese visitors. See section on Japan in 'International Cooperation in the Peaceful Uses of Atomic Energy Through the Instrument of the Bilateral Agreement for Cooperation' USAEC in US Congress JCAE Report Review of International Atomic Policies and Programs of the United States USGPO Washington DC 1960 v.2. pp.421-493 (hereinafter referred to as the McKinney report).

148 See USAEC Press Release J-194 August 15th 1966.

149 Consult Umeno Tamo-D Director of JAPCO 'Financial problems in the Japanese Atomic Power Development Program' in Proceedings of a US-Japanese Atomic Industrial forum Joint Conference on Nuclear Power Tokoyo December 1961 JAIF Tokoyo 1962 (hereinafter referred to as USAIF-JAIF Conference 1961).

150 ibid.

151 Atoms in Japan V6 No.12 December 1962

152 See Export-Import Bank Press Release July 13th 1966

153 Report of the Working Group op cit p.84.

154 ibid p.86

155 On this consult Mullenbach P. Civilian Nuclear power Twentieth Century Fund NY 1963 pp.293

156 This is discussed in Atoms in Japan V.3 No.6 June 1959.

157 This was part of the government's larger foreign investment policy to restrict the penetration of Japanese industry by US capital during the period of reconstruction. But by 1964 membership of the IMF, convertability of the Yen, and membership of the OECD brought increasing pressure from the US for Japan to liberalize its foreign investment laws. Thus liberalization was agreed in stages commencing July 1967. See Monroe W.F. Japan, Financial Markets and the World Economy Praeger NY 1973 Ch.10.

158 Fo example, Bechtel acted as an advisor to the JAEC's Enrichment Survey Committee from 1972 onwards and US companies such as AMF were involved in Japan's early reprocessing plans.

159 Report of the Working Group op.cit. p.46.

160 On the changing character of alliance ties in the 1960s and 1970s see Hellmann D.C. 'Japanese Security and Postwar Japanese Foreign Policy' and Momoi M. 'Basic Trends in Japanese Security Policies' both in Scalapino ed op.cit. pp.321-340 and 341-354 respectively.

161 On these controversies see particularly Destler op.cit. Ch.2

162 On this change see Momoi op.cit.

163 On the trade and economic issues see Saxonhouse G.R. 'The World Economy and Japanese Foreign Economic Policy' in Scalapino op.cit. pp.281-318.

164 This is evident from even a cursory examination of Atoms in Japan but is also supported by interviews with US officials.

166 ibid. Imai (1970) op.cit. also notes that a similar arrangement held for Japanese scientific attaches.

167 Destler op.cit. p.143.

168 ibid

169 One source notes that '...views within the US nuclear industry are closer to the Japanese viewpoint on many ... issues on which the government have differences.' Report of the Working Group op.cit. p.52.

170 Interivew with GE Executive

171 ibid

172 ibid

173 Destler op.cit. p.144.

174 Report of the Working Group op.cit. p.2.

175 Destler op.cit. p.134.

176 Report of the Working Group op.cit. p.77.

177 Report of the Working Group op.cit. p.2.

178 Huff op.cit p.152.

179 On this consult Atoms in Japan V1 No.1 January 1757 and ibid pp.55-57.

180 This is confirmed in Atoms in Japan ibid.

181 See the discussion in Huff op.cit. pp.55-56.

182 These early contacts are discussed in Atoms in Japan V3 No.6 June 1959 pp.5-7. GE was in a unique position since much commercial secrecy surrounded BWR technology because it had been developed largely with GE and private capital. GE was therefore reluctant to go straight to

licensing arrangements. Westinghouse, on the other hand, sought a strategy of licensing almost immediately and was the first to sign a license agreement with a Japanese company, Mitsubishi, in April 1957. See the chapters on GE and Westinghouse in Nehrt L.J. International Marketing of Nuclear Power Plants, University of Indiana Press Bloomington 1966.

183 It also had negative consequences too since MITI and the MOF were concerned by early commitment to licensing arrangements particularly since the commercial viability of LWR technology was then far from proven. Indeed GCR technology appeared to be the only viable commercial technology at that time. See Nehrt ibid pp.167-8; Atoms in Japan ibid.

184 See Atoms in Japan V1 No.3 March 1957 p.4.

185 See Huff op.cit.p.70.

186 Westinghouse began negotiations on a licensing agreement with Mitsubishi in 1957 and this was approved by MITI in 1961. GE began negotiations with Hitachi and Toshiba in 1964 and license and manufacturing agreements were approved in 1966. See Nehrt op.cit. p.298 and the latter confirmed by GE documents.

187 On this point see Dunning J. 'Multinational Enterprises, Market Structure, Economic Power and Industrial Policy' Journal of World Trade Law V8 No.6 November 1974 pp.575-613.

188 On the problem of overcapacity see 'Survey of Japan' Nuclear Engineering International 1973 op.cit.

189 The only possibility is to merge FAPIG and Sumitomo into the three other consortia. But the latter would resist this since it would affect their own commercial viability as well as their commercial relationships with their American licensors.

190 In a study done in 1963 the JAIF noted that over 50% of the reactors patents were American in origin. See Atoms in Japan V8 No.7 July 1964.

191 This is confirmed by interviews with GE executives and also internal GE documents.

192 One GE executive noted, in an interview, that there was a strong conflict between the GE nuclear marketing division and the technology division, over the question of licensing.

193 Mitsubishi, Hitachi, and Toshiba, as a result of their subcontracting arrangements with their US licensors, have manufactured reactor pressure vessels and turbine generators for at least 13 major projects in the US and abroad. See Mochizuki S. 'Nuclear Supply Industries in Japan' Japanese Delegation to the Second Joint Meeting of the JAIF-BNF, September 1975, London (mimeo).

194 This was moreso the case for GE since much less technical information was publically availavble for the BWR than for the PWR. See Nehrt op.cit. p.261.

195 For a detailed discussion on foreign licensing policy see Monroe op.cit. and also Yoshino M.Y. 'Japan as Host to the International Corporation' in Frank I. ed The Japanese Economy in International Perspective John Hopkins University Press, London 1975 Ch.10.

196 On this see Atoms for Japan V3 No.6 June 1959.

197 See Monroe op.cit. and Yoshino op.cit.

198 Interview with GE executives.

199 See Huff op.cit. p.107. Interviews with GE executives also confirmed that GE personnel were given the key management positions in the new venture.

200 This arose out of GE's own corporate strategy in the nuclear sector. Interivew with GE executives.

201 Huff op.cit. p.107.

202 ibid.

203 This occurred with respect to JAPCO's Tokai Mura GCR imported from the UK.

204 See for example Atoms in Japan V7 No.9 September 1963 and also Huff op.cit. p.171-173.

205 See Matsui, A. 'Gaining Public Support for Nuclear Power' in Nuclear Engineering International V24 No.293 December 1979 pp.70-72.

206 The JSC held a conference on nuclear safety in 1961 and publicly criticized the JAEC's safety standards. This resulted in changes to safety procedures and policy. See Atoms in Japan V5 No.2 February 1961.

207 On the nature of local government in Japan and its ability to block central government policy on such issues as siting see Ward op.cit.

208 The Mito bombing range controversy is discussed in Huff op.cit. pp.165-168 and also Atoms in Japan V3 No.11 November 1959.

