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WEST OF SHETLAND DATA BUOY PROJECT

FIFTH REPORT

APRIL 1978 to SEPTEMBER 1978

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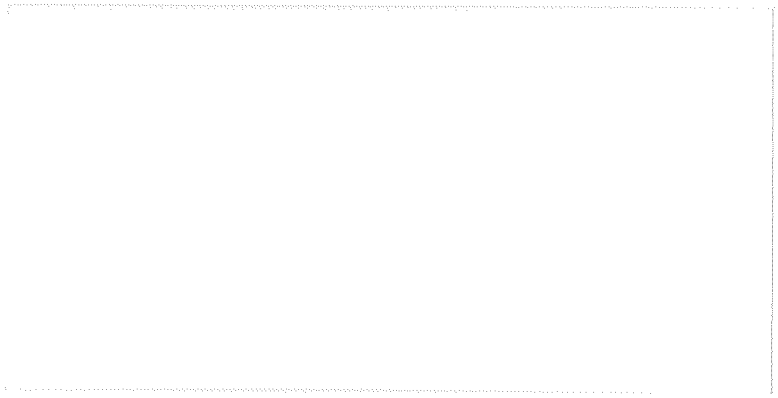

CONFIDENTIAL to UKOOA Oceanographic Committee Participants

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FIFTH REPORT

APRIL 1978 to SEPTEMBER 1978

Internal Document No 47

Institute of Oceanographic Sciences
Crossway
Taunton
Somerset

April 1979

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 1 April 1978 to 18 September 1978

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West of Shetland Data Buoy Project - Summary Table : 1 Apr[illegible] to 18 September 1978

Date	Events		Marex buoy		Waverider		Foula Station	
April 1978	1	Marex data buoy 02 deployed, heave sensor 13027 fitted	1	Buoy deployed Data recorded using prototype processor		Waverider 6679 deployed- signal weak		Receiving waverider signal
	13	Heave sensor 13026 calibrated at NMI						
	19	W/R 6500 calibrated at NMI						
May	1/2	Service visit to buoy	1/2	Service visit	1/2	W/R 6500 (intended to replace 6679) faulty on test & not deployed.	3	Switched to data buoy channel
	12/16	IOS visit to Foula	13	Power failure No data		W/R 6679 found to have no output & recovered.	12/16	IOS visit, serviced petrol generator, checked system calibration
	22/28	Service visit to buoy	22/28	Recording data		No W/R deployed		
	28	W/R 6679 recalibrated at NMI	30	Battery failure	26	W/R 6500 deployed		
June	12	IOS agent on Foula reported no signals		Data buoy off-station: No data	12	W/R faulty - thought to be lost	12	No signals
	14	Air search - no sign of data buoy 01 or W/R						No data received
	29	Lost processor module returned to Marex (PROD-1)						
July	18	Meeting with Marex at IOS Wormley to discuss mooring system.	18	Data buoy 02 recovered by 'Western Pacesetter' 60 miles NE of Peterhead	12	W/R 6679 deployed on IOS mooring. 6500 found on station- faulty on test.	12	W/R buoy received
	21/27	Data buoy 03 assembled and tested at Scalloway, Heave sensor 13026 fitted						
August	8	Data buoy 03 deployed	8	Data recorded using production processor		Waverider 6679 on station		W/R buoy received
	24	Heave sensor 13027 recalibrated						
September	1/4	Buoy service unit	1/4	No data recorded after service visit - tapes failed to restart		Waverider 6679 on station	18	Report of minor storm damage - loss of data buoy signal.

INTRODUCTION

This is the fifth in a series of reports on the conduct of the UKOOA West of Shetland data buoy project. It covers the period from 1 April 1978 to 18 September 1978.

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 the major sub-contractor, to be responsible for the supply and operation of a data buoy.

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

The present report again documents periods of data loss due to a variety of failures and mishaps, so that the overall data return continues to be disappointing.

Scope and organisation of the 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 table which summarises in chronological order the main events which occurred during the period (Table 1).

There are two appendices:

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

Appendix C - Description of IOS checking procedure.

