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WEST OF SHETLAND DATA BUOY PROJECT

THIRD REPORT

March 1977 to September 1977

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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Institute of Oceanographic Sciences
Crossway
Taunton
Somerset

Report from the Institute of Oceanographic Sciences to the United Kingdom Offshore Operators Association on the conduct of the West of Shetland data buoy project from 11 March 1977 to 24 September 1977

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INTRODUCTION

This is the third in a series of documents which reports on the conduct of the UKOOA West of Shetland data buoy project. Since the report series is much in arrears of the events it describes, it seems sensible for the reports to cover six-month periods, instead of the three-month periods originally envisaged. Accordingly, this report covers the six months or so from 11 March to 24 September 1977. The second report described events up to and including the stranding of the first buoy, and the present report carries on from there.

The organisational aspects of the project have remained the same, ie the Natural Environment Research Council, Institute of Oceanographic Sciences, has contracted with UKOOA to make measurements to the West of Shetland and UKOOA have nominated Marine Exploration Ltd (Marex) as a major subcontractor, to be responsible for the supply and operation of a data buoy.

A brief description of the project is again included as an Appendix.

This report covers the Spring and Summer of 1977. After a good start the performance of the buoy system deteriorated, and the occurrence of long periods of gales or near gales in the area did nothing to ease the task of maintenance.

Scope and Organisation of Report

The narrative is divided into parts dealing respectively with the Marex operation and the receiving station on Foula. The data from both sources are considered separately.

Part 1 is preceded by a schedule of the main events which occurred during the period (Table 1).

There are a number of appendices.

Appendix A – Brief description of the project (reproduced from the first report).

Appendix B – Table of data return for the project as a whole up to 9 November 1977, this being the date on which the first extension to the contract terminated.

The operational narrative for the period 24 September to 9 November will appear in the next report when all the information for the period has been collated.

Appendix C – A description of the IOS checking procedure (reproduced from the second report).

TABLE 1 - Schedule of main events

1977

11 March	- (The Marex buoy had been stranded on 10/11 March.)
to	- Receiving data from back-up Waverider. Periodic loss of signal.
12 April	- Waverider not heard after this date.
18 March	- Back-up heave sensor calibrated at NMI.
25 March	- Attempted deployment of back-up data buoy.
10 April	- Deployment of back-up data buoy.
19 April	- IOS recommendation to Marex on design of buoy mooring.
4 May	- Project meeting at Marex, Cowes.
11 May	- Service visit to buoy.
16 June	- Service visit to buoy.
Mid-July	- No service visit because of persistently poor weather.
9/11 August	- Service visit to buoy - installation of Mark 2 processor - diver inspection of mooring.
17/18 September	- Service visit to buoy - prototype processor put back.

PART 1 - The Marex Data Buoy

Redeployment of Marex data buoy

Marex worked quickly to prepare the buoy (subsequently called No 03) which was to replace the one (subsequently called No 02) which went ashore (see second report).

The heave sensor was calibrated under IOS supervision at NMI, Hythe on 18 March, and the anemometer was tested in a wind tunnel at the British Hovercraft Corporation, Cowes. The other sensors were check calibrated in Marex's laboratory.

The deployment was organised much as previously. A converted trawler, used as a stand-by vessel on the northern oil fields was to be diverted while on her way north in order to ship the buoy from Aberdeen to Scalloway and to deploy it.

The buoy was transported by road to Aberdeen, arriving on 25 March and was there loaded onto the trawler Cevic, arriving at Scalloway at midday on the 26th. However, the weather continued unsuitable, and on the 28th with an unfavourable forecast, the discovery that the transmitter had been accidentally damaged, it was decided to call off the attempt.

The next attempt to deploy took place on Easter weekend, the intervening weekend being unsuitable on account of the weather. This was successful, the buoy being transported to the area by the trawler Cevic, which deployed the buoy at 0430 GMT on 10 April (Easter Day).

An IOS observer was present at both deployment attempts.

Details of the deployment are given below.

Date:	10 April 1977
Time:	0430 GMT
Position:	$60^{\circ}07'30''N$ x $02^{\circ}57'W$
Depth:	88 fathoms

Back-up Waverider

There was evidence from the receiving station during March that the Waverider buoy was adrift, since reception from it would cease for periods of a day or two before coming back. While Cevic was in the deployment area a search for the Waverider was made, the intention being to renew the mooring, but although it could be heard on the direction-finder, the Waverider could not be found.

The Waverider was not found on the next service (11 May) either, and apart from an unconfirmed sighting to the south of Foula in early May it was not seen or heard from again until June when it was reported in the possession of John Brown & Co of Fraserburgh. It had been found drifting by one of their fishing vessels and was completely undamaged.