209 The JSP and the JSC opposed the plan with considerable force. See ibid.

210 On the details of the policy consult Atoms in Japan V5 No.3 See ibid and Huff op.cit. p.168.

211 This disclaimer was written into the cooperation agreements. See Atoms in Japan V2 No.7 July 1958.

212 Atoms in Japan V2 No.6 June 1958.

213 See Preliminary Report - Financial Protection against Atomic Hazards June 1958 Committee on Atomic Hazards Indemnity JAIF Tokyo 1958.

214 Consult Atoms in Japan V3 No.8 August 1959.

215 On this point se Huff pp.176-179.

216 See Nehrt op.cit. p.276.

217 Atoms in Japan V5 No.10 October 1961.

218 These requirements were established by Article 8 of the 1955 research agreement op.cit.

219 See Atoms in Japan V3 No.1 January 1959.

220 See USAEC Press Release F-189 September 23rd 1963.

221 The JAIF and nuclear industrialists were worried that Agency safeguards

would hamper the development of nuclear power in Japan. See Atoms in Japan V7 No.6 June 1963, V7 No.8 August 1963d and V8 No.2 February 1964.

222 The Smyth report was published in 1962 committing the US to the strengthening of the Agency. Both the USAEC and the US AIF were in favour of trilateral arrangements for safeguards.

223 Both Huff's and Lester's studies, as well as that of the Working Group confirm this dependence. See Huff op.cit. ch.5; Lester op.cit. and Report of the Working Group op.cit.

224 Huff op.cit.p36.

225 According to Huff: 'JAERI scientists ... feared ... too much reliance would be placed on proven foreign-made equipment at the expense of a strong domestic research and development program.' Huff op.cit. p.57. See also the comments by Wit on Japanese domestic opposition to cooperation with the US. Wit op.cit.

226 Huff op.cit. p.68.

227 See Atoms in Japan V1 No.1 January 1957.

228 On this issue see Huff op.cit p.70 and Atoms in Japan V1 No.6 June 1957.

229 This is discussed by Seiki op.cit.

230 Report of the Working Group op.cit. p.80.

231 See Atoms in Japan V2 No.9 September 1958.

232 Huff op.cit. p.70.

233 ibid kp.70.

234 The JAERI first announced the import of a small LWR reactor in 1958 and then later confirmed plans for this to become the first project in its power demonstration reactor program. A contract with GE was signed in 1959. See Atoms in Japan V2 No.6 June 1958, V2 No.8 August 1958, and V3 No.3 March 1959.

235 On this see Atoms in Japan V2 No.9 September 1958.

236 They even offered to undercut the price of the GCR just as JAPCO was preparing to sign contracts with the UK Atomic Energy Authority. Atoms in Japan V.4 No.1 1960.

237 Atoms in Japan V4 No.3 March 1960.

238 ibid. And later that year the JAIF reported that the LWR was being given greater emphasis by the JAEC and JAPCO. See Atoms in Japan V4 No.8 August 1960.

239 See Atoms in Japan V5 No.2 February 1961.

240 On these discussions see Atoms in Japan V7 no.5 1963.

241 See the talk by Tamo o Umeno op.cit.

242 The USAEC also made clear its liberal fuel supply arrangements to the Japanese at a joint JAIF-USAIF conference in Tokyo in 1961. See Wilson, R.E. 'USAEC Policies Relating to Foreign Reactors' in Proceedings of US-Japanese AIF Joint Conference op.cit. Moreover, the USAEC announced a major cut in enriched uranium fuel prices in 1961 just as JAPCO was considering its LWR project. See Atoms in Japan V5 No.6 1961.

243 On these plans see Atoms in Japan V8 No.3 1964 and for the plans of the largest utility TEPCO see Atoms in Japan V8 No.12 December 1964.

244 These plans are discussed in 'Japan amongst the most active nations in nuclear power' Electrical World V168 July 10 1967 p.80.

245 Because of high interest rates in Japan the lower capital cost of the LWR relative to other reactor technologies gave the LWR a considerable commercial advantage. See Gilinsky and Langer op.cit. p.18.

246 Both GE and Westinghouse extended their agreements with their Japanese partners in the mid 1970s. GE also initiated joint cooperative research and development projects. Source: interviews with GE executives.

247 Lester op.cit.

248 See Setok S. 'Problems in US-Japanese Commercial Arrangements and Suggestions for Solving them' in Proceedings of a US-Japanese AIF Joint Conference op.cit.

249 Huff details these complaints and concerns. See Huff op.cit. p.109.

250 This was not unconnected with the massive increase in R & D activity proposed in the 1967 long term programme.

251 Although there were calls for a joint R & D programme at the 1961 conference noted above, these came to nothing.

252 There was some cooperation with regard to the unclassified aspects of enrichment technology and assistance as well as training was given with respect to reprocessing technology. But this latter faded when, in the late 1960s, the USAEC became concerned at the spread of reprocessing capabilities.

253 See Huff cop.cit. p.112.

254 ibid p.135.

255 See the Letter from the AEC to the President Transmitting the Agreement for Presidential Approval February 15th 1968, reprinted in the Congressional Record Senate S6363-6367 op.cit.

256 Under Article 7(d) of the 1968 agreement each reactor project was guaranteed a specific quantity of fuel. But this allocation could not be transferred to other projects nor could the dates of supply be changed without the consent of the USAEC. See ARticle 7(d) 1968 cooperation agreement op.cit.

257 On June 8th 1971 the USAEC revised the terms of enrichment contracts. As well as new higher prices the AEC weakened the provisions of its enriched uranium supply guarantee.

258 The Working Group Report op.cit. p.88.

259 See Kodoma op.cit.

260 See the Basic Atomic Energy Law op.cit. Chapter 5

261 Atoms in Japan V1 No.6 June 1957.

262 See Article 7(d) of the 1958 power agreement op.cit.

263 Atoms in Japan V2 No.5 May 1958.

264 ibid

265 Reports that the USAEC was considering granting permission for private ownership abroad came to the industry's attention in Atoms in Japan V5 No.6 June 1961. Private ownership of uranium was granted in Japn shortly after this in September 1961, see Atoms in Japan V5 No.9 September 1961.

266 See Atoms in Japan V7 No.1 January 1963 pp.1-3.

267 The details are given in Atoms in Japan V7 No.8 August 1963.

268 In fact pressure for private ownership began building up during 1963 when the US Congress first began consideration of the USAEC's legislation. See Atoms in Japan V7 No.9 September 1963, and V8 No.2 February 1964,

269 For details consult Atoms in Japan V7 No.9 September 1963 pp.1-9.

270 See Huff op.cit p.78 and Gilinsky and Langer p.24.

271 The agreement came into force in July and private ownership was effective from November 1st. See Gilinsky and Langer op.cit. p.24.

272 Imai (1970) op.cit.

273 This began in 1960 and progress with centrifuge technology made headway from 1962 onwards. See Atoms in Japan V4 No.4 April 1960 and V6 No.3 March 1962 respectively.

274 Gilinsky and Langer op.cit p.23.

275 See Huff op.cit. p.112.

276 Through international cooperation it hoped to switch the basis of enrichment development away from centrifuge technology. See Wonder E.F. Nuclear Fuel and American Foreign Policy Westview Press Boulder 1977 Ch.1 and 2

277 This is noted in Huff op.cit. p.114

278 See Imai (1970) op.cit.

279 See Nuclear Engineering International August 1971 p.618 and Wonder op.cit. ch.1.

280 See US Congress JCAE Hearings Future Structure of the Uranium Enrichment Industry Part 2 Phase 2: Industry Witnesses 93rd Congress 1st Session October 1973 USGPO Washington DC 1973 (Hereinafter referred to as Enrichment hearings) Testimony of Masahiro Wada pp.248-255.