PART 1 - The Marex Operation

Data buoy serial No 02 was deployed on 1 April 1978 - see Fourth Report in this series - with the prototype processor fitted.

The next service visit was made on 1 May 1978 when it was also intended to replace Waverider No 6679 with No 6500, which had already been recalibrated and was stored at Scalloway. However, when Waverider 6500 was checked using the outputmeter prior to departure from Scalloway it appeared to be giving no output and so could not be deployed.

The MV Sceptre was used for the service visit and the vessel reached the buoy at 2000 GMT, 1 May. The buoy was listing slightly, but was considered to be safe. The data acquisition module was recovered, and the tapes, which appeared to have advanced correctly, were changed. The module was then replaced in the buoy and the replacement battery module connected at 2125 GMT. The air thermometer was cleaned and the rigging checked.

Waverider 6679 was then recovered and was found to be giving a low output when tested using the output meter. It was brought back into Scalloway, so that no Waverider was deployed for the following period. Subsequent inspection raised doubts about whether the outputmeter was giving reliable readings.

Both buoys were checked out at Scalloway on 24 May, prior to the next service visit. A faulty component was found in the transmitter screening bowl of buoy 6500, but buoy 6679 was found to be working. The transmitter screening bowl of buoy 6679 was then transferred to buoy 6500 which then worked.

The next service visit was made on 26 May. MV Sceptre was used, and a successful service was accomplished in winds of up to 20 kn. In addition, Waverider 6500, now repaired, was deployed.

Deployment details of Waverider 6500 were as follows:

Date:	26 May 1978	Time:	1730 GMT
Position:	60°08'N 2°57'W	Depth:	92 Fm
Wind:	WSW F5	Moderate sea.	

Subsequent inspection of the data tapes showed that recording ceased on 13 May. The cause of the failure was a damaged cable which caused premature discharge of the processor batteries.

On 12 June IOS informed Marex that no signals from either the data buoy or the Waverider were being received on Foula. Marex organised an air-search on 14 June, during which neither of the two buoys was seen. Since weather conditions, including visibility, were good it was assumed that the buoys had moved off station.

On 12 July, after two abortive attempts Waverider 6679 was deployed. An IOS-devised sub-surface float mooring was used on this occasion, and an IOS engineer was present. However, the deployment did not go quite as planned, and the anchor clump had to be dropped to the sea-bed, rather than lowered. During this deployment, Waverider 6500, thought to have been lost, was found on station and recovered. Subsequent testing showed that although it would give an output into the outputmeter for a few minutes, it could not sustain this output, which soon fell to a low level. The buoy was returned to Datawell for overhaul. They reported no fault in the transmitter but a loose connector from the transmitter circuit board to the chassis may have caused the problem.

Deployment details of Waverider 6679 were as follows:

Date:	12 July 1978	Time:	0120 GMT
Position:	60° 11' N 2° 55' W	Depth:	88 Fm

On 18 July the missing data buoy serial No 02 was recovered by the drilling rig 'Western Pacesetter' at a position 60 miles NE of Peterhead. It had 70 feet of surface line attached and was undamaged.

The buoy was collected from Western Oceanics depot in Aberdeen on 24 July.

On 18 July a meeting was held at IOS Wormley to discuss the Marex mooring. As well as IOS and Marex scientists and engineers, representatives from British Ropes Ltd were present. A report and recommendations will be issued by IOS in due course. At their invitation the surface line referred to above was subsequently sent to British Ropes Ltd for examination, and their laboratory reported that the rope had been cut.

In view of the numerous failures which had afflicted the project, now culminating in the 12 June breakaway, Marex decided that they would be especially thorough in their preparation of the replacement data buoy, and in its testing. The buoy, serial No 03, was assembled at Scalloway over the period 24 - 27 July, 1978 with heave sensor No 13026 fitted. Further testing of the data acquisition system took place over the period 5 - 7 August and data buoy 03 was deployed on 8 August.

The MV Sceptre was used for this deployment and this proved to be a convenient arrangement. The processor module fitted was a production unit, designated PROD-2 and this was checked out with the portable test set immediately before sailing from Scalloway.

