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Technical Report 568
(NEMP-I-80-H-0001)

MEASUREMENTS OF OCEAN SPECTRAL IRRADIANCE FOR CORRELATION WITH SATELLITE REMOTE SENSING

R.F. Howarth

1 May 1980

Final Report for Period 6 February - 1 May 1980

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ADMINISTRATIVE INFORMATION

The work was performed by a representative of the NOSC Communications Research and Technology Division under joint sponsorship of the Naval Electronic Systems Command, the Office of Naval Research, the Defense Advanced Research Projects Agency, and the US Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Monitoring Program (Dr. John B. Pearce, Manager). The period covered by this report is 6 February-1 April 1980, and is based on the NIMBUS VII Coastal Zone Color Scanner (CZCS) experiment conducted aboard the National Oceanic and Atmospheric Administration Research Vessel ALBATROSS IV during February 1980. The designation NEMP-I-80-H-0001, which appears on the cover, is the Department of Commerce identification of this report. The field procedures, as well as data handling and computer processing techniques, are presented in detail in accordance with a Bureau of Fisheries request, so that they might be used in the development of approaches for future work.

Released by
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ACKNOWLEDGMENTS

The author wishes to express appreciation to colleague M. E. Hyde for his assistance in data reduction and for his helpful discussion regarding this work. Appreciation is also extended to T. E. Keenan for his suggestions and managerial support, which contributed significantly toward this publication.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NOSC Technical Report 568 (TR 568) (NEMP-80-H-0011)	2. GOVT ACCESSION NO. AD-A093312	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) MEASUREMENTS OF OCEAN SPECTRAL IRRADIANCE FOR CORRELATION WITH SATELLITE REMOTE SENSING	5. TYPE OF REPORT & PERIOD COVERED Final Rept. 6 February - 1 April 1980	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) R.F. Howarth	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Ocean Systems Center San Diego, CA 92152	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS US Department of Commerce National Oceanographic and Atmospheric Administration National Marine Fisheries Service Northeast Fisheries Center Highlands, NJ 07732	12. REPORT DATE 1 May 1980	13. NUMBER OF PAGES 104
	15. SECURITY CLASS. (of this report) UNCLASSIFIED	17a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Oceans Radiometry Satellites Expendable bathythermographs Underwater visibility Spectral irradiance Remote sensing		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Underwater ocean truth data were collected in conjunction with the NIMBUS VII Coastal Zone Color Scanner (CZCS) experiment. The data were provided to permit a correlation of remote radiometric measurements with the biological constituency and optical properties of the seawater investigated. Preliminary examination of expendable bathythermography data indicates that a correlation between irradiance data and water temperature may exist where the thermocline structure is significant.		

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PROBLEM

Collect underwater ocean truth data in conjunction with the NIMBUS VII Coastal Zone Color Scanner (CZCS) experiment. Provide collected data for correlation of remote radiometric measurements with the biological constituency and optical properties of the seawater investigated.

RESULTS

Downwelling and upwelling spectral irradiance measurements were made at five stations in the Atlantic Ocean and the Gulf of Mexico for correlation with concurrent satellite measurements. Preliminary examination of expendable bathythermograph data suggests that a correlation between irradiance data and water temperature may exist where thermocline structure is significant.

RECOMMENDATIONS

1. Comparison and possible correlation among spectral irradiance, spectral K, and chlorophyll and/or suspended matter should be attempted.
2. Possible correlation between irradiance data and water temperature should be examined.
3. Use of a ship's electronics laboratory as a control site for radiometric work is recommended, since such an arrangement proved effective during the NOAA CZCS cruise.
4. Since it was determined that the euphotic depth $\approx 4 \times$ the Secchi disk depth, it is recommended that this be employed as a first approximation of euphotic depth.
5. Significant modifications should be made to the underwater irradiance meter to improve the quality of the measurements, increase depth resolution, and reduce time on station.

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1.0 INTRODUCTION

1.1 BACKGROUND

The Naval Ocean Systems Center (NOSC) has been engaged for some 10 years in various programs and efforts to investigate and effect optical communication between airborne/satellite and underwater platforms. Such involvement necessarily requires analysis and mathematical modeling of the propagation path or "link" consisting of the atmosphere, the air-sea interface, and the sea itself. Because the properties of the seawater portion dominate and largely constitute the salient characteristics of the link, significant analysis, study, and field measurement of the seawater path have been performed by NOSC personnel.^{2,3} Indeed, this measurement activity and need for seawater-related information is a continuing concern in contemporary programs at NOSC.

A portion of the Strategic Blue/Green Optical Communications Program, under the sponsorship of the Naval Electronic Systems Command, the Office of Naval Research, and the Defense Advanced Research Projects Agency is concerned with investigating the possibility of correlation between remote radiometric measurements of the sea surface made from satellites and the optical parameters of the underlying sea. As technical advisor for this program, and in view of our background, it was fitting that NOSC should favorably respond to an inquiry from US Department of Commerce, National Bureau of Fisheries, regarding the possibility of cooperative support in obtaining detailed underwater data in conjunction with NIMBUS VII satellite measurements.

1.2 PURPOSE

The purpose of the NOSC participation in the oceanic cruise of the Research Vessel ALBATROSS IV was to collect underwater ocean data in conjunction with the NIMBUS VII Coastal Zone Color Scanner (CZCS) experiment. Underwater spectral irradiance measurements were to be made in six narrow spectral bands to euphotic depth at a time coincident with satellite flyover. Water chlorophyll and suspended matter samples would be taken by marine hydrocasts performed by Bureau of Fisheries personnel simultaneous with the NOSC-conducted measurement. The data collected would be compared later to provide a correlation of remote radiometric satellite measurements with the biological constituency and optical properties of the seawater investigated.

¹ NOSC TR 387, Naval Blue/Green Single-Pulse Downlink Propagation Model, by Technical Advisor to the Blue/Green Optical Communication Program Joint Coordinating Committee, 1 January 1979.

² NELC TD 489, Submarine/Aircraft Optical Communications System (SAOCS), vol III, Feasibility System Description, by D. O. Milstead et al, 28 October 1976.

³ NELC TD 490, OPSATCOM Field Measurements, vol II, by R. D. Anderson et al, 1 June 1976.

2.0 CRUISE DESCRIPTION

2.1 SCHEDULE

NOAA Cruise 80-01 began as the RV ALBATROSS IV departed from Woods Hole, MA, in midafternoon on 4 February 1980; the weather was clear and cold (21°F). As the vessel proceeded southward, the sky was generally overcast, the sea was moderately rough to rough at times, and the air temperature gradually increased.

The first radiometric measurements were taken on 6 February at station 15 under overcast sky. The deployment procedure agreed upon was implemented successfully despite light snow flurries; some difficulty was encountered in stowing the underwater unit after taking the measurements. After some discussion, it was decided to move the NOSC radiometer control site from the main deck wet lab to the next upper deck in the electronics lab area. This new location proved highly satisfactory and was used for the remainder of the cruise.

Malfunctioning of the NOSC radiometer was detected late on the afternoon of 6 February after the move. After performing checks for loose components, moisture, leakage, broken wires, etc, console readout indications were still unsatisfactory and attempts were made on 7 February to contact the instrument's manufacturer by radiophone patch. After appreciable effort and several poor contacts, further efforts were postponed until 8 February.

During successful radiophone patch communication on 8 February, arrangements for shipment of suspected failed parts were made. These would be awaiting scheduled arrival of RV ALBATROSS IV in Miami, FL, on 12 February 1980. Further checks suggested during the radio communication reinforced the choice of replacement parts to be shipped and also negated any need for further talks with the manufacturer.

Deck cell measurements of total sky illuminance were made from about 0800 to 1600 hours from 9 February through 17 February inclusive; sun/sky ratio was measured on the few days when the sun was visible. Underwater spectral irradiance measurements were reinitiated on 13 February after successful installation and checkout of electronic components at Miami on 12 February. Satisfactory data collection was performed on 13, 14, 15, 16, and 17 February during satellite flyover, although sky conditions featured broken clouds or overcast.

Hydrocasts for chlorophyll content and suspended matter were made, and expendable bathythermographs (XBTs) were made during eight of the 12 possible candidate flyovers to form an incomplete measurement complement. It was anticipated that these data could help to establish correlation between non-optical water characteristics and the remote satellite measurements. Later correlations between underwater spectral irradiance measurements, hydrocast-XBT data, and data from the satellite might possibly be strengthened by the incomplete measurement complement.

2.2 SATELLITE FLYOVER TIME

A calculation was made prior to 0800 hours each morning to determine the flyover time and longitudinal displacement of NIMBUS VII for that day. An estimate of ship's position for near midday was obtained from Chief Scientist R. Marak or from Ship's Commander M. Fleming. This information, plus orbital tables and a temporal-positional correction curve for NIMBUS VII, were used to effect the calculation. After determining flyover time, the author would so inform the Chief Scientist and also post the information on the chalk board in the Scientists' Study, where numerous daily briefings were held.

About 45 minutes prior to flyover, the ship was stopped, XBT and hydro-cast measurements were made and then the NOSC radiometer was deployed. The timing was such that satellite flyover occurred about midway through the spectral irradiance measurement set. Figure 2-1 shows the ship's positions for the candidate satellite flyovers.

2.3 SATELLITE SUMMARY

A summary of satellite-related conditions and of the measurements taken during the cruise is given in table 2.1.

3.0 MEASUREMENT SYSTEM

3.1 SPECTRAL IRRADIANCE METER

The underwater radiometer used on this cruise was built to NOSC specifications by Research Support Instruments, Inc, of Timonium, MD, and their electronics subcontractor, Spa Com Electronics of Camarillo, CA. The instrument, Model 31-187, is a six-channel oceanographic optical instrument system consisting of sensor, tankage, cabling, and surface control unit.

The sensor assembly consists of cosine collectors to collect the downwelling and upwelling radiation, a rotating mirror to direct the radiation to the detector, and a detector assembly. The various wavelengths are selected by indexing filters in a wheel into the beam. Six positions are available, nominally 440 nm, 488 nm, 500 nm, 520 nm, 550 nm, and 670 nm. The detector is a miniature photomultiplier tube packaged in a pulse amplifier-high voltage supply package. These components are housed in a stainless steel tank designed for use at depths to 150 m.

The surface control unit controls and monitors all functions of the sensor. The detector system pulse output is fed to this unit, where the microprocessor system averages the data to reduce surface effects, subtracts dark count information, and provides autoranging. The system has a total dynamic range of 10^6 . The data are displayed on an LCD monitor, and are also available at connector outputs as raw pulses and analog information. Calibration is discussed in appendix A.

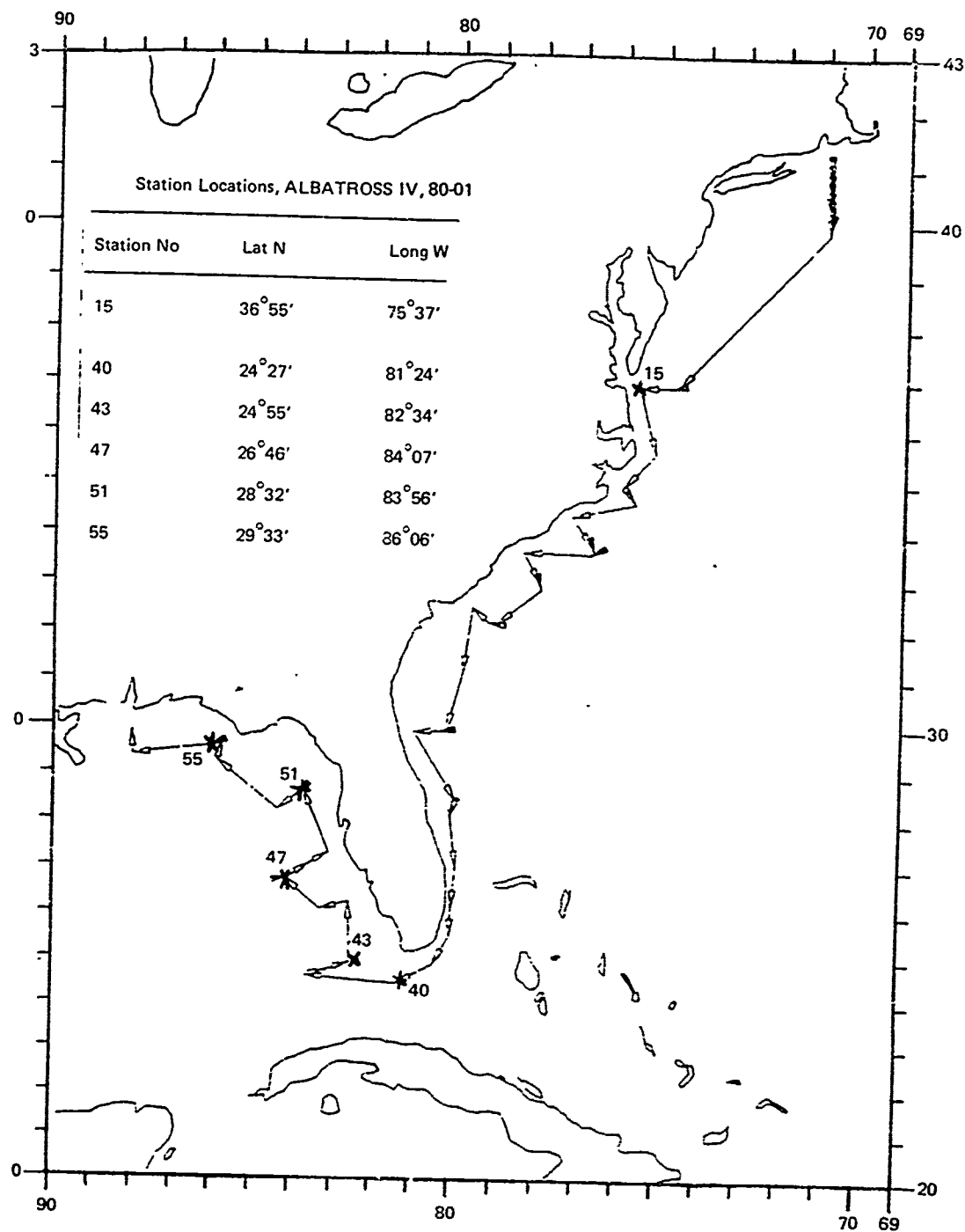


Figure 2-1. Cruise track for ALBATROSS IV, 80-01.