281 The Working Group Report op.cit. p.89.

282 Enrichment hearings op.cit p.68.

283 ibid p.251.

284 ibid p.252,

285 What particularly aggravated the Japanese was the allocation of contracts. Both Israel and Egypt were given firm contracts even though both had not signed the NPT nor were they long-standing AEC customers. On the other hand some Japanese utilities were given less preferential treatment. See The Working Group Report op.cit. p.91.

286 ibid p.92.

287 See Huff op.cit. p.199.

288 On this point consult Ward op.cit. ch.7.

289 Johnson (1977) op.cit. p.245.

290 For a discussion of these developments and their impact see Surrey op.cit.

291 Huff op.cit. p.91.

292 Writing about the Tsuruga BWR plant one GE executive noted that: 'USAEC licensing activities affected the progress of work on the Japanese plant. For instance, it was GE's obligation to duplicate for Tsuruga those safeguards systems which the USAEC required at the Oyster Creek plant. This caused several late changes, retrofit of new designs into existing systems ... In one case, late rulings on Oyster Creek required

significant redesign at Tsuruga.' See Ferguson D.F. & Kilsby E.R. 'Tsuruga - Triumph of Teamwork' Power Engineering V75 April 1971 pp.40-42.

293 As in the US major delays caused escalating costs see 'Japan's Nuclear Industry' Nuclear Engineering International 1974 p.19.

294 See Huff op.cit. p.173 and Surrey op.cit.

295 On these citizen groups and jumin undo see Ward op.cit. pp.81-83. On their impact on the licensing process see ibid.

296 See Surrey ibid.

297 In fact the LDP lost votes whilst the JSP gained them. See Ward op.cit p.125.

298 On these developments see Surrey op.cit.

299 Imai (1970) op.cit.

300 ibid

301 Huff op.cit p.98.

302 On this point see Lester op.cit.

303 The Working Group Report op.cit. p.77.

304 Imai (1975) op.cit.

305 Gallinni op.cit. p.199.

306 ibid p.206.

307 Consultative status was granted in 1960. See Atoms in Japan V4 No.6 June 1960 pp.3-9.

308 Gallinni op.cit. p.210.

309 This committee was made up of 26 members drawn from MITI, AEB, JAEC, FEPC, JAPCO, PNC, JAERI, Tochiba, Mitsubishi, Hitachi, JAIF, and Japan Nuclear Fuel amongst others. See Gallinni op.cit. p.189.

310 It was unlikely that it was coincidental. Evidence for this is garnered from interviews combined with the discussion in Gallinni op.cit. p.204 and Atoms in Japan V7 No.9 September 1963.

311 See Atoms in Japan V7 No.9 September 1963.

312 Since all the Euratom coutnries were excluded from Agency safeguards, because since they operated their own Euratom insepction system, this left only a few Western states, such as Sweden, Canada and Switzerland, in which Agency safeguards could be applied.

313 The agreement is discussed in Atoms in Japan V7 No.10 October 1963.

314 See the discussion in Gallinni op.cit. p.225-227.

315 The Working Group Report op.cit. p.86.

316 This is confirmed by Gallinni and Atoms in Japan. See Gallinni op.cit p.269 and Atoms in Japan V7 No.8 August 1963.

317 On these criticisms consult Huff op.cit. p.272 and Jensen L. Return from the Nuclear Brink Lexington 1970.

318 Atoms in Japan V8 No.2 February 1964.

319 This is given particular emphasis by Imai in his discussion of Japan's attitude to the NPT. But it was also a more widespread concern amongst the more advanced NNWS, such as Germany. On the former see Imai R. 'The Non-proliferation Treaty and Japan' Bulletin of the Atomic Scientists V25 May 1969 pp.1-7. On the latter see Jensen op.cit. ch.3.

320 Gallinni op.cit. p.226

321 Atoms in Japan V8 No.2 February 1964.

322 On this incident see Huff op.cit. p.272.

323 ibid p.285.

324 Gallinni op.cit. p.321.

325 Interview with US ACDA Official.

326 ibid.

327 Gallinni op.cit. p.238.

328 Evidence for this comes from Gallinni op.cit. p.241-2 and Interview with US ACDA Official.

329 Gallinni op.cit. p.227.

330 Huff op.cit. p.257.

331 Frankel J. 'Domestic Politics of Japan's Foreign Policy: a case study of the ratification of the non-proliferation treaty' British Journal of International Studies V3 No.3 October 1977 pp.254-269.

332 On the weakening of Japan's confidence in the US guarantee see Huff op.cit. p.341-345.

333 This is noted in ibid p.265.

334 ibid p.264.

335 This is discussed in Frankel op.cit. and ibid p.260.

336 Frankel notes that Moiyama the Minister responsible for the STA was known to be in favour of Japan maintaining a nuclear option. This led to his removal from office in 1975, for such views were highly unpopular in Japan. See Frankel op.cit.

337 On the Japanese attitude to this discrimination see The Working Group Report op.cit. p.51.

338 Frankel op.cit.

339 ibid.

340 This is discussed in some detail by Imai (1969) op.cit.

341 Imai makes this point very forcefully. See ibid.

342 ibid.

343 Huff op.cit. p.279.

344 Gallinni op.cit. p.228.

345 Gallinni makes this point unambiguously. See Gallinni op.cit. p.228-9.

346 Huff op.cit. p.291.

347 On the extent of Japanese diplomacy with respect to the NPT see ibid pp.276-7.

348 ibid p.290.

349 Destler op.cit. p.102.

350 ibid p.116.

351 On the different objectives which these groups sought see Huff pp.266-281.

352 ibid p.296.

353 This is quoted in ibid p.297.

354 The Working group report op.cit. p.98. According to Frankel it was the government's deliberate strategy to separate, for political reasons, the question of ratification from that of accession. See Frankel, op.cit.

355 Huff op.cit. p.297.

356 This is noted in Gallinni op.cit. p.228

357 ibid p.235.

358 ibid p.243

359 On this consult ibid p.258.

360 ibid p.259.

361 On these two particular points see The Working Group Report op.cit. p.99 and ibid p.243-4.

362 Both Gallinni and Frankel note the swift change in the JAIF's attitude once the safeguards issue had been dealt with to their satisfaction. See Gallinni op.cit. p.259 and Frankel op.cit.

363 Frankel ibid.

364 It was also delayed because there was an intense bureaucratic struggle within the government concerning who should have responsibility for safeguards and the proposed nuclear materials control agency. See Gallinni op.cit. pp.260-65.

365 Frankel op.cit.

366 This is discussed in Huff op.cit. p.285.

367 On the US support for Article 7 see p.143 in Donnelly W.H. Nuclear Weapons Proliferation and the International Atomic Energy Agency - An Analytical Report Prepared for the Committee on Government Operations March 1976 USGPO Washington DC 1976.

368 Baker makes this point, quoting Japanese sources as evidence. See Baker S.J. Commercial Nuclear Power and Nuclear Proliferation Cornell University Peace Studies Occasional Paper No.5 May 1975 p.30.

369 Frankel op.cit.

370 Frankel op.cit. Also an interview with a US ACDA official confirmed that the Japanese nuclear industrialists used the issue of Enriched uranium supply in the internal debate against opponents of ratification.

371 Huff op.cit. p285.

372 This was particularly the case, according to Frankel, on the issue of US-Japan security ties, which became caught up in the NPT ratification debate. See Frankel op.cit.