Service Visits

Service visits were made by Marex on 11 May and 16 June 1977.

During the middle and later part of July, the weather in the area was characterised by persistent strong winds, mainly from the south and south-east. Because of this it proved impossible to carry out the mid-July service visit on schedule.

The next service visit to the buoy was made on 9 to 11 August, and the following actions taken:

1. The Mark 2 (production) processor was installed for the first time. Note that this was the first time the processor modules were exchanged in the way originally envisaged. Previously it had been necessary to replace the tapes in the same module at sea.

2. The transmitter battery module was exchanged. (IOS had reported that the signal was weak, see Part 2.) A faulty connector in the cable to the masthead transmitter was found and this was replaced.

3. A diver inspection of the mooring to below the sub-surface float was made. The mooring was found to be in good condition.

The next service visit was made on 17/18 September. The processor modules were exchanged, the prototype being put back into the buoy. It was noted that the tapes in the Mark 2 processor had failed to advance.

PART 2 - The receiving station on Foula

The receiver had been switched to the back-up Waverider frequency on 10 March, and good reception was obtained for most of the following month. However, for a time between 1 and 3 April the signal disappeared entirely. In view of the generally very reliable reception during this period, it is perhaps possible that the buoy had come adrift and had moved out of reception range (see Part 1).

After the deployment of the data buoy on 10 April, IOS continued to receive the Waverider for a few days in order to obtain some data to compare with those recorded on the buoy. On 12 April the Waverider signal again disappeared, and the receiver was switched over to the data buoy.

The generator used for charging the storage batteries on Foula was becoming increasingly unreliable during this period, and a replacement alternator unit was flown out to the island on 13 April.

Fairly good reception was obtained during the following two months until the middle of June when data loss due to interference increased greatly. Marex were informed of our difficulties - however it was not easy to decide if the increased data loss indicated more interference or a weaker signal.

Reception remained poor for the rest of June and into July and on 21 July our agent informed us that interference was now very severe.

Marex were aware of these problems but because of the persistent strong winds they could not make a service visit to the buoy. Although the back-up Waverider had by this time been recovered, no instructions for its redeployment had been given, and in any case the weather would have prevented it.

On 5 August our agent informed IOS that very little information was now getting through, and that he considered that much of the interference was originating from Scottish fishing vessels working in the area. Accordingly, IOS sent a letter to the Aberdeen Fishing Vessel Owners Association describing our transmission system and recording schedule and pointing out the difficulties we were experiencing.

After the service visit of 9-11 August a substantial improvement in reception occurred. During the visit a suspect plug in the power supply to the transmitter had been replaced, and this may have been the cause of the improvement.

PART 3 - The Data

Scrutiny of data recorded on the buoy

A brief description of the checking procedure employed by IOS on the data from the Marex buoy appeared in the second report, and this is reproduced in the present report as Appendix C.

The results of the checking procedure are shown in Table 2, an explanation of which is now given.

The table shows the percentage data loss for each element recorded, and for each of the four module periods. The periods covered by the modules are as follows:

Module No	Period covered (1977)
1	10 April - 11 May
2	11 May - 16 June
3	16 June - 11 August
4	11 August - 17 September

In addition the table is subdivided into errors detected by Group 1 checks and those detected by Group 2 checks. An explanation of the data validation procedures employed is given in Appendix C. Briefly, Group 1 checks are simple checks on the data carried out by the computer, to assess its reasonableness while Group 2 checks involve comparisons with data from other sources. The letters A, B, C, D, E refer to the comments about the data listed below the table. No data were disqualified by the Group 2 checks.

TABLE 2 (for explanation see text)

Module No	Group 1				Group 2			
	1	2	3	4	1	2	3	4
RMS	9	12	93A	100B	C	C		
Hmax	7	6	93A	100B	C	C		
H1	7	6	93A	100B	C	C		
Tz	6	13	93A	100B	E	E		
Wind speed	5	6	93A	100B				
Wind direction	5	3	93A	100B				
Barometric pressure	8	10	93A	100B	D	D	D	
Air temperature	6	4	93A	100B				
Sea temperature	8	6	93A	100B				

Comments on the data

A – The on-buoy recording system failed four days after the beginning of the period.

B – Recording system failure.

C – All wave height data showed some scatter when compared with Foula data.

D – The buoy recorded pressures were about 1 mb higher than the LWC estimates on average.

E – The values of Tz recorded on the buoy did not correlate well with those calculated from the transmitted data.