Date, Feb 80	Station No	Flyover Time ¹	Longitude Displacement ²	% Cloud Cover ^{3,5}	Zenith Photo ⁴	Sky Lum- inance ⁵	Hydro- cast
6	15*	1040	+11.6°	100	0	X	0
7	-- ^a	1058	- 7.3° ^a	100	0	0	0
8	23	1117	- 4.1°	0	0	0	X
9	27	1136	- 1.6°	100	0	X	X
10	30	1153	+ 1.2°	100	0	X	0
11	33	1212	+ 5.0°	100	0	X	0
12	37	1046	-16.0°	S/S ₁ =5.5	0	X	X
13	40*	1104	+11.4°	<100	0	X	X
14	43*	1123	-10.0°	<100	0	X	X
15	47*	1143	- 6.4°	100	0	X	X
16	51*	1202	+ 0.08°	≈50	X	X	X
17	55*	1221	+ 1.79°	≈75	X	X	X

¹ Eastern Standard Time

² Longitudinal difference between ship's position and meridional plane of satellite orbit. Negative displacement indicates ship was west of orbital plane; positive means ship was east of orbital plane.

³ Estimated at flyover time.

⁴ Collection of this extra bit of information was initiated at station 51.

⁵ Sky luminance measured with photopic deck cell; S/S₁ indicates sun/sky ratio where applicable.

* Underwater spectral irradiance measurements taken.

^a Estimated from XBT log; between stations 17 and 18.

X Measurement made or action taken.

0 No measurement or action.

Table 2-1. Satellite flyover conditions.

The sensor can be commanded to operate in two modes, either continuously running or pausing. In the continuous run mode, each filter is indexed into the light path and held for about 15 seconds; then the next filter is moved

into position. Total cycle time is about 2 minutes, and the sensor will operate in this fashion continuously. In the pause mode, a filter must be commanded into position. Front panel readout will give the filter position.

The underwater unit (UWU) was mounted in a 0.76-m-diameter stainless steel hoop and bridle assembly for deployment. A lead weight of 100 pounds was suspended from the hoop to stabilize the unit and to minimize wire angle. The effectiveness of this arrangement was quite satisfactory, as observed by the operator viewing the LCD readout of UWU pitch and roll which, for the most part, were nearly always less than $\pm 3^\circ$. Instrument depth was also read from the LCD and then recorded for each measurement sequence. Figure 3-1 is a block diagram of the equipment complement. Appendix B lists the spectral filter characteristics and appendix F shows the deployment hoop.

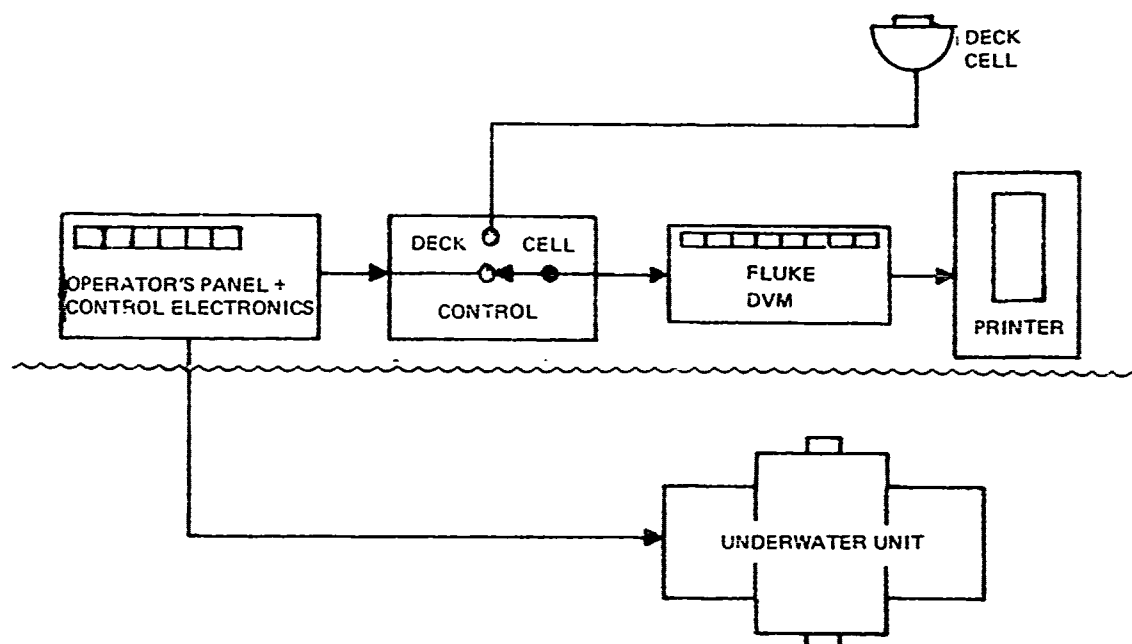


Figure 3-1. System block diagram.

3.2 DECK CELL

This unit consists of a Weston photovoltaic cell and diffuse cosine collector mounted in a two-axis gimbal frame. The cell is fitted with a Wratten 102 spectral filter which results in photopic response and hence measures illuminance (lumens foot⁻²). The model C-1 deck cell and the model S-1 control box-readout were manufactured by Bendix Environmental Science Division of Baltimore, MD.

The S-1 control box was modified at NOSC to provide a millivolt analog signal to the data recorder upon operator demand. A circuit diagram and a calibration conversion are given in appendix F.

The deck cell assembly was daily mounted topside on the outboard railing of the afterdeck of ALBATROSS IV. Some occlusion of a portion of the sky was caused by one of the ship's air exhaust stacks, but this was considered relatively insignificant in that the occluded solid angle was small, vessel orientation relative to the sun was relatively fixed during the measurement period, and the frequency of shadow presence was small due to the generally extant overcast conditions.

3.3 RECORDING PRINTER

Millivolt analog signals from the irradiance radiometer and from the deck cell were applied by operator-actuated switch to a Fluke model 8800A digital multimeter coupled to a Fluke model 2010A paper printer, which generated the permanent printed tape. Output resolution was 10^{-6} , accuracy was 0.01%. The data period was 10 seconds for each record (ie, the period over which the 10-ms accumulate time, 16-bit data from the UWU are averaged). Figure 4-1 and appendix C show typical data records.

4.0 MEASUREMENT PROCESS

These sections describe the measurements related to obtaining the desired underwater data germane to the NIMBUS VII CZCS experiment.

4.1 SCHEDULE

The schedule outlined in table 4-1 was defined essentially as shown prior to the first flyover. A few changes were made as the cruise proceeded. Item 6 was added near the end of the cruise. Ordinarily, all the measurements under 5 were completed just prior to placing the NOSC radiometer into the water to avoid the possibility of cable intertwine; ie, only one cable in the water at one time was the rule followed.

4.2 PROCEDURE

The customary preparations for measurement and the implementation of the radiometric measurements are listed in table 4-2.

At each data depth, the radiometer operator performs the required actions to generate a printed data tape similar to that shown in figure 4-1. During the measurement period, the continuous sequence capability of the spectral filter changer in the underwater unit is utilized and the operator must press the "print" button on the Fluke model 2010A printer at the appropriate times. Hand notes indicating depth, time of day, downwelling (Dn/W) or upwelling, (Up/W) also must be entered on the paper tape by the radiometer operator. Depth determination is done by the radiometer operator, who reads the LCD depth indication on the radiometer control panel and relays this information by "walkie-talkie" radio to the deck technician and to the winch operator.

iii

Blk 9
1222
08/W
48m

.000303
.000304
.000304

.004411
.004530

.000303
.000302

.000302
.000302

.000301
.000301

.000302
.000302

.000303
.000303

.000303
.000303

.004710
.004571

ii

1219
08/W
48m

.006036
.006464

.000303
.000302

.010674
.010674

.019226
.019226

.024104
.024104

.028371
.028371

.005184
.005183

.010495
.010593

Figure 4-1. Data tape record.

Item	Time, hours	Action	Bridge	Chief Scientist	Radiometer Operator	Deck Technician	Winch Operator	Deck Assistant
1	0800	Request expected position @1100	X	X	X	--	--	--
2	0830	Compute flyover time by using expected position, T_O ; post	--	--	X	--	--	--
3	$T_O - 1$	Connect deck cell, turn on system, warm up, check operation	--	--	X	X	--	--
4	$T_O - 0.5$	Take & log latitude, longitude, & wind velocity (corrected)	X	--	X	--	--	--
		Make depth sounding	X	--	--	--	--	--
5	$T_O - 0.4$	Implement data run	X	X	X	X	--	--
		Take Secchi Disk	--	--	--	X	--	--
		Take XBT	--	--	--	X	--	--
		Take bucket temperature	--	--	--	X	--	--
		Take chlorophyll, hydrocast	--	--	--	X	X	--
		Make radiometric measurements	--	--	X	X	--	--
6	T_O	Take zenith sky photo	--	--	--	--	--	X
		Take sun/sky readings	--	--	--	--	--	X
7	$T_O + 1$	Complete operator log sheet	--	--	X	--	--	--

Table 4-1. NOAA/CZCS schedule for radiometric experiment.

Preparation

- o Deck cell--Set out and connect
- o UW cable--Place on deck for deployment
- o Weight--Attach to lower portion of bridle
- o Attachment--Tape lowest 5 to 6 m of UW cable to winch wire
- o Walkie-talkies--Operator to deck chief.

Measurement

- o Air Reference--(With unit dry) hold loop 1 to 1 1/2 m above water;
(With stabilizing weight in water) data set, Dn/W only.
- o Subsurface reference--Hold hoop 1/2 to 1 m below surface; data set, Dn/W and Up/W.
- o 1% descent--Lower unit to estimated euphotic depth as determined by Secchi measurement. Check for 1% reading and adjust depth as required.
Data set, Dn/W and Up/W.
- o Raise to 1/2 of 1% depth--Take data set, Dn/W and Up/W.
- o Increment up--Raise in 2 or 3-m increments. Data sets.
- o Subsurface reference (check)--Just prior to removal.

Table 4-2. NOAA CZCS radiometric measurements procedure.

5.0 DATA REDUCTION

5.1 CORRECTION PROCEDURE

The correction procedure used and the justification for it are described in this section.

Definition of symbols:

Let:

R_{si} = raw signal as recorded on printer

R_D = dark reading as recorded on printer

r_i = net signal = $R_{si} - R_D$

E_{00} = deck cell signal at initiation of R_{si} measurements as recorded on printer

E_{0z} = deck cell signal when underwater sensor is at depth Z meters, as recorded on printer

E_{01} = E_{0z} taken at start of each filter sequence

E_{02} = E_{0z} taken at end of each filter sequence

$\Delta E_0 = E_{02} - E_{01}$

$E_{E0} = E_{01} + E_{02}$

i = filter index, $1 \leq i \leq 6$.

Reference to figure 5-1 should facilitate ready comprehension of the data correction procedure.

For any filter $1 \leq i \leq 6$, the corrected signal R' (ignoring subscripts) can be expressed as:

$$R' = [R + R (\text{ISF})] (\text{CF}) \quad (5.1)$$

where

ISF = intrasequence correction factor

CF = ambient correction factor.

ISF is needed because the surface ambient irradiance, E_{0z} , is measured and recorded on the printer just prior to and just after each six-filter measurement set (sequence); these measurements are E_{01} and E_{02} , respectively. The assumption is made that any change in E_{0z} , (eg, $E_{02} - E_{01} = \Delta E_0$) is linear over the sequencing interval and that linear correction is applicable.

Therefore, ISF can be expressed as

$$\text{ISF} = \frac{\text{filter number}}{7} \frac{E_{02} - E_{01}}{E_{01}} \quad (5.2)$$

or

$$\text{ISF} = 0.143 (\text{filter number}) \frac{\Delta E_0}{E_{01}} \quad (5.3)$$

The factor CF arises from the same source, the change in surface ambient, but for a much longer temporal period than the filter sequence interval. Change in sun elevation angle and variations in the atmospheric path (haze,

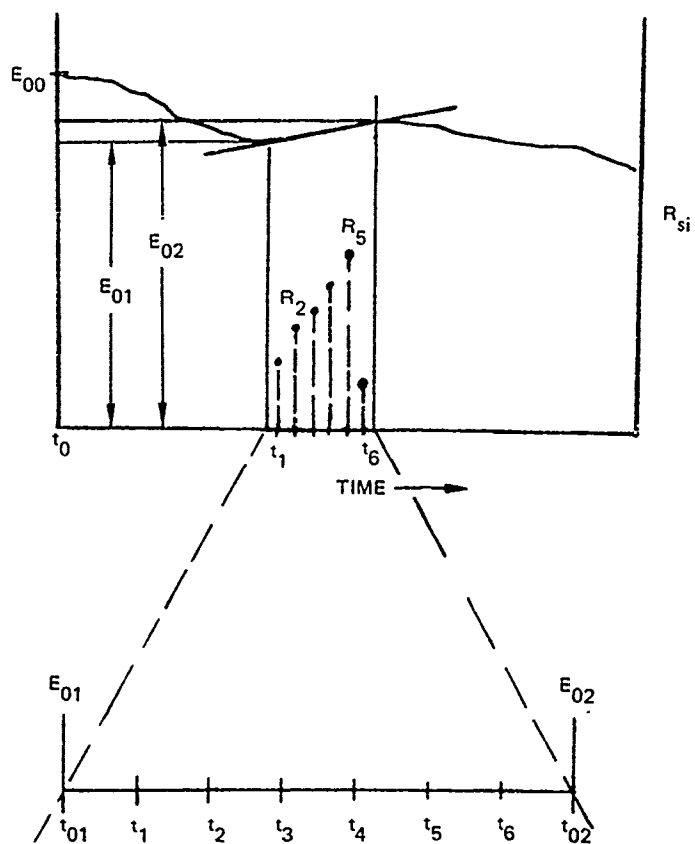


Figure 5-1. Data correction scheme.

light fog) are the types of phenomenon that require the correction approximated by CF. The ambient correction factor can be expressed as

$$CF = \frac{E_{00}}{E_{01}} \quad (5.4)$$

By utilizing the above, the expression to obtain the corrected signal R' can be written

$$\begin{aligned} R' &= R (1 + ISF) (CF) \\ \text{or} \quad R' &= R \left[1 + 0.143 (\text{filter number}) \frac{\Delta E_0}{E_{01}} \right] \times \frac{E_{00}}{E_{01}} \end{aligned} \quad (5.5)$$

For spectral filters 1 through 6, table 5-1 provides the corrected signal (relative irradiance).