373 In this regard see Lester op.cit.

CHAPTER SIX - CONCLUSION : TECHNOLOGY , COMPLEXITY , AND THE INTERNATIONAL POLITICS OF CIVIL NUCLEAR POWER

This study has examined the complex inter-connections between the development of the US nuclear industry , its transnational expansion abroad , and its impact upon Japanese civil nuclear development . It has given particular emphasis to the role of US state agencies , such as the AEC , in facilitating this transnational expansion and establishing a legitimate international framework , in the Atoms for Peace regime , for managing the spread of US nuclear technology and materials in conformity with US non-proliferation objectives . An extremely complex pattern of international and transnational activity , involving a multiplicity of political actors , has been uncovered confirming Nau's observation , quoted earlier , that :

> ...actor behaviour in technological areas is complex and multipurpose . No one analysis can account for all this complexity .(1)

In this concluding chapter the focus returns to the perspectives introduced in chapter one and to the interpretations which each provides of the origins and consequences of US civil nuclear ' expansionism ' . The chapter is divided into three main sections . In the first section the three perspectives are utilised to interrogate the case study material presented in the body of thesis in order to offer some insights into the questions raised in chapter one , part 1.4.1 . This is followed by an evaluation of the three perspectives in terms of their utility as analytical tools for explaining the complex

inter-relationship between the domestic and international politics of the civil atom . Finally , some attempt is made at suggesting some generalisations which might be drawn from this study concerning the impact of technology upon world politics.

6.1 Perspectives upon The Politics of International Nuclear Technology Transfer

In chapter one five central questions were raised about the transnational expansion of the US nuclear industry . These were :

Was Atoms for Peace driven by commercial or security interests ?

How did US foreign atomic policy throughout this period (1954 - 1974) connect with domestic development of the civil atom ?

Through what means did the US promote adherence to its evolving non-proliferation regime ?

To what extent did the US government encourage and support the transnational expansion of the domestic nuclear industry ?

What were the political and other consequences of reliance upon US nuclear technology ?

As will become evident the answers to these questions depend partly upon the perspective which is adopted .

6.1.1 The Realist Perspective upon the International Politics of Civil Nuclear Technology Transfer

Given the proliferation implications of the dissemination of

nuclear technology one would expect the realist perspective , with its emphasis upon security considerations , to provide a rather robust interpretation of the origins and development of the Atoms for Peace programme . Yet , as chapter four has discussed , Atoms for Peace was conceived in much broader strategic terms than simply a mechanism to resolve the problem of horizontal proliferation . It was very much part of the New Look strategy and thereby a consequence of the power competition between the Soviet Union and the US . Indeed nuclear technology was conceived as an instrument through which the US could extend its political influence , and reinforce the development of Western capitalism , in the newly emerging battle ground of the Cold War , the Third World . Moreover , cooperation with Euratom , Japan , and other western states was perceived in terms of the consolidation of the post war political and economic orders in these strategic regions of the world . And in the case of Euratom , the US pursued cooperation as a means by which to reinforce and encourage the trends towards greater European political integration .

1. Was Atoms for Peace driven by commercial or security interests ?

In realist terms the origins and development of the Atoms for Peace programme are explained in terms of the strategic and power political imperatives which govern the actions of all states , but even moreso those of a superpower in a bipolar world . Cold war politics , perhaps even more than the problem of horizontal proliferation , was central to this unique American initiative . Through its dissemination of civil nuclear technology and fuel the US sought to promote

its ideological and political interests and to enhance its power and prestige in the world vis a vis the Soviets . But security considerations were not irrelevant since the dissemination of the civil atom provided the US with the opportunity of extending its control over the development of foreign nuclear power programmes . Using US corporations and its fuel monopoly the US sought , with varying degrees of success , to erect powerful constraints upon indigenous nuclear developments abroad . In both Europe and Japan , for instance , this led to the adoption of the more proliferation resistant LWR technology and discouraged the construction of independent commercial enrichment plants .

2. How did US foreign atomic policy throughout this period (1954 - 1974) connect with domestic development of the civil atom ?

Realists would see a strong connection between the powerful promotional role of the US government in the development of the domestic nuclear power industry and the nature of US foreign atomic policy in the period 1954 to 1974 . A robust domestic nuclear industrial capability was essential to the establishment of US commercial and technological hegemony in the world nuclear power market . This was vital to the achievement of Us foreign atomic policy goals and in particular to the creation of an international nuclear order which reflected American interests . Indeed the apparent contradiction between the highly interventionary role of the state and the overwhelming ideological commitment to private development of nuclear power can be explained as a reaction to external forces . On the one hand the Cold war

ideological competition between capitalism and communism made private development of nuclear power almost a sine qau non for each successive administration in the fiv ties and sixties . On the other hand the state had to assist in the process of nuclear power development in order to ensure US commercial and technological hegemony in the nuclear business which was so essential to the achievement of broader foreign policy and national security objectives . This is evidenced , for example , in the Congressional debates in the mid-1950's over the Gore-Holifield bill to accelerate the domestic nuclear programme by public investment and the fact that until the late 1960's , or even later , nuclear power was not essential to meet US energy requirements . In realist terms the priority attached to developing a nuclear industrial capability can be explained as a product of both superpower ideological competition and the US desire to ensure its primacy in the civil nuclear field .

3. Through what means did the US promote adherence to its evolving non-proliferation regime ?

By utilising its commercial and technological dominance in the civil nuclear power industry the US was also able to create an international nuclear order which sustained its primacy and cohered with its major foreign policy and national security objectives . But realists would emphasise the overwhelming power of the US in the international system as part of their explanation of why states agreed to accept the nature of the Atoms for Peace regime and the infringements upon national sovereignty it imposed . The evolution of the non-proliferation regime is therefore

conceived largely , as discussed in chapter one , in terms of the exercise of hegemonic power and its maintenance , not as pluralists might argue a reaction to the collective problems created by the national exploitation of nuclear power technology . Moreover , the institutionalisation of the Atoms for Peace regime , through the creation of multilateral institutions and mechanisms of control , such as the NPT and international safeguards , can be explained as a reaction to hegemonic decline . As Smith points out realist conceptions of the non-proliferation regime highlight the fact that the US faith in multilateralism grew as its power to control developments abroad underwent a steady decline from the 1960's onwards .(2) Multilateralism thus became another instrument through which it could attempt to sustain its primacy . Underlying such decline is the natural diffusion of technological and industrial power which realists , such as Gilpin , conceive as being a product of the competitive struggle for power and security in an anarchic world .(3) But what realist analyses fail to be able to explain is why , when the relative power of the US to enforce the rules of its preferred international nuclear order was in decline , did other states , like Japan , continue to be bound by this order . The explanations provided by liberal-pluralist and neo-marxist theories may be more convincing on this point .

4. To what extent did the US government encourage and support the transnational expansion of the domestic nuclear industry ?

The massive support which the US government provided for the

international expansion of the domestic nuclear industry is evidence for the realist proposition that non-state actors in the international system have little autonomy or power . Rather they are dependent upon the hegemonic state to create a framework of international order which allows them to function . In this case the US corporate penetration of foreign nuclear industries and the international activities of US multinationals were endorsed and encouraged only because this was consistent with the foreign policy objectives of the US government . Indeed , the US regarded the transnational expansion of the nuclear industry as a vital instrument for sustaining some control over the development of nuclear programmes abroad and as a means to achieve vital foreign policy and national security objectives . Thus the US corporate penetration of the Japanese nuclear industry was part of a more determined US strategy to lock Japan more firmly into the Western international political order . Consequently , the extensive transnational activity documented in this study is only significant in realist interpretations to the extent to which it promoted US foreign policy interests and reinforced US power in the world .