Raw data recording

The on-buoy raw wave data recorder did not operate during the period of this report.

Foula (telemetered) data

Table 3 shows the percentage of data lost during each of the six periods between magnetic tape changes. The loss of data was due entirely to problems with the radio link.

TABLE 3

Period (1977)	% data lost
14 March – 18 April	17
18 April – 22 May	11
22 May – 23 June	22
23 June – 24 July	47
24 July – 19 August	52
19 August – 24 September	28

APPENDIX A

Brief description of the Foula Data Buoy Project

The project is based on the use of the Marex data buoy which is moored at a site chosen to be in the same general area as the Fitzroy location and in a comparable depth of water, but close enough to land to enable the telemetry of wave data from the buoy.

The buoy makes hourly recordings of the following parameters:

Wave height
Wave period
Wind speed
Wind direction
Atmospheric pressure
Air temperature
Sea temperature

The computations involved are carried out by an onboard microprocessor and the results are recorded using a cassette type digital magnetic tape recorder.

The microprocessor and the tape recorder are housed in one of four replaceable waterproof modules, the batteries are housed in two others, and the Datawell heave sensor in the fourth.

The changing of the magnetic tapes and batteries is accomplished by simply exchanging the self-contained modules. This is done at approximately monthly intervals by Marex staff using a chartered fishing boat.

As well as being processed and recorded on the buoy, the wave data is transmitted continuously using a standard waverider modulator and transmitter. A receiving station has been set up on the island of Foula which is switched on for 25 minutes once every 3 hours and during this time the signal is received and samples of the wave data are recorded using both analogue and digital tape recorders.

The receiving station is visited every few days by IOS's agent who is resident on the island, to check that the buoy signal is still being received. Battery charging is necessary once per week and the tapes are changed once per month. If for any reason the buoy signal is not received, our agent telephones IOS to discuss the problem and IOS in turn informs Marex. At the end of each month the tapes are transported to the mainland of Shetland for onward transmission to IOS.

As a back-up to the data buoy measurement of waves, Marex deployed a waverider close to the buoy position. In the event of a failure of the data buoy transmission the waverider can be received and recorded on Foula by selecting the appropriate channel on the receiver. In normal circumstances the waverider signal is checked once every few days but is not sampled.

APPENDIX B

OVERALL DATA RETURN OF PROJECT

Summary Data Return Figures for the period 4 December 1976 to 9 November 1977

Data Type		Overall percentage data return	
Wind		43	
Pressure		42	
Temperatures		43	
Waves (internally recorded on Marex Data Buoy)	42		
Waves (transmitted by Marex Data Buoy)	24	)	These figures refer to "fill-in" data derived from the IOS Foula series
Waves (transmitted by back-up Waverider)	8	)	
Total for waves		74	

IOS Foula wave data

Overall percentage data return for the period 4 December 1976 to 9 November 1977 - 64

Note that the signal from the data buoy was probably substandard during the latter part of June, all of July and the beginning of August when a fault on the buoy was repaired. The transmissions from the data buoy probably ceased completely in the middle of October.

APPENDIX C

Description of IOS data checking procedure

In order to operate the 'continuity of operations' clauses in the contract, it was necessary for IOS to develop a checking procedure to be used on all the data buoy results. As well as having purely contractual use, this work was important in that the performance of the buoy, which was a comparatively untried system, was monitored closely and recommendations regarding specific aspects of its performance could be made as necessary.

Briefly, the checking scheme used was as follows. A copy of each buoy data tape was sent to IOS by Marex. This was checked by a computer program to determine how much of the data was retrievable, and how much of the retrievable data passed some simple checks for reasonableness. These we refer to as 'Group 1 checks' - see ref 1.

In addition comparisons were made:

(a) between the wave data recorded on the buoy, and the wave data recorded on Foula; and

(b) between the meteorological data recorded on the buoy and estimates of the meteorological conditions at the buoy site prepared by the Meteorological Office (London Weather Centre) using the appropriate synoptic charts.

These comparisons we refer to as 'Group 2 checks' - ref 1.

The results of these procedures were used in the following way:

1. We used the Group 2 checks to assess the general performance of the buoy. In particular we could detect any systematic errors. If there were errors, depending on the nature of these, we either disqualified the data (for payment) or accepted it, but in any case asked that Marex qualify the data as being erroneous or suspect.

2. If we considered that as a result of the Group 2 checks the data were useful, then the results of the Group 1 checks were used to determine the data return figures to be used contractually.

Reference 1

Pitt, E G. 'The Quality Control of Data from an Offshore Station'. Symposium on Offshore Data Acquisition Systems, Southampton September 1974. SUT.