Filter No

$$\begin{aligned} 1 \quad R'_1 &= R_1 (1 + 0.143 \Delta E_0/E_{01}) \times E_{00}/E_{01} \\ 2 \quad R'_2 &= R_2 (1 + 0.286 \Delta E_0/E_{01}) \times E_{00}/E_{01} \\ i \quad R'_i &= R_i (1 + 0.143i \Delta E_0/E_{01}) \times E_{00}/E_{01} \end{aligned}$$

Table 5-1. Corrected signal, R'_i .

Defining a filter coefficient $\rho_i = 0.143(i)$, the general expression becomes

$$R'_i = R_i (1 + \rho_i \Delta E_0/E_{01}) \times E_{00}/E_{01} \quad (5.6)$$

The ρ_i are given in table 5-2:

i	ρ_i
1	0.143
2	0.286
3	0.429
4	0.572
5	0.715
6	0.858

Table 5-2. Filter coefficients.

The raw signal data R_s are taken from the recording printer output strip (see figure 4-1) and entered on the correction work sheet (figure 5-2). The indicated operations are then performed with a hand calculator or a computer

programmed for this task. The program listing used on the Hewlett-Packard calculator and processed data printouts are included in appendix C.

5.2 SPECTRAL CALIBRATION

The factor A heading column 8 of figure 5-2 is the calibration quantity enabling conversion of relative irradiance R' to absolute irradiance. "A" has units of microwatts per volt per square centimeter ($\mu W V^{-1} cm^{-2}$); its derivation may be inferred from indices A and B. Since the units of the R' are actually volts, it follows that AR' yields $\mu W cm^{-2}$.

5.3 UNCORRECTED QUICK LOOK

Some of the data collected during the cruise were plotted as relative irradiance with no or minimal correction in order to provide a quick look for the author and for the chief scientist. Figure 5-3 shows a field plot of total sky illuminance on a relative 0 to 10-mV scale and also in photopic units (lumens/ft²) for station 40. Sun/sky ratio is also shown. These curves show that during the data taking period, the total illuminance (and total irradiance) was increasing with the ascending sun, but that sun/sky decreased because of deteriorating atmospheric conditions (increasing haze and cloudiness). This phenomenon was not unusual during the cruise; indeed, often no shadows were observable; hence sun/sky was effectively zero at those times.

Figure 5-4 is a field plot of spectral irradiance at 488 nm versus depth for station 40. Three points of the upwelling data, Up/W , were corrected and replotted, as were two points of the downwelling data, Dn/W . Figures 5-3 and 5-4 illustrate the desirability of the correction technique described in section 5-1. Some field calculations from this and similar data for other stations were made in the field as uncorrected quick-look indications of the diffuse attenuation coefficient. Average values or $\bar{K}$ computations made over 12-m to 94-m intervals yielded values in the interval $0.03 m^{-1} < \bar{K} < .1 m^{-1}$. Since field calculations were not made at all wavelengths and were made for relatively long paths, the $\bar{K}$ values cited are not necessarily indicative of any $K(\lambda)$. The results of calculations from corrected data will be given in section 6.0, Data Presentation.

6.0 DATA PRESENTATION

6.1 SPECTRAL IRRADIANCE VERSUS DEPTH

Spectral irradiance, $E(\lambda)$, versus depth (Z) for each station is plotted in figures 6-1 to 6-12 inclusive. The program used and the processed data printouts are included in appendix C. Straight-line fits adequately represent the measurements in most cases. The effects of bottom reflectance on the upwelling measurements at station 43 are evident in figure 6-6 at depths >20 m. Bottom depth was 31 m at this site. Difficulty in fitting continuous straight lines to the Up/W data at station 51, figure 6-10, is thought to be at least partially due to the reflectance of the 27-m bottom.

NOAAGZCS Cruise 80-01 Irradiance Data Correction Work Sheet

DATE _____ Sta. # _____
Dn/W: _____ Up/W: _____
Dark Reading (R_D) = _____
Initial Deck Cell E_{00} = _____

Fil. No.	p_1	$A(\mu W V^{-1} Cm^{-2})$
6	.858	
5	.715	
4	.572	
3	.429	
2	.286	
1	.143	

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Depth	Fil.	Raw Sig.	Net Sig.	Deck Cell	E_{00}	ΔE_0	$R' =$	AR'	$Log AR'$
$Z(m)$	#	R_S	$R = R_S - R_D$	E_{0Z}	E_{01}	E_{01}	$1 + p_1 \cdot (5)$	$(2 \cdot 4 \cdot 6)$	$(\mu W Cm^{-2})$
	1								
"	2				"	"			
"	3				"	"			
"	4				"	"			
"	5				"	"			
"	6				"	"			
	1								
"	2				"	"			
"	3				"	"			
"	4				"	"			
"	5				"	"			
"	6				"	"			
	1								
"	2				"	"			
"	3				"	"			
"	4				"	"			
"	5				"	"			
"	6				"	"			

OBSERVERS

SHEET

OF

SHEETS

Figure 5-2. Data correction work sheet.

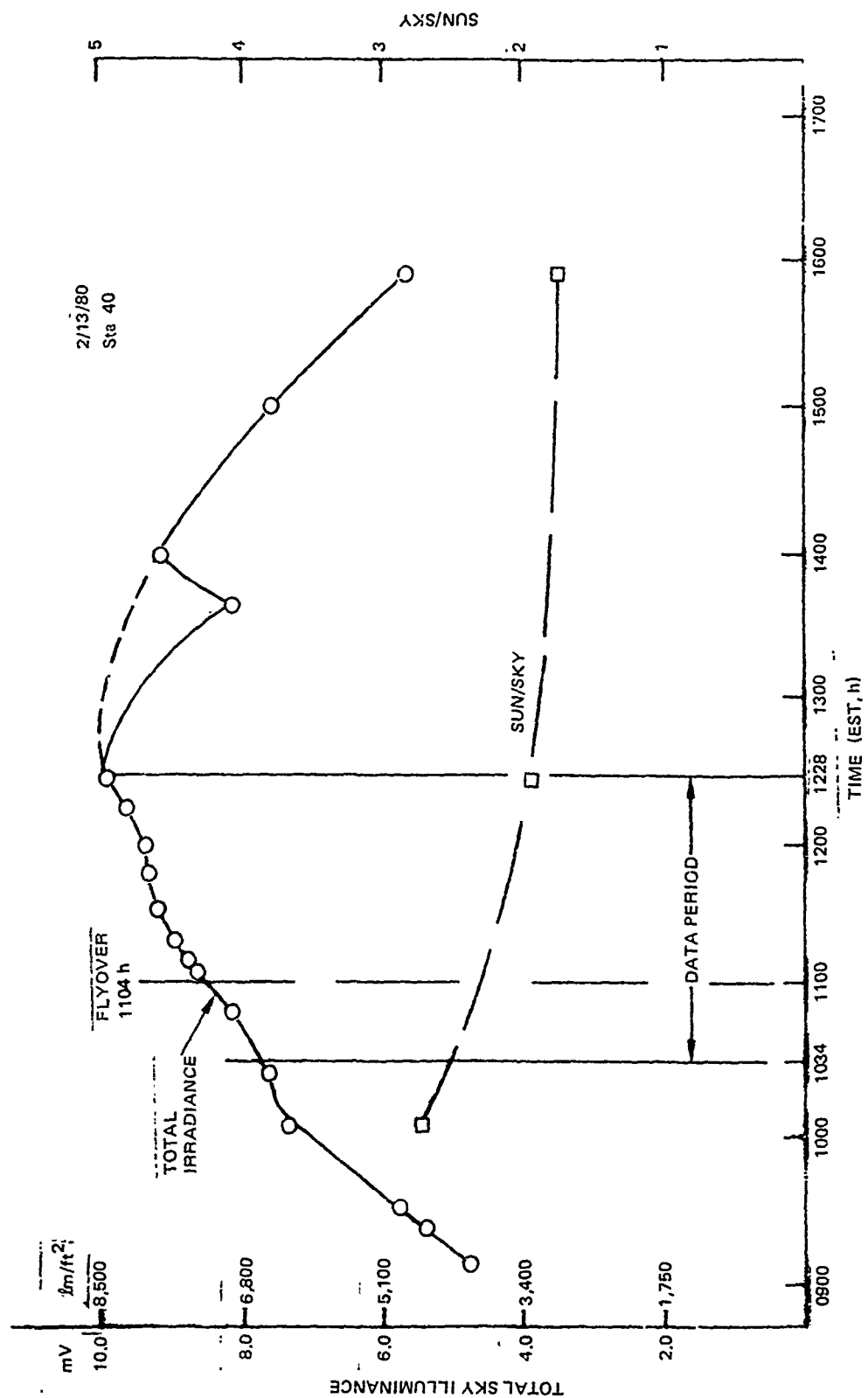


Figure 5-3. Field plot of total sky illuminance.

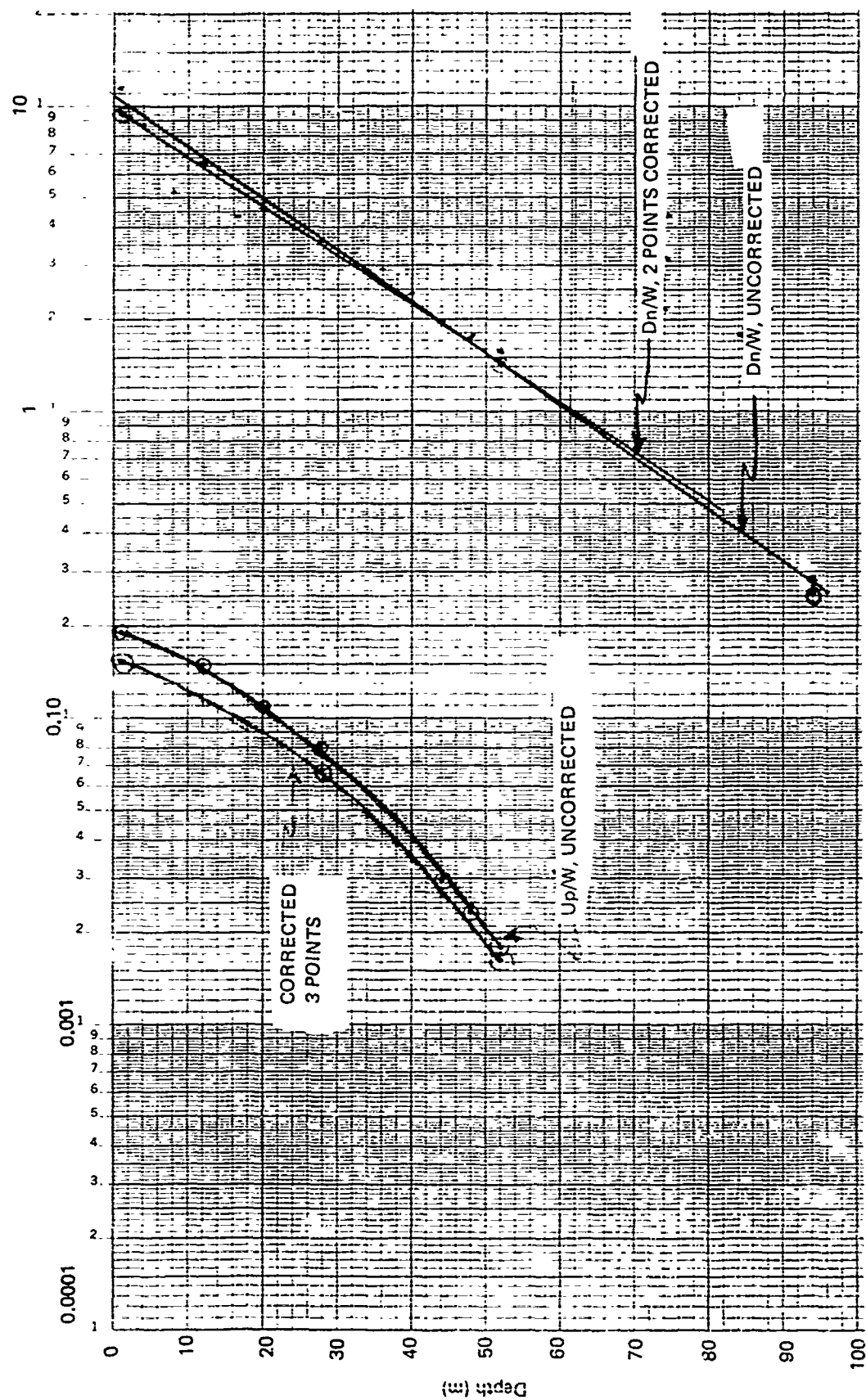


Figure 5-4. Spectral irradiance at 488 nm, station 40.