5. What were the political and other consequences of reliance upon US nuclear technology ?

As this study has shown , reliance upon US nuclear technology and fuel significantly reduced Japan's political autonomy . Whilst a realist interpretation would not dispute this observation it would stop short of suggesting that this was in any sense the major determinant of Japan's domestic and foreign atomic policy over the years 1954-1974 . Rather

Japan's apparent deference to US interests and receptivity to US corporate penetration of its nuclear industry can be explained as a rational policy designed to further its own national interests . In particular the vital need for secure supplies of energy and , as chapter five discussed , the desire to enhance its industrial capabilities by ' catching up ' in the nuclear technology ' race ' point to the significance of strategic factors in the determination of Japan's domestic and foreign atomic policy . Thus Japan did not slavishly react to American demands or changes in policy , as the debates over accession to the NPT demonstrated and the success of its policy in limiting the extent of foreign direct investment in its nuclear industry . Instead it accepted US policy where this cohered with its national interests and exercised its limited autonomy where its vital interests were perceived to be challenged . Moreover, it constantly strove , by developing its nuclear industrial capabilities, to increase its potential autonomy and this , as chapter five explained , brought it in later years into direct conflict with the US government . Cooperation with the US , and reliance upon US nuclear technology and fuel , did not translate into direct US control over Japan's domestic and foreign atomic policy .

To summarise . In the realist perspective the Atoms for Peace programme is interpreted as a mechanism for achieving US security and foreign policy objectives and extending US control over the utilization of this sensitive technology abroad . This accounts for the fact that domestic nuclear development was oriented very much to the establishment of

US commercial and technological hegemony in the world nuclear power market . Together with its predominant position in the hierarchy of world power this provided the basis for the creation of a non-proliferation regime which reflected US commercial , security , and political interests . By encouraging the transnational expansion of the domestic nuclear industry the US government sought to use multinational corporations as an instrument of state policy . Whilst the consequences for Japan of reliance upon the US were felt in restricting its scope for independent action this did not undermine its attempts to develop a national nuclear industry as part of its pursuit of longer term national strategic goals . Nuclear power technology , in this realist perspective , is therfore conceived very much as an instrument and a source of state power , as a means to an end rather than an end in itself . It is regarded as subservient to the dynamics of power politics in the international system .

6.1.2 The Liberal-Pluralist Perspective upon the International Politics of Nuclear Technology Transfer

One of the major differences between the realist and the pluralist perspectives lies in the conception each has of the state as an actor in world politics . Whereas the realist conceives the state as a monolithic rational actor the pluralist envisages a multiplicity of bureaucratic organisations . Consequently , whilst the pluralist would not disagree with the realist assessment that strategic and security interests dominated the initial

phases of the Atoms for Peace programme , this would be regarded as only a partial explanation of the particular form that it took .

1. Was Atoms for Peace driven by commercial or security interests ?

A pluralist perspective would emphasise the variety of bureaucratic actors and organised interests involved in the determination of the Atoms for Peace programme . Thus what becomes significant is not so much the motivations of the decision makers as the political process from which the programme emerged and how it was implemented . Whilst this study has described how the policy originated in the White House it has also detailed meticulously the predominant role that the AEC and private industry came to have ion its implementation . This , Scheinman suggests indicates that the Atoms for Peace programme was driven both by security and commercial interests , reflecting the demands of different domestic constituencies in the policy process .(4)

2. How did US foreign atomic policy throughout this period (1954 - 1974) connect with domestic development of the civil atom ?

The lack of any clear separation between domestic and foreign policy , as chapter one described , is a central assumption of pluralist analyses . This study contains many illustrations of this . Perhaps the most dramatic is the issue of the privatisation of enrichment plants which exercised US policy makers in the early 1970's. As the discussion in chapter four demonstrated what was perceived as an essentially domestic policy issue came to have profound ramifications for civil nuclear programmes abroad ,

as well as the non-proliferation regime . This , together with many more examples of a similar kind , tends to confirm the pluralist view that , because of the nature of complex interdependence , a viable foreign policy has to be underwritten by a viable domestic policy and vice versa . However, as pluralists argue , the problem is that one of the consequences of growing international interdependence is that governments lose control over domestic and foreign policy . Consequently , they are forced to establish international regimes in order to inject stability and predictability into the policy making process .

3. Through what means did the US promote adherence to its evolving non-proliferation regime ?

Whilst realists emphasise the vital role of the US in establishing , through the exercise of its hegemonic power, order in the international system , pluralist analyses stress the significance of interdependence and functional cooperation as determinants of the development of international regimes . Moreover the exploitation of technology in the pluralist perspective create common or collective problems which can only be effectively managed at the international level . Thus the development of the Atoms for Peace regime , as Smith suggests , can be explained in terms of the desire of states to exploit the civil atom whilst simultaneously wishing to avoid the dangers to national security which might arise from further proliferation .(5) Without some form of international nuclear order the anarchic exploitation of civil nuclear power technology threatened to undermine the security of all

states . Consequently , pluralists would argue that the Atoms for Peace regime arose out of functional necessity and was not , as realists suggest , imposed upon states by the US . Rather the role of the US was to provide leadership and incentives for states to participate in the regime which is precisely what it did through the instrument of the bilateral agreement for cooperation . As Chapter six demonstrated even when the commercial and technological hegemony of the US was challenged in the 1970's Japan's adherence to the non-proliferation regime was not diminished precisely because the regime fulfilled important functions for it .

It is in relation to the issue of the changing nature of US foreign atomic policy , in the period of this study , that the pluralist perspective provides some extremely valuable insights . In chapter four the discussion of the institutionalisation of the Atoms for Peace regime suggested that this was a reaction to the loss of control which the US government experienced as the world-wide exploitation of nuclear technology expanded in the wake of power reactor commercialization . One of the primary causes of this , it was suggested , was the very success of US corporations in disseminating civil nuclear power technology abroad. By assisting and contributing to the development of foreign nuclear power industries US corporations were making it increasingly impossible for the US authorities to control unilaterally the global dissemination of nuclear technology . This loss of national control , and the attempt to regain it in the form of increasing emphasis upon institutionalising the Atoms for Peace regime , is exactly

what pluralist analyses of world politics predict to be the consequences of extensive transnational activity and the resultant complex interdependence which arises . This is quite different from the realist view which , as noted above , explains the increasing emphasis upon multilateralism in US foreign atomic policy as a reaction to its decline as a hegemonic power .

4. To what extent did the US government encourage and support the transnational expansion of the domestic nuclear industry ?

Pluralists would accept the realist claim that the transnational expansion of the US nuclear industry was highly dependent upon government support but they would dispute the suggestion that US multinationals were merely passive conduits for the achievement of US foreign policy objectives . Rather , these corporations are conceived as autonomous and powerful actors with their own commercial interests to pursue and . as chapter four has indicated , were in many key respects beyond the direct control of US government agencies . Their expansion abroad cannot be explained simply as a reaction to US government policy but rather has to be understood in terms of the commercial imperatives to which they were subject . In addition they exercised considerable power in the US policy making process and , as chapter five described , came to have an influential role in the determination of nuclear energy policy in Japan , even if somewhat indirectly . Indeed much of the evidence in this study seems to suggest that US multinationals in the nuclear field were rarely directly

used as a conduits for the achievement of US foreign policy objectives . Instead they acted as autonomous agencies pursuing their own commercial interests . In doing so they contributed to the relations of complex interdependence between the US and those states , like Japan , in which they operated .