Deployment details for data buoy Serial No 03 were as follows:

Date:	8 August 1978	Time:	0550 GMT
Position:	60° 12' N 2° 55' W	Depth:	90 Fm
Wind:	NE F4	Slight - moderate sea	

The Waverider (6679) was sighted on station.

The next service visit took place on 3 September 1978. It was intended to replace the installed processor, PROD-2 with PROD-1 which had been on extended test at Cowes. On arrival at Scalloway, however, it was found that the test set had developed a fault so that the replacement processor could not be fully tested. On arrival at the buoy it was found that the installed processor had apparently operated successfully (the tapes had advanced) and so it was decided to put PROD-2 back into the buoy after the tapes were changed. PROD-1 was returned for further testing.

The Receiving Station on Foula

IOS were informed that the data buoy had been redeployed on 3 April 1978. The Waverider signal continued to be received as routine on Foula, with a check on the data buoy signal every two or three days. On 1 May the data buoy was serviced and the Waverider removed (see Part 1), and on 3 May our agent on Foula switched over to the data buoy channel.

On 6 May our agent on Foula reported difficulties with the recording equipment, which indicated that power supply failure was imminent. A visit to Foula was arranged as quickly as possible, the IOS party arriving on the island on the afternoon of 12 May. The Honda generator was repaired, all batteries recharged, the recording system fault cleared, and the calibrations checked. The party left the island on 16 May.

On 12 June our agent informed us that the data buoy could not be heard, and IOS informed Marex immediately by telephone. It was during this conversation that IOS was told that Waverider 6500 had been redeployed on 26 May. Nevertheless since our agent checks both channels as a matter of routine it seemed likely that Waverider 6500 was not being received and this was confirmed by him the following day (see Part 1 for an account of the technical problems of the Waverider). On the strength of this information Marex arranged an air search of the area (see Part 1) when neither buoy was seen.

No further data were received during the following month until Waverider 6679 was deployed on 12 July. Soon after the deployment our agent reported that a good signal was being received.

The data buoy was deployed on 8 August, and our agent reported that he could receive both signals. On 17 August he reported that both buoys were being received, although the data buoy was weaker than the Waverider.

On 18 September he reported that he could no longer hear the data buoy, and that the Waverider signal, though present, was much affected by interference and unlocking. He further reported that there had been a major gale over the preceding weekend, and the aerial array had suffered some minor damage.

Part 3 - The Data

Scrutiny of the 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 of data lost 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
1	1 April to 1 May 1978
2	1 May to 26 May
3	26 May to 11 June when buoy went adrift
4	8 August to 3 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, F refer to comments about the data listed below the table.

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 five periods between magnetic tape changes. This was calculated as:

$$(1 - N_u/N_p) \times 100\%$$

where N_u is the number of usable records recovered, and N_p is the number of records which should have been obtained during the period of the data tape in question (assuming 3-hourly sampling). The data return has continued at a disappointingly low level, and in particular no usable data at all were received between 1 June and 13 July (see Parts 1 and 2).

When a signal was present, it was again found that night-time records were received more reliably than day-time records.

TABLE 2

Marex buoy data summary (for explanation see text)

Module No	% data lost							
	Group 1				Group 2			
	1	2	3	4	1	2	3	4
RMS	8	60C	80F	4			D	D
H	3	54C	80F	4			D	D
H_{max}	0	55C	80F	4			D	D
T_z	10	57C	80F	4				E
Wind speed	5	53C	80F	4				
Wind direction	3	53C	80F	4				
Barometric pressure	8			4		100B	100B	
Air temperature	100A	100A	100A	100A				
Sea temperature	100A	100A	100A	4				

NOTES:

A Temperatures suspect

B Barometer suspect throughout

C Power failure after 13 days

D 6% scaling difference noted

E T_z calculated using different algorithm from that used in rest of project.

F Power failure after 4 days

TABLE 3

Data recorded on Foula

Period	% data lost	Comments
16 March to 6 April	68	
6 April to 13 May	43	
13 May to 15 June	73	No data received between 1 June and 13 July (see text, part 1)
15 June to 17 July	93	
17 July to 19 August	32	
19 August to 21 September	37	

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 are 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.

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 C1.

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 C1

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