6.2 SPECTRAL DIFFUSE ATTENUATION COEFFICIENTS

Spectral diffuse attenuation coefficient, $k(\lambda)$, for both upwelling (Up/W) and downwelling (Dn/W) measurements were computed from figures 6-1 to 6-12 and are tabulated in table 6-1.

Station		λ_1 440 nm	λ_2 488 nm	λ_3 500 nm	λ_4 520 nm	λ_5 550 nm	λ_6 670 nm
15	Up/W	0.329	0.21	0.187	0.17	0.144	-- ²
	Dn/W	0.32	0.23	0.209	0.196	0.181	0.461
40	Up/W	0.064	0.058	0.054	0.064	0.062	-- ²
	Dn/W	0.039	0.035	0.039	0.056	0.075	0.073
43	Up/W	0.161	0.078	0.076	0.087	0.102	-- ²
	Dn/W	0.112	0.085	0.085	0.105	0.112	0.512
47	Up/W	0.058	0.05	0.05	0.072	0.103	-- ²
	Dn/W	0.068	0.056	0.059	0.079	0.094	-- ²
51	Up/W	0.052	0.041	0.043	0.042	0.041	-- ²
	Dn/W	0.035	0.025	0.031	0.051	0.065	0.512
55	Up/W	0.115	0.066	0.092	0.112	0.144	-- ²
	Dn/W	0.111	0.084	0.096	0.10	0.096	0.50

1 Computation equation: $K(\lambda) = \frac{\Delta \log[E(\lambda)_z / E_o]}{0.434 \Delta Z}$

2 Inadequate sensitivity in Up/W channel for $K(670)$ determination.

Table 6-1. Spectral diffuse attenuation coefficients $K(\lambda)$ ¹.

7.0 SHORTCOMINGS

Probably the most far-reaching limitation of these data derives from the phenomenon over which we have the least control; that is, atmospheric conditions. Most days were partially or completely overcast, as indicated in table 2-1. It appears unlikely that significant remote versus in situ correlation can be obtained for most of the data.

A second problem area, also weather-related, was that of rapid changes in surface ambient irradiance. Although this was monitored and periodically

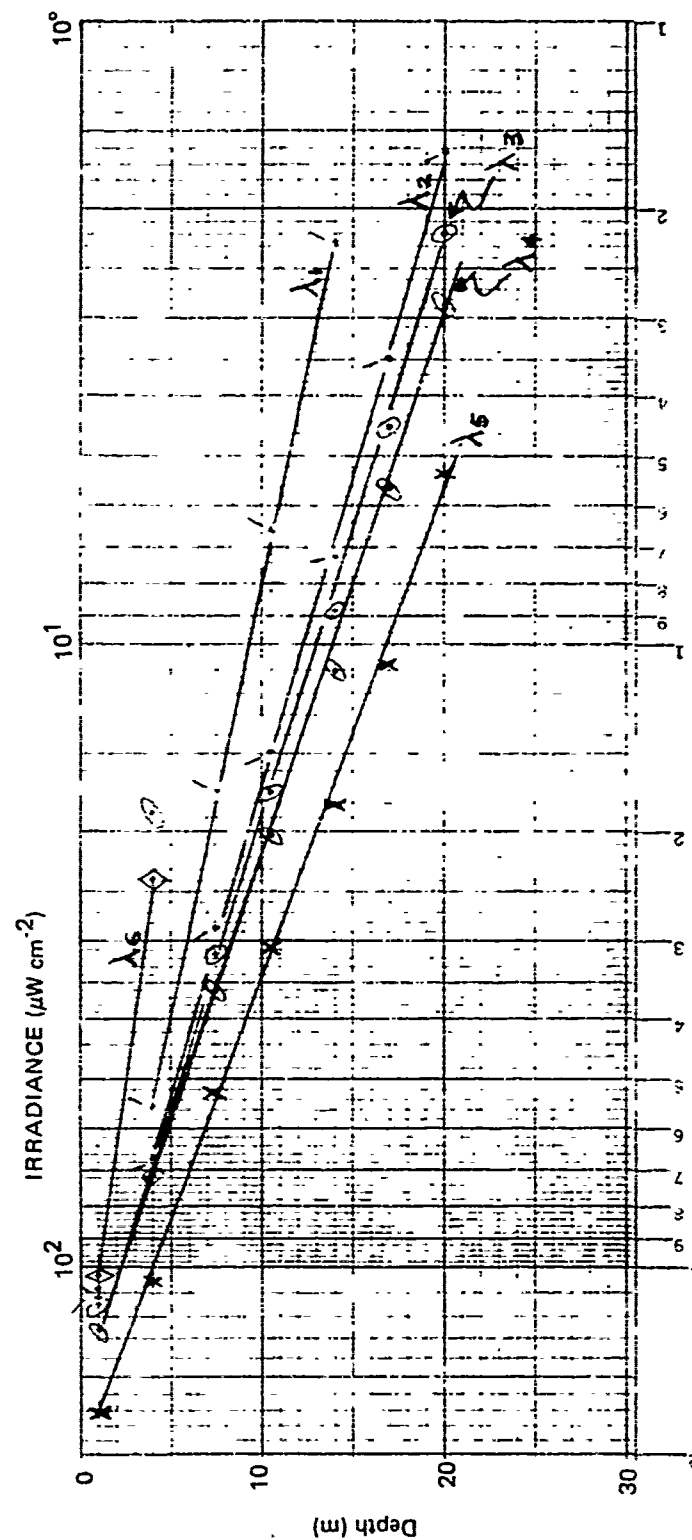


Figure 6-1. Spectral irradiance versus depth for station 15, Dn/W.

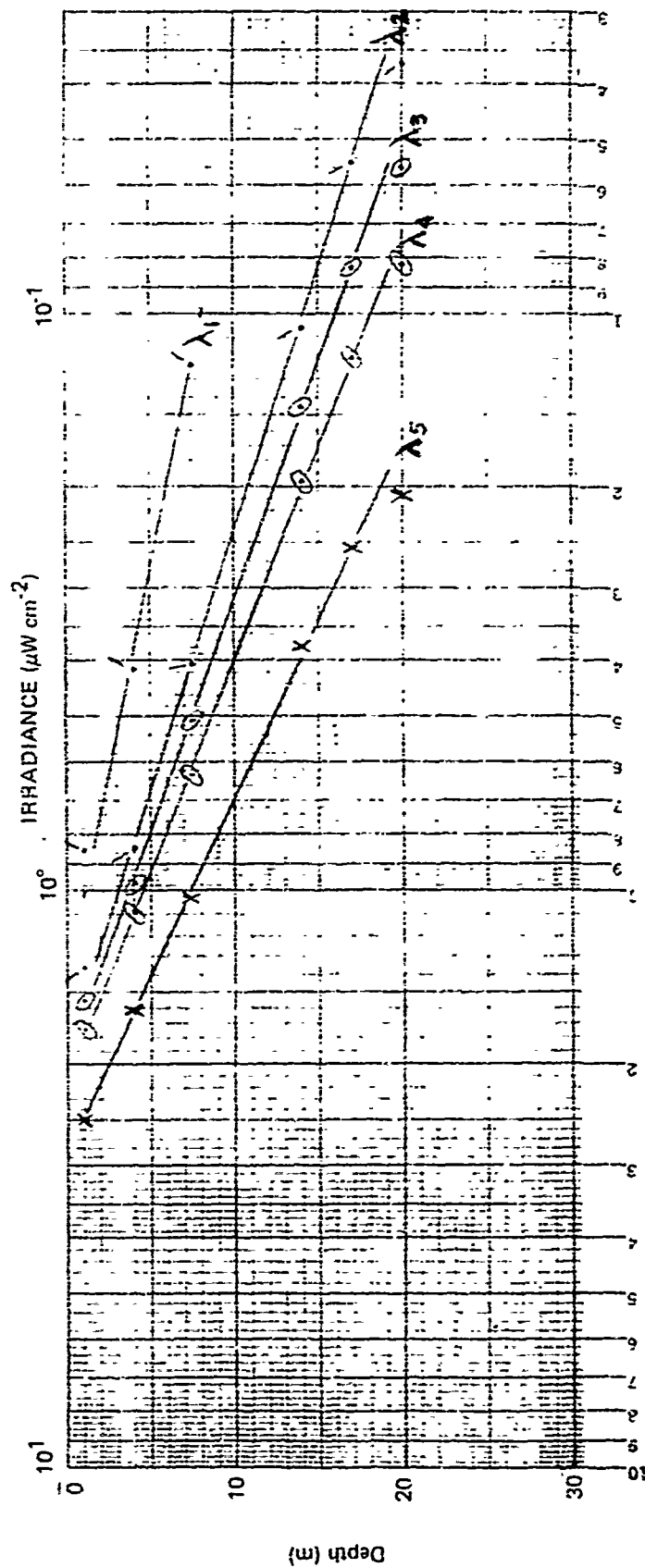


Figure 6-2. Spectral irradiance versus depth for station 15, Up/W.

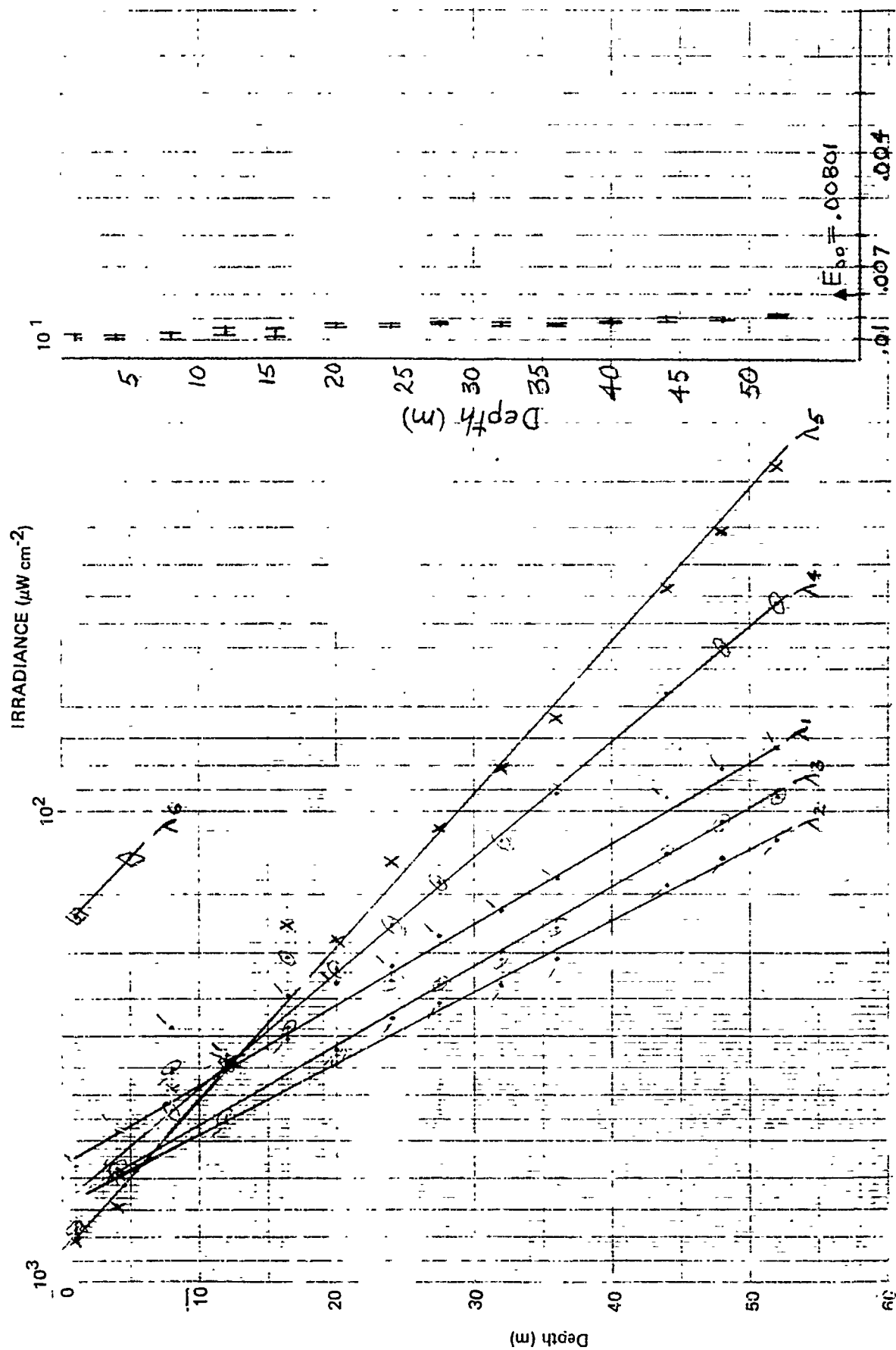


Figure 6-3. Spectral irradiance versus depth for station 40, D_n/W .