5. What were the political and other consequences of reliance upon US nuclear technology ?

Complex interdependence , at least on the surface , would appear to describe the relationship between the US and Japan throughout the period of this study . As chapter five has indicated it was a relationship in which there were multiple channels of contact between both governments and societies , a broad agenda of political issues , of which nuclear cooperation was just one , and the absence of military force or coercion as an instrument for settling any disputes between them . It was , however , an asymmetrical relationship in that Japan was , on the whole , much more dependent and sensitive to American actions than vice versa . This was , as the thrust of chapter five makes so clear , particularly the case in respect of nuclear cooperation . Reliance upon US nuclear technology and fuel brought the atomic energy policy making communities in Washington and Tokyo into intensive interaction to manage the relationship . But it was Japan which was most vulnerable to developments in US domestic or foreign atomic policy . Chapter five's discussion of enrichment policy , safety issues , and private ownership of nuclear fuel policy in Japan illustrates the extent to which the relationship was highly asymmetrical . In particular it demonstrates how

on key issues Japan's domestic and foreign atomic policy was intimately tied to that of the US AEC and State Department . For Japan complex interdependence brought with , as pluralists predict , a considerable loss of control over domestic and foreign atomic policy . Equally it made American multinationals and government agencies informal participants in the domestic policy process just as on major issues , such as that of enrichment policy , Japanese corporate and government actors became participants in the policy discussions in Washington . This reinforces the pluralist argument that interdependence makes the distinction between the ' foreign ' and the ' domestic ' increasingly anachronistic amongst modernised societies .

To summarise . A pluralist interpretation of this study would highlight the fact that nuclear technology has created a new issue-area in world politics in which the separation of domestic from international politics is no longer feasible and in which international cooperation to manage the peaceful exploitation of this technology is essential. It would emphasise the convergence of security and commercial objectives in the Atoms for Peace programme and the functional requirements of adherence to the non-proliferation regime . Moreover , it stresses the loss of autonomy which arises as a consequence of the nature of complex interdependence , particularly where he relationship is an asymmetrical one . Civil nuclear technology therefore creates its own form of international nuclear politics in which the major actors , issues , and sources of power are quite distinct from those prevailing in other issue-areas .

6.1.3 The Neo-Marxist Perspective upon the International Politics of Nuclear Technology Transfer

1. Was Atoms for Peace driven by commercial or security interests ?

Whereas a pluralist interpretation tends to emphasise the benign aspects of nuclear technology , in generating greater international cooperation , a neo-marxist interpretation stresses its role in maintaining a particular form of world order . The transnational expansion of the US nuclear industry is therefore explained not as a an altruistic gesture but as one significant means by which the worlds dominant capitalist power could reinforce and reproduce the world capitalist order . The lack of significant indigenous energy resources in Europe , Japan , and many pro-Western Third World countries made the US dissemination of nuclear technology an essential requirement for the reconstruction and consolidation of the post-war international capitalist order . Thus nuclear technology was harnessed to the achievement of American strategic objectives which in turn were driven by the structural requirements of its role as the hegmonic capitalist power . In this perspective neither commercial advantage nor security requirements were the determining factors in the development of the Atoms for Peace programme but rather the consolidation of international capitalism .

2. How did US foreign atomic policy throughout this period (1954 - 1974) connect with domestic development of the civil atom ?

There is some common ground between pluralist and neo-marxist interpretations in accounting for the intimate connections between the domestic and international exploitation of the civil atom . In the neo-marxist perspective the domestic role of the AEC in promoting private development of the atom was essential to the success of the Atoms for Peace programme . For the dissemination of nuclear technology abroad , through private enterprise , was an important mechanism for de-politicising the whole Atoms for Peace programme , making it appear a primarily commercial undertaking . Moreover , as chapter four explained , encouraging the development of nuclear power abroad was also one means by which the AEC could subsidise the domestic nuclear programme without , at least in the early period , undermining the state's vital political and ideological attachment to private enterprise development of the atom . Equally , US commercial and technological hegemony in the world market required a massive and expanding domestic nuclear industrial base . As the nuclear power industry became enveloped in domestic crisis , in the late sixties and early seventies , this contributed directly to undermining US technological and commercial hegemony in the world market as prospective customers sought suppliers less vulnerable to the vagaries of domestic politics .

3. Through what means did the US promote adherence to its evolving non-proliferation regime ?

Where the neo-marxist perspective differs considerably from realist and pluralist analyses is in its explanation of how the US promoted adherence to the evolving Atoms for Peace regime . Rejecting the realist explanation that adherence

was a product of the simple exercise of hegemonic power, and the pluralist conception that it arose from functional necessity , the neo-marxist explanation stresses the legitimacy accorded to the regime by its members . Thus it was neither imposed upon them by the US nor arose out of some common desire to resolve the collective problems resulting from the international exploitation of civil nuclear technology . Rather, the US utilised its hegemonic position to establish an international nuclear order which was first and foremost perceived as fair and one which benefited all states , even if in reality it most benefited the US . Thus the US , as chapter five has illustrated , respected the demands of the Japanese government in the framing of the 1955 , 1958 and 1968 bilateral cooperation agreements even though it could quite readily have rejected them . What brought conformity to the US inspired non-proliferation regime was the fact that the US expended considerable political political effort in ensuring that it was perceived as legitimate . Initially this was assisted by the common ideological bonds amongst those states with which the US established its bilateral agreements for cooperation . The central importance of legitimacy to US hegemony in the nuclear arena is also significant to the explanation of the shift in US foreign atomic policy , as commercial nuclear power came of age, towards multilateralism .

As already discussed , realists conceive the decline of US hegemonic power to be the prime cause of its attempts, from the 1960's onwards , to institutionalise the Atoms for

Peace regime by recourse to multilateral structures of cooperation and international management . Pluralists , on the other hand , explain the drift towards multilateralism primarily as a reaction to the loss of control caused by the diffusion of nuclear technology and the growth of transnational activity in the nuclear arena . In contrast , neo-marxists stress the institutionalisation of the Atoms of Peace regime as primarily an attempt to sustain the legitimacy of the US dominated nuclear order as the willingness to tolerate bilateral controls and regulation , with the onset of the commercialization of nuclear power , was increasingly diminished . This was certainly the case , as evidence in chapter five , with Japan . In addition the growing domestic burdens of hegemony , as the use of civil nuclear power abroad expanded enormously , reinforced the pressures in US foreign atomic policy for greater emphasis upon multilateral approaches to managing the spread of nuclear technology . Furthermore , as the process of uneven development took its toll , with the emergence of a European challenge to the US commercial and industrial monopoly over civil nuclear technology , the attractions of multilateralism were considerably enhanced .

To what extent did the US government encourage and support the transnational expansion of the domestic nuclear industry ?