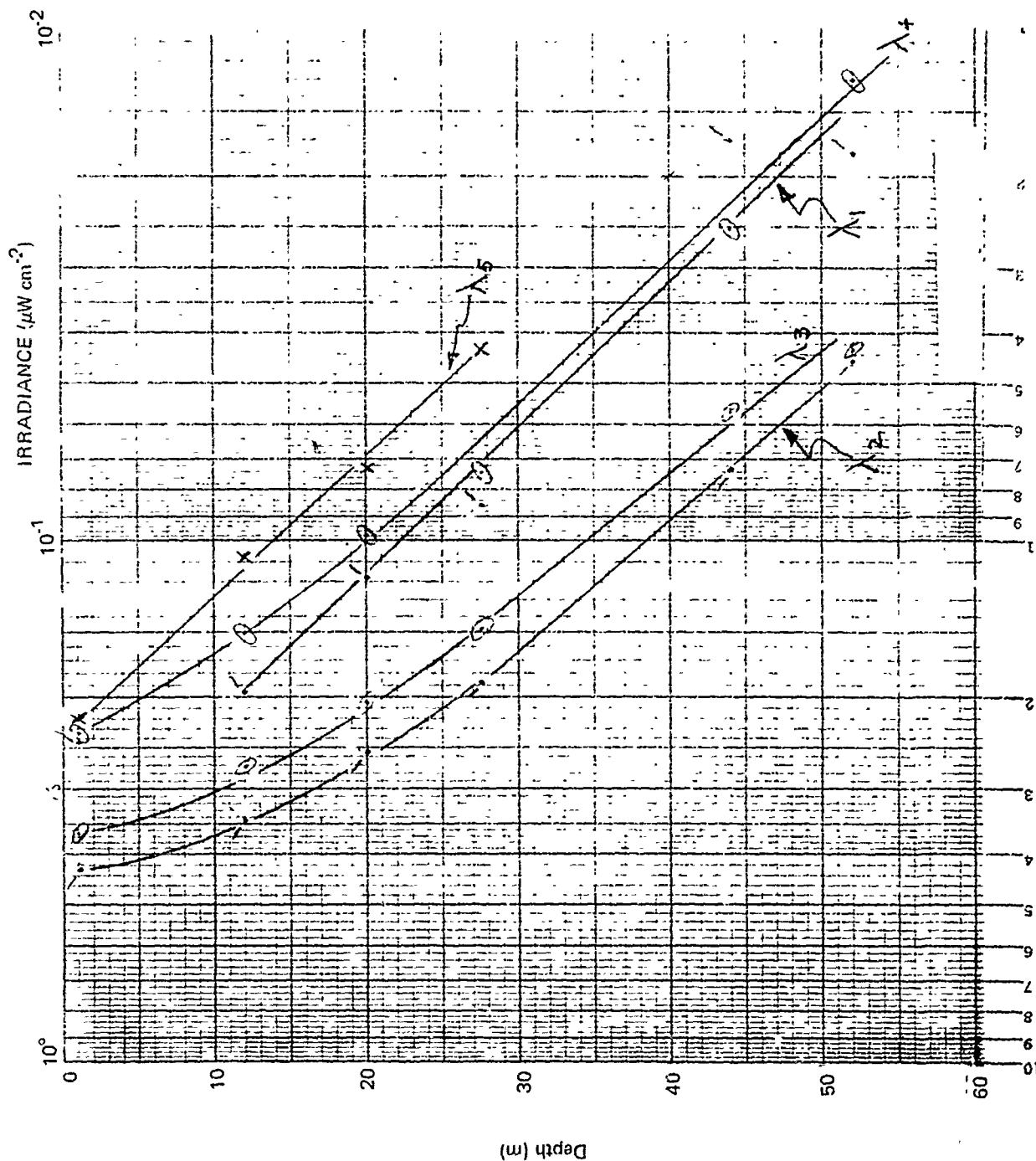


Figure 6-4. Spectral irradiance versus depth for station 40, Up/W.

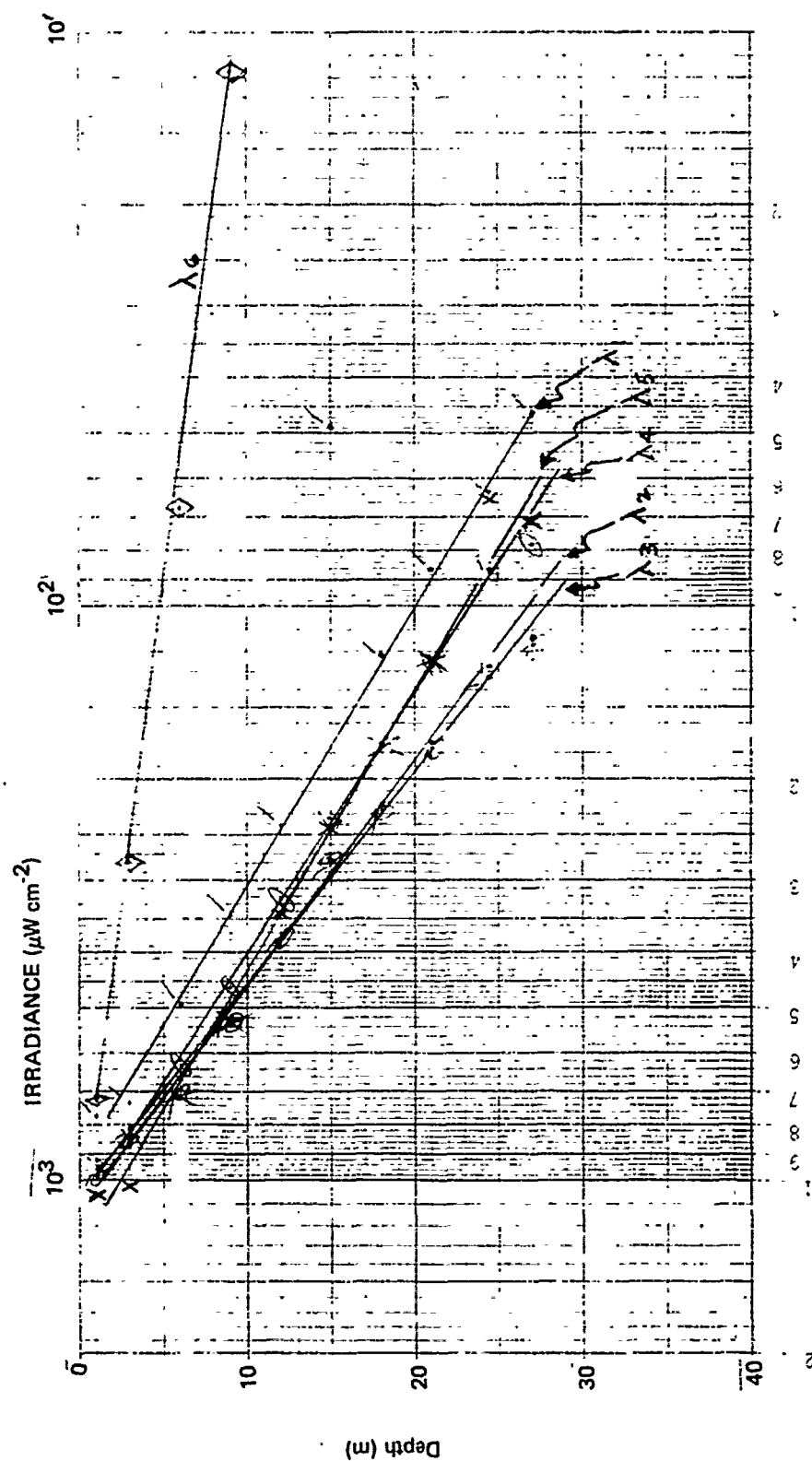


Figure 6-5. Spectral irradiance versus depth for station 43, Dn/W.

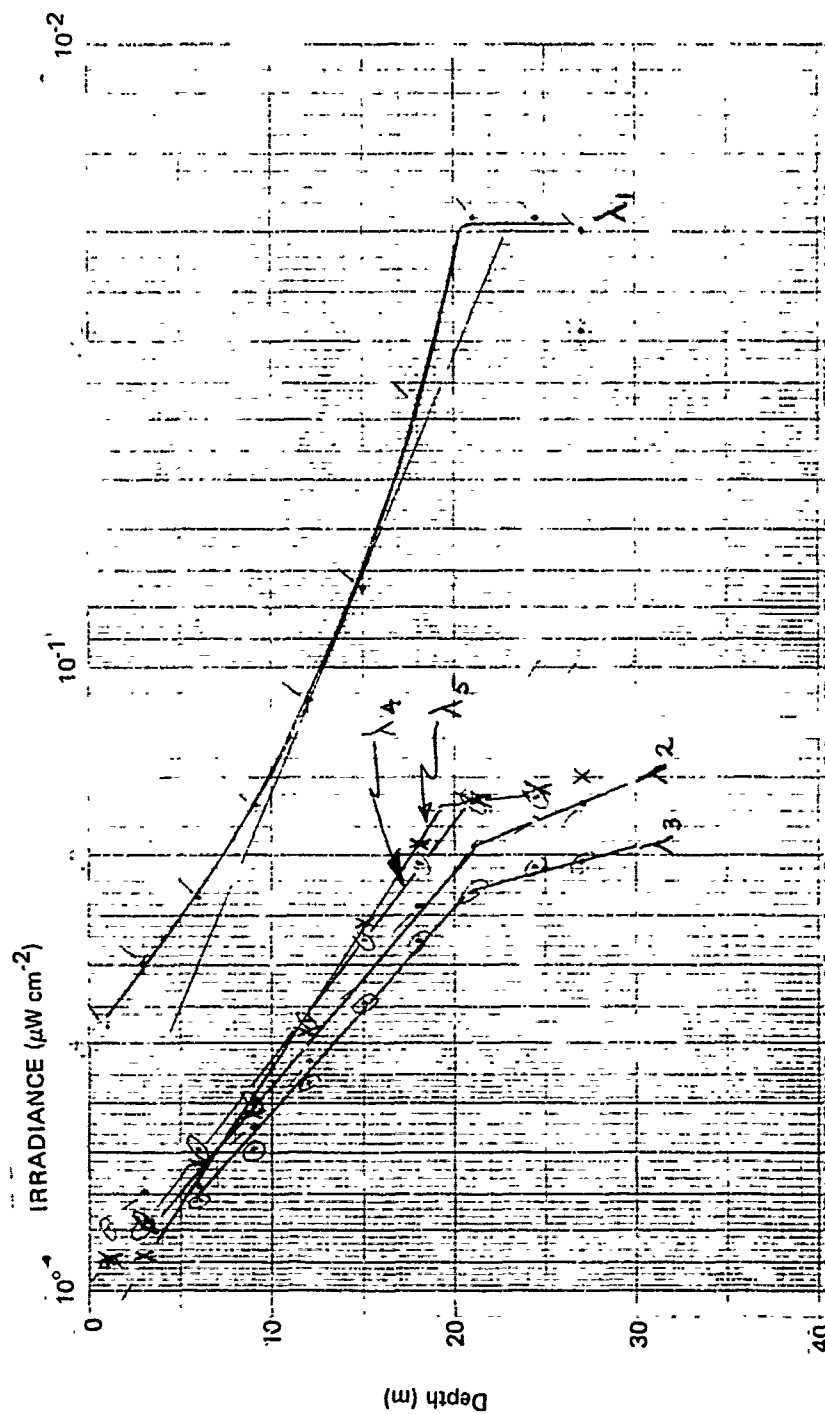


Figure 6-6. Spectral irradiance versus depth for station 43, Up/W.

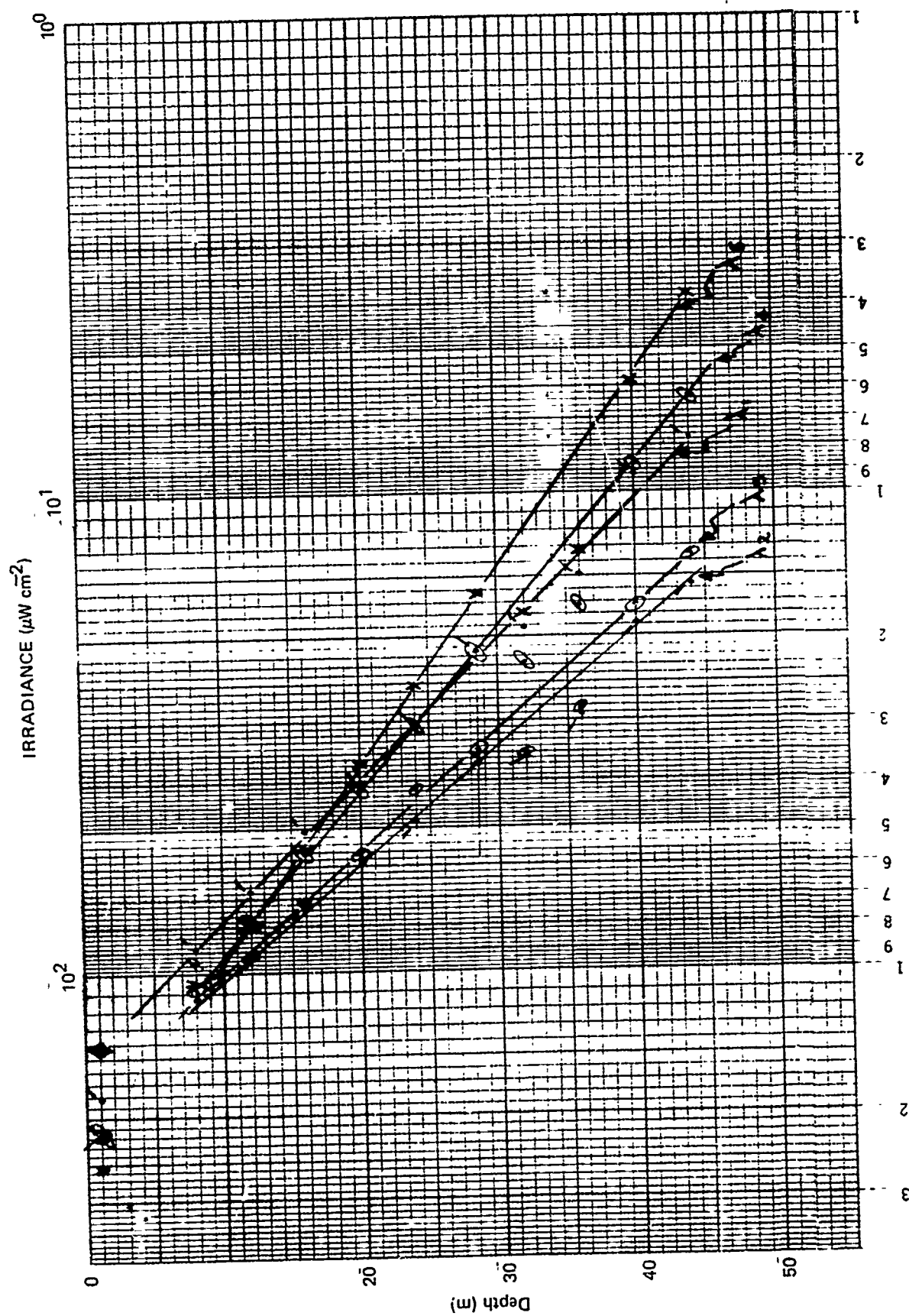


Figure 6-7. Spectral irradiance versus depth for station 47, Dn/W.