Underlying the transnational expansion of the major US corporations in the nuclear industry was an ' alliance ' between the state and industry . As chapters three and four have discussed in some detail , the relationship between the AEC , JCAE, and the nuclear industry became increasingly

central to the direction of US domestic and foreign atomic policy in the years after the passage of the 1954 atomic energy act . Camilleri notes , for example , that the effect of this was to :

> ...establish and increasingly institutionalise a nucleocracy whose function was to co-ordinate and fuse ever more closely the interests and the objectives of the state ,of industry , and of the scientific and technological community .(6)

This fusion of the interests of the state and big business facilitated the achievement of their separate commercial and political interests . But the AEC was in no sense industry's ' puppet ' but rather acted with considerable autonomy on many major policy issues , as did private industry . Thus whilst the AEC provided extensive financial and other support for the international expansion of the domestic nuclear industry the major corporations involved were largely driven by the imperatives of commercial competition . Moreover even though the US established the international regulatory framework which legitimised international nuclear trade , thereby creating a world market for the US nuclear industry this , as chapter four has indicated , was not done at the behest of industrial interests but rather reflected the strategic policy objectives of the state itself . But , neo-marxists would also point to the overwhelming coincidence of state and industrial interests in attempts to sustain , as with the proposals for multinational enrichment ventures in the early 1970's , US industrial and technological hegemony in the world market since this was of vital importance to both parties .

What were the political and other consequences of reliance upon US nuclear technology ?

Camilleri suggests that :

> ...the nuclear industry has had to operate ... in the context of an international division of labour characterised by stratification , competition , and uneven development . Relations between metropolitan [core] , semi-peripheral and peripheral states have mirrored and reinforced that division of labour.(7)

Japan , in the context of this study , is classed very much as a semi-peripheral state since it is , and was even in the 1950's , by no means an industrialising but rather an industrialised state . Nevertheless , the lack of indigenous nuclear capabilities made it highly dependent upon the US and the US nuclear industry . On this issue there is a convergence between all three perspectives . However , the neo-marxist interpretation stresses how the structure of nuclear cooperation between Japan and the US reproduced and sustained the formers dependence upon the latter . It was not simply that the relationship was an asymmetrical one but that Japan's nuclear development was determined as much by technological , political and commercial decisions in the US as it was by indigenous policy choices . Chapter five provides a rich source of evidence to reinforce this proposition . It also demonstrates the significance of the integration of Japan's governmental and industrial elites in the nuclear issue-area into a world-wide nuclear community with the US at its commercial and technological core .

Both the structure of nuclear co-operation and the existence of strong ideological , commercial and technological bonds between the policy making elites in both states created subtle mechanisms by which the US could

influence the outcome of domestic policy debates in Japan . Thus direct intervention was unnecessary since the very structure of nuclear cooperation , as well as the elite linkages to which it gave rise , ensured that Japan's policy makers were always consciously aware of US interests and priorities on any policy issue . For instance , on the issues of the NPT , IAEA safeguards , and enrichment policy , dependence upon the US is an important factor in explaining the nature of Japanese policy . But the neo-marxist perspective does not conceive such dependence in a deterministic fashion . Far from it for it contains its own inherent contradictions .

One of the consequences of the US corporate penetration of the Japanese nuclear industry was to enhance its indigenous nuclear capabilities . Since Japan acquired the most advanced nuclear technologies and know-how there was a sense in which by transferring nuclear technology US corporations were contributing to the emergence of potential commercial competitors . In Japan's case the development of a more sophisticated nuclear industrial capability increased not only its potential for reducing its technological dependence upon the US but also increased its its political motivation to do so . Civil nuclear cooperation with the US thus had contradictory consequences for Japan's autonomy in the nuclear issue -area .

To summarise . In the neo-marxist perspective the international expansion of the US nuclear industry , and the Atoms for Peace programme , were essentially part of a larger project to facilitate the expansion and consolidation of the post-war world capitalist order . The creation and

maintenance of a legitimate international nuclear order was therefore a prime concern of the US as the hegemonic capitalist state . This necessitated a close relationship between the state and the nuclear industry in all aspects of foreign and domestic policy with respect to the civil atom . Reliance upon US nuclear technology brought with it a structure of technological dependence which had significant consequences for the domestic development of nuclear power . Nuclear technology , in this neo-marxist perspective , is therefore conceived as one element in the maintenance and reproduction of the world capitalist order .

6.2 Evaluating the Interpretations Provided by the Three Perspectives

Each of the three perspectives provides an original and perceptive set of answers to the five questions raised in chapter one . But in providing different , and in some cases similar answers , to these questions it seems logical to go further and ask which , if any , of these perspectives offers the most convincing answers and thus which , if any , affords the most plausible interpretation of the origins , dynamics , and consequences of the transnational expansion of the US nuclear industry .

6.2.1 Evaluating the Perspectives

Since each of the three perspectives introduced in this study has its origins in different philosophical and intellectual traditions in the social sciences there can be no theoretical synthesis which integrates them into some

type of grand or global theory .(8) Nor are there any objective epistemological criteria , upon which all theoreticians would agree , by which it would be possible to distinguish between the validity of competing explanations or interpretations of the same political or social phenomenon .(9) But this does not mean that prejudice , informed or otherwise , can be the only judge of what counts as a valid explanation , nor that relatavism is the only refuge for the student of international relations .

As Deutsch has argued there are some general criteria by which competing theories can be evaluated namely : originality ; economy or parsimony ; and predictive powers .(10) But these , particularly the latter , are still very much located within a positivistic frame of reference . Reynolds on the other hand emphasises the criteria of coherence and consistency.(11) This study veers more towards the Reynolds approach and the criteria utilised here are : coherence ; comprehensiveness ; and parsimony . Coherence refers to the degree to which an interpretation of social or political phenomena provides a clearly argued and reasoned narrative .(12) By comprehensiveness is meant the extent to which the range of available evidence about a particular phenomenon can be accounted for by a given interpretation and how much relevant data is left unexplained . Finally , parsimony refers to the extent to which an explanation provides a selective and economical account of the phenomena being studied . The more coherent , comprehensive and parsimonious the explanation the better it is judged to be . (13)

With these three criteria firmly to the fore it may be possible to make some tentative judgements about which of the three perspectives provides the better explanation of the origins and consequences of the transnational expansion of the US nuclear industry . To do this the three perspectives are evaluated in relation to how effectively they explain the central concerns of this study : the origins and motivations underlying the Atoms for Peace programme ; the evolution and connection between US foreign and domestic atomic energy policy ; and the political consequences of reliance upon US nuclear technology .

6.2.2 Atoms for Peace : Origins and Motivation

Both the realist and neo-marxist interpretations of the origins and motivations underlying the Atoms for Peace programme appear to have all the attributes of a coherent , comprehensive , and parsimonious explanation . Each accounts for the programme in terms of the purposive and strategic goals of the US as a hegemonic state in the international system . Where the two accounts differ is that the realist conceives great power competition to be the primary determinant of US policy whereas the neo-marxist perspective stresses the requirements of the US role as the hegemonic capitalist power in the world system to be the dominant explanatory variable . Nonetheless each perspective is parsimonious , coherent within its own framework of rereference , and appears to account for the evidence as described in this study .

Although the pluralist perspective provides valuable

insights into the implementation and evolution of the Atoms for Peace programme it appears wanting in its discussion of its origins . This is partly because pluralist analyses conceives the policy process in terms of bureaucratic politics and bargaining between government and organised interests . Yet , the Atoms for Peace programme originated at the highest levels of the executive branch , with little bureaucratic interference , and no societal input ; not even the AEC was party to its formulation . This compares with its implementation which was almost the sole preserve of the AEC and private corporations . In addition , whilst the pluralist perspective explains the development of international regimes essentially as a reaction to the conditions of complex interdependence the fact is that in this particular case the regime came into existence prior to the emergence of any transnational activity or international civil nuclear transactions between states . In this respect at least the pluralist explanation lacks coherence .