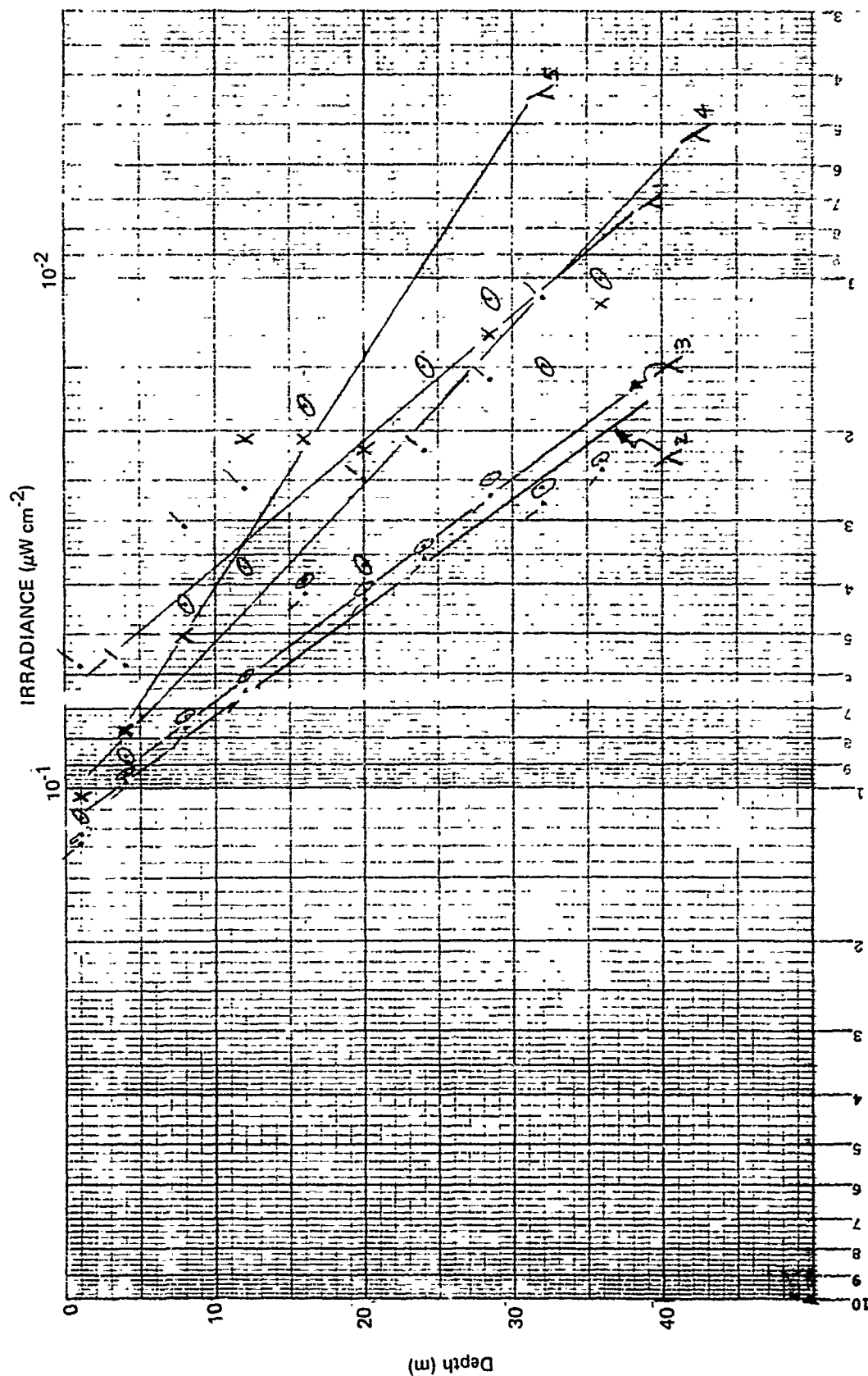


Figure 6-8. Spectral irradiance versus depth for station 47, Up/W.

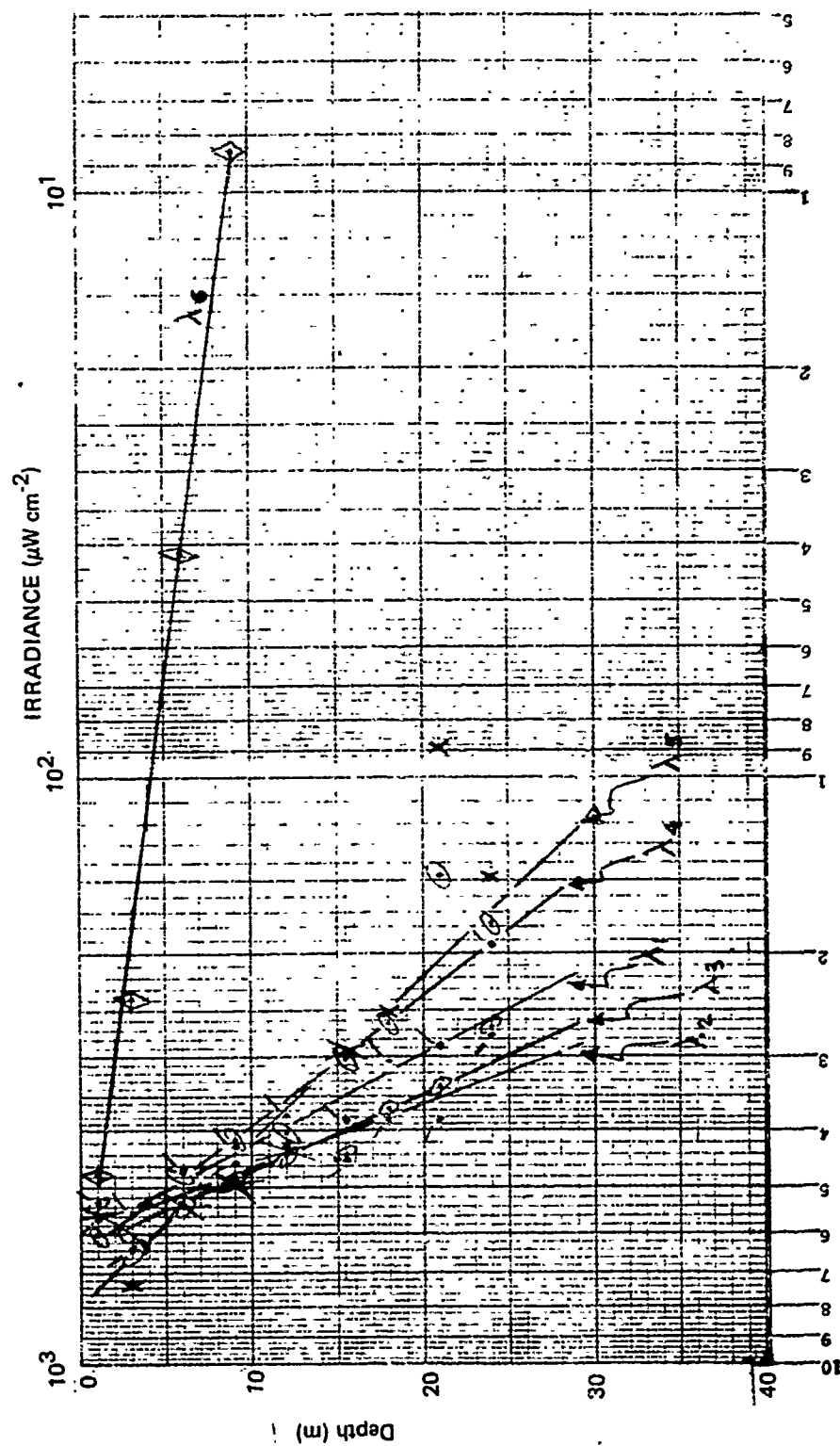


Figure 6-9. Spectral irradiance versus depth for station 51, Dn/W.

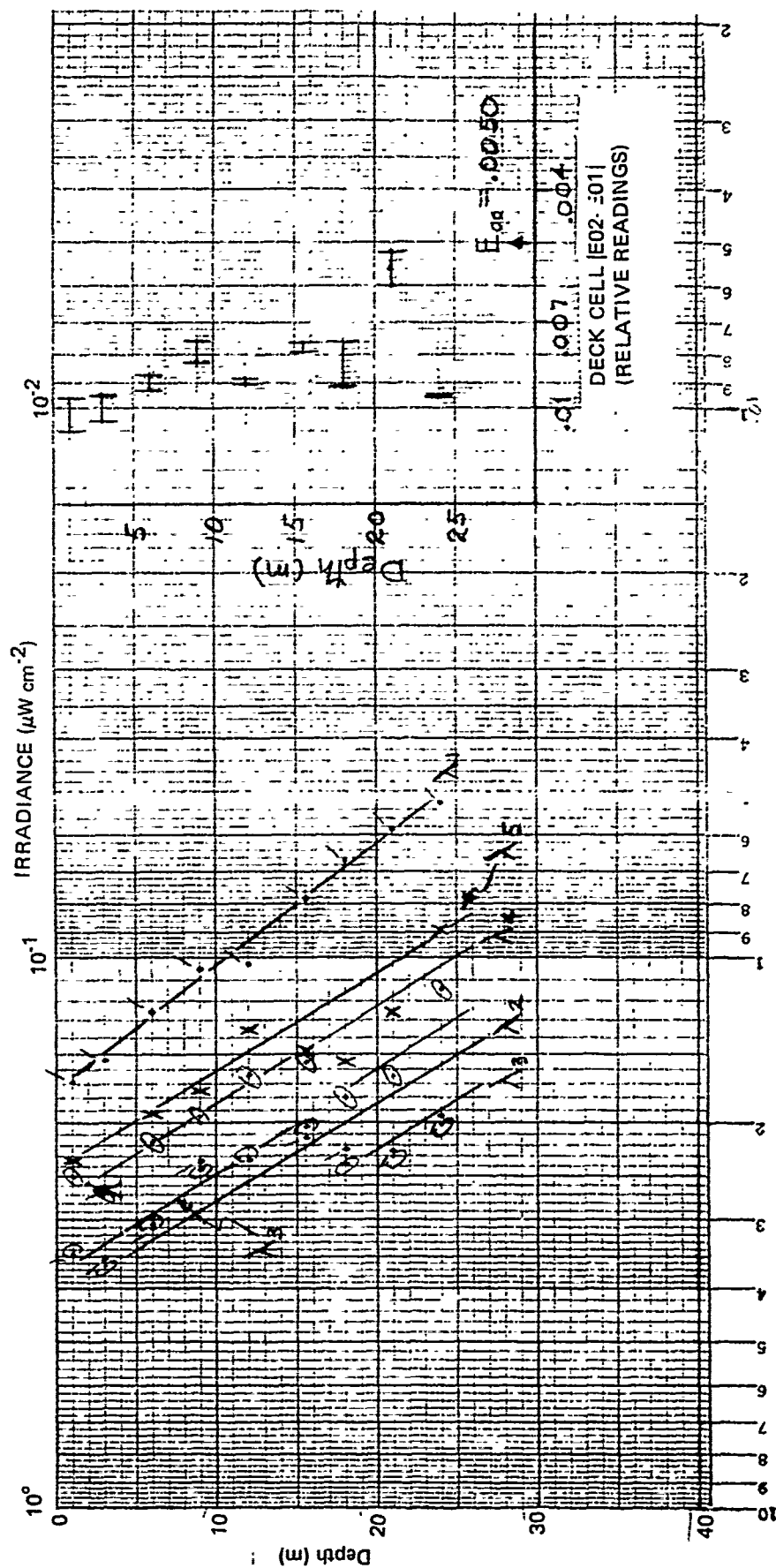


Figure 6-10. Spectral irradiance versus depth for station 51, Up/W.