6.2.3 The Evolution and Relationship between Foreign and Domestic Atomic Energy Policy

All three perspectives proffer some explanation for the close connection between domestic and foreign atomic energy policy , as well as the increasing drift of US foreign atomic energy policy towards multilateralism . Whilst the realist perspective provides the most parsimonious explanation of the three it lacks both comprehensivesness and coherence . It conceives of both domestic and foreign

atomic policy as merely servicing the maintenance of US hegemony and the drift towards multilateralism as a product of hegemonic decline . It thus fails to recognise the complexity of the inter-relationship between domestic and foreign policy , particularly the fact that domestic policy was in no sense subservient to the US hegemonic role , as the enrichment contracting debacle of 1974 demonstrated . Equally , as chapter four emphasised , the notion of decline is not a convincing explanation of the evolution of US foreign atomic policy . Thus the realist perspective lacks both coherence and comprehensivesness .

In comparison the pluralist and neo-marxist perspectives score highly in relation to all three criteria . The pluralist perspective readily accounts for the intimate relationship between domestic and foreign policy in terms of the growth of complex interdependence . Foreign policy , because of complex interdependence , becomes domesticated and domestic policy becomes internationalised . Moreover , as pluralists would predict , the widespread international dissemination of nuclear technology by US corporations made it increasingly difficult for the US to control unilaterally the exploitation and utilization of US nuclear technology and fuel abroad . As a consequence US foreign atomic policy was therefore forced to exploit multilateral mechanisms of control .

The neo-marxist perspective , on the other hand . conceives the lack of any clear distinction between foreign and domestic atomic energy policy to be a product of the fusion of state and industrial interests with regard to the domestic and international government of the atom . But the

neo-marxist perspective is less convincing on this point than it is with respect to the evolution of US foreign atomic policy . Here the emphasis upon legitimacy and consent as the requirements for the exercise of hegemonic power , and thus the maintenance of the US inspired international nuclear order , seems to offer a much more convincing explanation of the drift towards multilateralism in US foreign atomic policy from the 1960's onwards .

6.2.4 Reliance upon US Nuclear Technology

On the surface both the pluralist and the neo-marxist perspectives would appear to be most appropriate analytical tools with which to explore the consequences for Japan of its reliance upon the US as its dominant nuclear supplier . But the realist perspective does provide some answers , however limited . By focusing upon the question of reduced political autonomy the realist explanation proffers a parsimonious account of the consequences for Japan of technological dependence in the nuclear field . But this account lacks both comprehensivesness and coherence since it fails to provide for the changing nature of the dependent relationship . It is in this context that the neo-marxist perspective becomes relevant .

Neo-marxism with its stress upon the dynamic character of technological dependence offers a much more coherent and comprehensive account of the consequences for Japan of civil nuclear co-operation with the US . The focus upon the integration of policy making and industrial elites in Washington and Tokyo , how the structure of technological

dependence conditions the character of Japanese domestic and foreign atomic policy , as well as the contradictions inherent in that structure , lead to a much more convincing explanation of the political impact of nuclear technology transfer .

Finally , the pluralist perspective too provides a far more insightful account than that of realism . Its concentration upon transnational and transgovernmental activity , the impact of complex interdependence upon the formulation of domestic and foreign atomic policy , and the consequences of integration into the non-proliferation regime encourage a more sophisticated appreciation of the implications of technological dependence for national political autonomy . However , the central weakness of the pluralist account is its conception of dependence solely as a relationship neglecting its equally important structural dimension .

6.3 Technology and World Politics : Some Concluding Remarks

Evaluating the three perspectives is a complex and uncertain business for there are no objective answers to be had . As these final few pages have illustrated not only does each perspective provides distinctive and original answers to the five questions raised in chapter one but also each can be seen to provide more or less convincing explanations of the central concerns of this empirical study . Each therefore has a role to play in our understanding of the impact of technology on world politics .

In relation to this study it might be suggested that the origins of the Atoms for Peace programme is best explained in the conceptual language of realism and neo-marxism . However , the subsequent transnational expansion of the US nuclear industry and the changing nature of US foreign atomic policy might best be described and explained using both the insights of pluralism and neo-marxism. Whilst any account of the political consequences of nuclear technology transfer may be more convincingly explained within the framework of neo-marxist or pluralist analyses . But are there any more general conclusions about the role and impact of technology upon world politics which might be drawn from this study ?

There are five significant conclusions which may be inferred from this study . Each is sketched out briefly below .

1. Technology cannot be conceived as a neutral force in world politics . Technology , as Nau observed , is always designed to serve particular political interests , be they of states or non-state actors , and to reinforce a particular form of world order .(14)

2. Technology does not necessarily lead to greater international cooperation or harmony but is equally a source of tension , conflict , and disharmony .

3. On issues of high technology there no longer appears to be a clear separation between domestic and foreign policy matters.

4. Far from technology diminishing the political significance of the nation-state it serves to increase its

salience as the primary focus of political analysis in the study of world politics .

5. Each of the three major contemporary analytical perspectives upon world politics - realism , liberal-pluralism and neo-marxism - provide distinctive and original insights into the impact of technology upon world politics .

Technology is an increasingly significant force in shaping the character and dynamics of world politics . But , as this study has demonstrated , it is not by any means an autonomous force . Moreover its impact is felt both in increasing complexity in world politics and a strengthening of contradictory tendencies towards both political unity and political diversity . Technology therefore presents the analyst of international relations with a profound intellectual challenge : a challenge which cannot be confronted without some recognition of the value of different theoretical traditions in the study of world politics .

CHAPTER SIX FOOTNOTES

(1) Nau H. National Politics and International Technology John Hopkins University Press Baltimore 1974 p239

(2) See Smith R.K. ' Explaining the non-proliferation Regime ' International Organisation v41 no 2 Spring 1987 pp253-282

(3) See Gilpin R. War and Change in World Politics Cambridge University Press Cambridge 1981 Ch 3

(4) See Scheinman L. ' Security and a Transnational System : The case of Nuclear Energy ' in Keohane R. and Nye J. eds Transnational Relations and World Politics Harvard University Press Cambridge Mass 1971

(5) Smith op cit

(6) Camilleri J. The State and Nuclear Power Harvester Press Brighton 1984 p26

(7) ibid p26

(8) On this point see McKinlay D. and Little R. Global Problems and World Order Frances Pinter London 1986

(9) See Reynolds C. Theory and Explanation in International Politics Martin Robertson London 1973 . But this would of course be disputed by positivists such as Waltz . See Waltz K. Theory of International Politics Addison-Wesley New York 1979 Ch1

(10) See Deutsch K. The Nerves of Government Free Press New York 1963 pp16-18

(11) See Reynolds op cit p 354

(12) ibid p338

(13) ibid

(14) See Nau op cit chapter 9

A NOTE ON SOURCES

Whilst there is a voluminous and readily accessible primary literature on the American civil nuclear programme there is only a limited secondary literature on the Japanese civil nuclear programme , and only a limited amount of primary documentation published in English . Consequently , whilst this study has been able to rely upon primary sources in covering the development of the US programme , it has relied solely upon the Japan Atomic Industrial Forum publication ' Atoms in Japan ' , together with those reports published in English , and various secondary sources , for its discussion of the Japanese civil nuclear programme . It is believed that this has not unduly biased the nature of the study or distorted its conclusions .

Research on the history of the US civil nuclear programme was carried out using the facilities of the Library of Congress , the archives of the Atomic Energy Commission (now Department of Energy) in Maryland , the Congressional Research Service , and the library of the Atomic Industrial Forum , all in Washington DC .

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