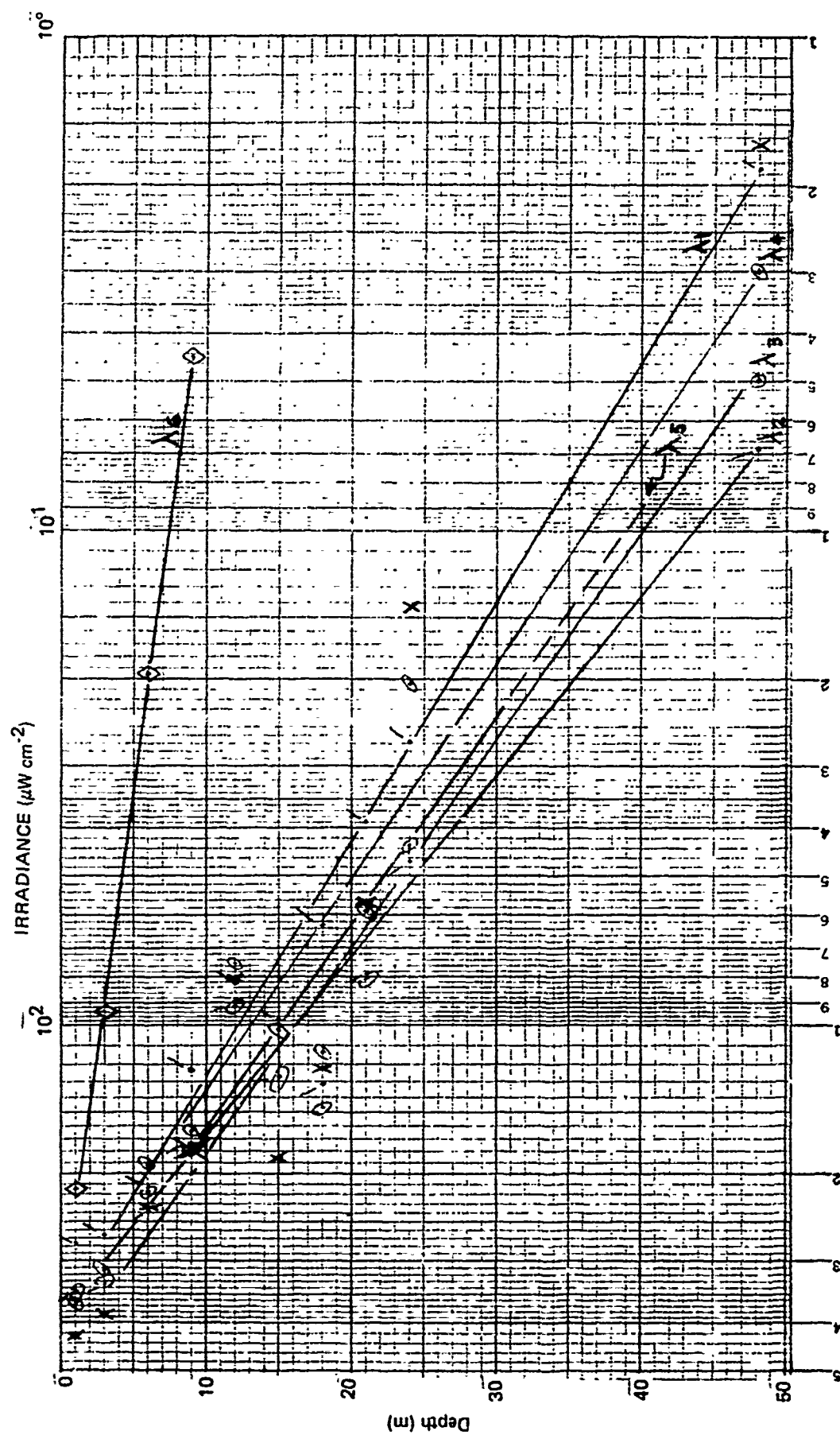


Figure 6-11. Spectral irradiance versus depth for station 55. nm/W .

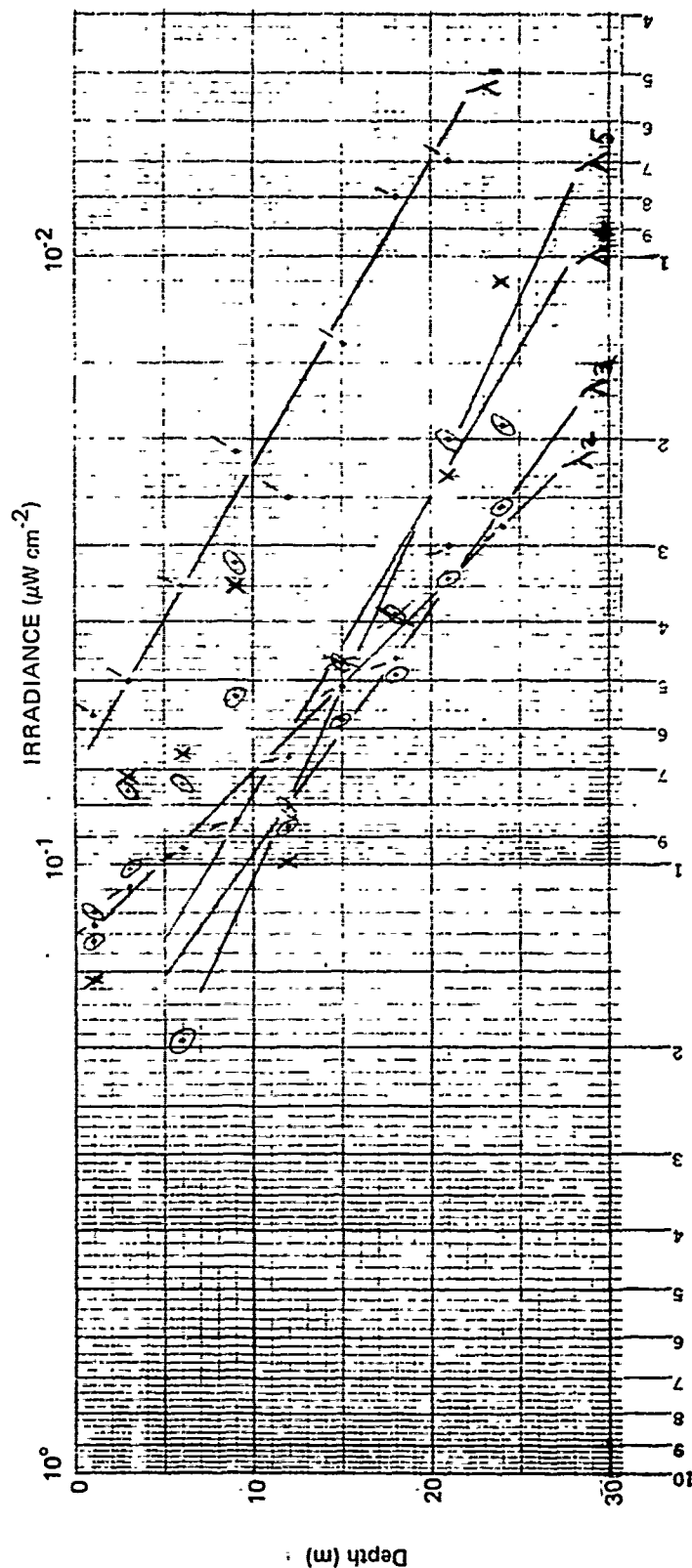


Figure 6-12. Spectral irradiance versus depth for station 55, Up/W.

recorded as previously discussed in sections 3 and 4 and the correction algorithm of section 5.1 was applied, there were situations when large and rapid changes in ambient occurred during a measurement sequence. These were at best only partially corrected by the algorithm, and in a few cases error could have been inserted by the algorithm. Station 55 at 24-m depth (Dn/W) illustrates the situation described; here $E_{o1} = 0.00995$ at the start and $E_{o2} = 0.00328$ at the end of the measurement sequence. Refer to equation (5.2) of section 5.0 and to the listing in appendix C to see the algorithm and its effect (CORR SIG versus NET SIG) when attempting to correct for the large, rapid ambient change. This shortcoming can and should be eliminated by electronically normalizing the channel signal to the deck cell signal coincident with data recording. This equipment improvement is planned for the NOSC spectral irradiance meter.

8.0 CONCLUSIONS AND RECOMMENDATIONS

These remarks must be considered as interim pending more extensive examination, comparison, interpretation, and possible correlation between these spectral irradiance data, other measurements made on board ALBATROSS IV, and the remote spectral measurements taken from the NIMBUS VII satellite. Nevertheless, some items appear obvious:

a. Comparison and possible correlation among spectral irradiance, spectral K , and chlorophyll and/or suspended matter should be attempted since hydrocasts were made at five of the six stations where spectral irradiance measurements were made (table 2-1).

b. Possible correlation between the irradiance data and water temperature should be examined. Complete XBT charts are available for this. A preliminary look based on the author's hand copies of the XBT charts (appendix E) suggest that a correlation may exist where thermocline structure is significant. See the irradiance plot for station 40, Up/W (figure 6-4) and the XBT traces (appendix E) in the neighborhood of 25 m depth.

This comparison is all the more significant because the surface ambient illumination was relatively constant at station 40 (see figure 6-3), sea state was moderate at 1, and Beaufort wind force was 3 (7 to 10 knots). In addition, it is interesting that no significant effect is observable in the downwelling data for station 40 (figure 6-3).

It is the author's belief that awareness of and implementation of these recommendations will improve the quality and quantity of in situ ocean measurements to be made on future cruises having purposes similar to those of NOAA CZCS 80-01.

Measurement process/technique - Use of the ship's electronics laboratory as the control site for the radiometric work performed proved highly satisfactory and is recommended for future cruises. Environmental protection for the control and recording equipment, good access to the upper deck (overlooking the after main deck where the deck technicians handled the underwater unit assembly) as well as to the top after deck where the deck cell was stationed,

and sufficient remoteness from the work and activity of the biological laboratories all contributed to a highly efficient operation. Communication was good by means of ship's intercom to the bridge and hand radios (walkie-talkies) during the measurement period. Sufficient bench and electronics rack space, as well as bulkhead ports for the instrumentation cables, were available.

It was determined during the cruise that the Secchi depth could be used as a fairly good indication of the euphotic depth. The rule of thumb evolved was euphotic depth $\approx$ 4 Secchi depth for measurements at 488 nm and at 500 nm (filters 2 and 3). It is therefore recommended that the Secchi disk measurement be made as shown in table 4-1; ie, prior to submerging the underwater radiometer. Because of the subjectivity of the Secchi observation measurement, it is preferable to assign one observer for this task.

Measurement equipment - Significant modifications in the underwater irradiance meter are needed to improve the quality of the measurements, to increase the depth resolution of the irradiance measurements, and to reduce the required time on station. An outline of the recommended modifications is given in table 8-1. These modifications are projected for the NOSC spectral irradiance meter; a cost estimate from the manufacturer has been requested.

Operator training - In the event the National Bureau of Fisheries chooses to purchase and field its own underwater spectral irradiance meter, it would be advantageous and cost-effective to provide operator orientation and training in consort with experienced NOSC personnel. This could be accomplished by contracting for NOSC participation on another cruise with Fisheries personnel initially assisting and ultimately operating the equipment.

Another possibility might be Fisheries personnel accompanying a NOSC field effort in which the spectral irradiance meter would be used. It is the author's opinion that the preceding recommendation would be more effective for Bureau of Fisheries purposes because working conditions, support equipment, site location, and possibly even frequency of use of the equipment of interest could be significantly different on a NOSC field project than on a Fisheries cruise. It is further suggested that recommendations from Cruise 80-01 Chief Scientist R. Marak be solicited in this matter.

1. Normalization Capability. Divide each channel signal by the deck cell monitor signal. The initial deck cell reading, E_{oo} , is to be stored and applied to each channel signal to form $R'_i = E_{oo} R_i / E_o$, where R_i is the i^{th} channel signal, $1 \leq i \leq 6$, E_o is the deck cell monitor signal, and R'_i is the corrected signal which is to be recorded.
2. Over-Flux Protection and Indication. Provide high-voltage turnoff whenever $R_i > 10V$; also provide indicator light and reset button.
3. Normalization Capability, Multiple Deck Cells. Same as recommendation 1 except that up to six deck cells could be used, one for each channel. Here $R'_i = E_{oo} R_i / E_{oi}$. An analog I/O board with a minimum of eight single-ended inputs also would be desirable here.
4. Temperature Sensor. Provide the capability of measuring and recording the ambient water temperature ($^{\circ}C$).
5. Analog Output for Depth Transducer. Use this to drive XY recorder.
6. Analog Log Ratio Output. Use this to output log base 10 of R'_i for either 1 or 3 above. This output would be applied to XY recorder referred to in (5).
7. Voltage-to-frequency Detector Assembly with High-Voltage Adjust for Extended Dynamic Range. This option would allow utilization of the maximum sensitivity of the underwater sensor without the awkward and time-consuming necessity of removing optical attenuation filters. The over-flux protection 5 must be functional with this option. Some indication of the high-voltage range in use for the operator and for the tape data record must be provided to permit data reduction.
8. Count Indicator Light. Placed adjacent to the LCD readout, this light would be on when analog output signal is presented for any channel.
9. Control Console. A unit with keyboard entry, CRT display, and tape cassette record and playback might be the most cost-effective means of implementing relevant recommendations above. This is presently under consideration.

Table 8-1. Recommended modifications to the SE-267 six-channel underwater radiometer system.

APPENDIX A
INSTRUMENT CALIBRATION

APPENDIX A

INSTRUMENT CALIBRATION

The radiometric measurement instrumentation used on NOAACZCS Cruise 01 was calibrated prior to and after the cruise. The radiometric laboratory facility at NOSC was used for the calibrations requiring controlled and repeatable illumination. An Eppley working-standard lamp traceable to National Bureau of Standards spectral characteristics was used as the calibration reference source for both the spectral irradiance meter and the deck cell. No correction has been made for the "immersion factor" which would affect the accuracy of the calibration by some 10 to 20% for underwater measurements.

No claim is made as to the absolute accuracy of the irradiance measurements. From checks made during the NOSC calibrations, it was found that factors affecting the repeatability and stability of the irradiance meter contributed to a relative error of no more than $\pm 3\%$. It is this figure, not the absolute accuracy error, that impacts on the values for $k(\lambda)$ determined in table 6-1.

The depth transducer was calibrated prior to the cruise. An Ametek model T-3 comparator pressure meter was used to perform the calibration. Accuracy is within ± 0.6 m at any depth.

APPENDIX B

SPECTRAL FILTER CHARACTERISTICS

SPECTRAL FILTER CHARACTERISTICS
NOAACZCS Cruise 80-01

Filter No	Nominal Value (Edge Designate)	λ_c (nm)	$\Delta\lambda$ (nm)	Peak Transmittance
1	440	439.6	7.3	$T = 0.45$
2	488	487.8	6.5	$T = 0.52$
3	500	501.2	7.1	$T = 0.51$
4	520	520.9	8.1	$T = 0.63$
5	550	552.9	10.5	$T = 0.65$
6	670	668.8	11.8	$T = 0.60$
	Wratten 102	559	105	Deck cell, photopic $\hat{T} = 0.67$

Measurements made on Cary spectrophotometer from $380 \leq \lambda \leq 300$ nm.

APPENDIX C

DATA FORMAT, PROGRAM, AND DATA LISTINGS

DATA FORMAT

Start:

- o Line up bottom of paper strip to START near bottom of printer.
- o Deck cell 2 entries
- Space 3
- o Place filter position switch in 7.
- o Filter 1 2
- Space 1
- Filter 2 2
- Space 1
- Filter 3 2
- Space 1
- Filter 4 2
- Space 1
- Filter 5 2
- Space 1
- Filter 6 2
- Space 1
- o Place filter position switch in 6.
- Deck cell 2 entries.
- o Space 6 spaces

$t = 1422$ hrs end
Time for 1 data, .000301 Deck
Set at each .000301 Cell
depth ≈ 5.5 min.

UP/W
D=6m

SAMPLE DATA RUN

1/15/80

.001977 F6
.001977 F6
!
.003257 F5
.003257 F5
!
.003351 F4
.003351 F4
!
.003358 F3
.003358 F3
!
.003358 F2
.003358 F2
!
.003743 F1
.003743 F1
350

.030181 Deck
.030181 Cell

.030190 Deck
.030190 Cell

350

DN/W
D=6m

.030207 F6
.030207 F6
!
.021661 F5
.021661 F5
!
.018000 F4
.017999 F4
!
.014345 F3
.014345 F3
!
.010080 F2
.010080 F2
!
.006420 F1
.006420 F1
350

1/15/80 .031425 Deck
.031425 Cell
1416 hrs. start 2

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Program Listing

R260

Run on HP 9820A Calculator

```
0:
SPC 0;PRT "NOAC
ZCS 80-01";SPC 2
1:
ENT "STA NO.?",A
:PRT "STA NO.=";
END 0;PRT A;SPC
2:
ENT "1=UP,0=DOWN
":A;IF A=1;PRT "
UP/W";SPC
3:
IF A=0;PRT "DN/W
";SPC
4:
ENT "DEPTH?",A;
END 1;PRT "DEPTH
=";A;SPC
5:
END 6;ENT "RD=",
Z;PRT "RD=",Z;
ENT "EQ0?",R0;
PRT "EQ0=",R0;
6:
ENT "EQ1?",R1;
PRT "EQ1=",R1;
ENT "EQ2?",R2;
PRT "EQ2=",R2;
SPC
7:
PRT "RAW SIG ="
8:
ENT "1?",R3;PRT
R3;ENT "2?",R4;
PRT R4;ENT "3?",
R5;PRT R5;
9:
ENT "4?",R6;PRT
R6;ENT "5?",R7;
PRT R7;ENT "6?",
R8;PRT R8;
```

```
10:
.148+R11;.286+R1
21.429+R13;.572+
R14;.715+R15;.85
8+R16;
11:
298E-6+R31;
12:
128.8E-6+R32;
13:
115.5E-6+R33;
14:
103.6E-6+R34;
15:
126.2E-6+R35;
16:
9992E-6+R36;
17:
R3-Z+R3;R4-Z+R4;
R5-Z+R5;R6-Z+R6;
R7-Z+R7;R8-Z+R8;
PRT "HET SIG="
18:
PRT R3,R4,R5,R6,
R7,R8;SPC
19:
(R2-R1)/R1+R9;R0
/R1+R10;
20:
1+R9R11+R21;1+R9
R12+R22;1+R9R13+
R23;1+R9R14+R24;
21:
1+R9R15+R25;1+R9
R6+R26;
22:
R3R10R21+R3;R4R1
0R22+R4;R5R10R23
+R5;
23:
R6R10R24+R6;R7R1
0R25+R7;R8R10R26
+R8;
24:
PRT "CORR SIG=",
R3,R4,R5,R6,R7,R
8;S
```

```
25:
R31R3+R3;R32R4+R
4;R33R5+R5;R34R6
+R6;
26:
R35R7+R7;R36R8+R
8;PRT "MICRO-WAT
TS CM-2"
27:
PRT 1E6R3,1E6R4,
1E6R5,1E6R6,1E6R
7,1E6R8;SPC
28:
PRT "LOG MICRO-W
ATTS CM-2"
29:
IF R3<0;PRT 0;
JMP 2;
30:
PRT LOG (1E6R3);
31:
IF R4<0;PRT 0;
JMP 2;
32:
PRT LOG (1E6R4);
33:
IF R5<0;PRT 0;
JMP 2;
34:
PRT LOG (1E6R5);
35:
IF R6<0;PRT 0;
JMP 2;
36:
PRT LOG (1E6R6);
37:
IF R7<0;PRT 0;
JMP 2;
38:
PRT LOG (1E6R7);
39:
IF R8<0;PRT 0;
JMP 2;
40:
PRT LOG (1E6R8);
41:
GTO 4;SPC 3;
R2;
```

NO. 20-01

NO. 15

15

DEPTH

DEPTH

0.0

DEPTH

2.0

DEPTH

20.0

RD=

000315

RD=

.000315

RD=

000315

E00=

.001900

E00=

.001900

E00=

.001900

E01=

.001760

E01=

.001960

E01=

.001550

E02=

.001900

E02=

.002060

E02=

.001470

RAW SIG =

.740000
1.424000
1.560000
1.846000
1.956000
.023500

RAW SIG =

.434800
.910900
1.016000
1.217000
1.317000
.012500

RAW SIG =

.000926
.010600
.016100
.023500
.036300
.000313

NET SIG=

.739685
1.423685
1.559685
1.845685
1.955685
.023185

NET SIG=

.434485
.910585
1.015685
1.216685
1.316685
.012185

NET SIG=

.000611
.010365
.015665
.023185
.035985
-.000002

CORR SIG=

.807607
1.571898
1.741209
2.003160
2.231328
.028704

CORR SIG=

.424257
.895590
1.006143
1.213860
1.322940
.012545

CORR SIG=

.000743
.012518
.019017
.027581
.042483
-.000002

MICRO-WATTS CM-2

240.666822
202.460448
201.109622
215.815339
201.593625
206.809905

MICRO-WATTS CM-2

126.428695
115.352032
116.209531
125.755888
166.955038
125.351919

MICRO-WATTS CM-2

.221545
1.612310
2.196442
2.857421
5.361332
-.024467

LOG MICRO-WATTS

2.381416
2.306340
2.303433
2.334082
2.149623
457594

LOG MICRO-WATTS

2.101846
2.062025
2.065242
2.099528
2.222600
2.398131

LOG MICRO-WATTS

-.654538
.207449
.341720
.455974
.729273
100000

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Sta. 15, Dn/W

DEPTH=	17.0	DEPTH=	14.0	DEPTH=	10.5
RD=		RD=		RD=	
E00=	.000315	E00=	.000315	E00=	.000315
E01=	.001900	E01=	.001900	E01=	.001900
E02=	.001480	E02=	.001370	E02=	.001260
	.001440		.001380		.001240
RAW SIG =		RAW SIG =		RAW SIG =	
	.002160		.005810		.015000
	.021670		.040580		.077800
	.030810		.055220		.100400
	.043640		.076560		.132100
	.063750		.102820		.168200
	.000314		.000314		.000315
NET SIG=		NET SIG=		NET SIG=	
	.001845		.005495		.014685
	.021355		.040265		.077485
	.030495		.054905		.100085
	.043325		.076245		.131785
	.063435		.102505		.167885
	-.000001		-.000001		0.000000
CORR SIG=		CORR SIG=		CORR SIG=	
	.002359		.007629		.022094
	.027203		.055959		.116312
	.038695		.076384		.149894
	.054760		.106183		.196919
	.079863		.142902		.250287
	-.000001		-.000001		0.000000
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	.703109		2.273370		6.583948
	3.503784		7.207461		14.980990
	4.469281		8.822359		17.312771
	5.673144		11.000531		20.400822
	10.078725		18.034251		31.586189
	-.012813		-.013865		0.000000
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	-.152977		.356670		.318486
	.544533		.857782		1.175541
	.650238		.945585		1.238367
	.753824		1.041414		1.309648
	1.003406		1.256098		1.499497
	0.000000		0.000000		0.000000

Best Available Copy

Sta. 15, Dn/W

DEPTH= 7.5

RD= .000315
E00= .001900
E01= .001120
E02= .001120

RAW SIG =
.034460
.131500
.162100
.206600
.247500
.000312

NET SIG=
.034145
.131185
.161785
.206285
.247185
-.000000

CORR SIG=
.057925
.222546
.274457
.349948
.419332
-.000005

MICRO-WATTS CM-2
17.261517
28.663923
31.699748
36.254589
52.919660
-.050852

LOG MICRO-WATTS
1.237079
1.457336
1.501056
1.559363
1.722617

DEPTH= 4.0

RD= .000315
E00= .001900
E01= .001270
E02= .001350

RAW SIG =
.123600
.040200
.400600
.116600
.533700
.002160

NET SIG=
.123285
.339885
.400285
.116285
.533385
.001845

CORR SIG=
.186104
.517650
.615035
.180238
.833918
.002780

MICRO-WATTS CM-2
55.458860
66.673344
71.036509
18.672664
105.240447
27.782307

LOG MICRO-WATTS
1.743971
1.823952
1.851482
1.271206
2.022183
1.442729

DEPTH= 1.0

RD= .000315
E00= .001900
E01= .001290
E02= .001370

RAW SIG =
.254200
.567200
.652700
.801700
.878000
.007040

NET SIG=
.253885
.566000
.652385
.801385
.877685
.006725

CORR SIG=
.377255
.849756
.986441
1.222204
1.350035
.010397

MICRO-WATTS CM-2
112.422086
109.448557
113.933928
126.620370
170.374079
103.889845

LOG MICRO-WATTS
2.050852
2.039210
2.056653
2.102504
2.231114
2.014313

Sta. 15, Up/W

DEPTH=

1.0

FP=

.000315

E00=

.001000

E01=

.001380

E02=

.001440

RAW SIG =

.026550

.085740

.107100

.140600

.164500

.000312

NET SIG=

.026235

.095422

.106785

.140205

.164125

-.000003

CORR SIG=

.036345

.115077

.149765

.197949

.233079

-.000004

MICRO-WATTS CM-2

.854113

1.362237

1.545576

1.737996

2.498608

-.002497

LOG MICRO-WATTS

-.068485

.134253

.189090

.240049

.397598

0.000000

Best Available Copy

Sta. 15, Up/W

DEPTH=	14.0	DEPTH=	7.5	DEPTH=	4.0
RD=		RD=		RD=	
E00=	.000315	E00=	.000315	E00=	.000315
E01=	.001900	E01=	.001900	E01=	.001900
E02=	.001370	E02=	.001110	E02=	.001370
	.001320		.001130		.001290
RAW SIG =		RAW SIG =		RAW SIG =	
	.000314		.000366		.013130
	.007040		.021060		.054600
	.010680		.029000		.069850
	.016800		.042100		.093060
	.026350		.055830		.113200
	.000319		.000314		.000314
NET SIG=		NET SIG=		NET SIG=	
	-.000001		.000051		.012015
	.006725		.020745		.054205
	.010365		.028685		.069535
	.016485		.041785		.092745
	.026235		.055515		.112885
	-.000002		-.000001		-.000001
CORR SIG=		CORR SIG=		CORR SIG=	
	-.000001		.005236		.017624
	.009229		.035692		.074020
	.014150		.049480		.094020
	.022385		.072261		.124326
	.035435		.096250		.150019
	-.000003		-.000002		-.000001
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	-.000032		.123043		.414169
	.105583		.408322		.846885
	.146025		.510633		.970282
	.196541		.634452		1.091602
	.379862		1.031799		1.608207
	-.001666		-.001029		-.000829
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	0.000000		-.909942		-.382822
	-.976406		-.388998		-.072175
	-.835571		-.291091		-.013102
	-.706546		-.197601		.038064
	-.420374		.013595		.206342
	0.000000		0.000000		9.000000

DDHDCZOS 80-01

15

15

UP

DEPTH=

2.0

DEPTH=

20.0

DEPTH=

17.0

RD=

.000315

RD=

.000315

RD=

.000315

E00=

.001900

E00=

.001900

E00=

.001900

E01=

.002240

E01=

.001440

E01=

.001430

E02=

.002160

E02=

.001440

E02=

.001390

RAW SIG =

.045460

.140600

.170600

.226100

.265200

.000928

RAW SIG =

.000321

.002754

.004600

.008250

.015560

.000314

RAW SIG =

.000313

.003984

.006425

.010600

.018620

.000313

NET SIG=

.045145

.140295

.170295

.225785

.264885

.000613

NET SIG=

.000006

.002439

.004285

.007935

.015245

-.000001

NET SIG=

-.000003

.005000

.006110

.010860

.018305

-.000002

CORR SIG=

.000097

.117776

.142225

.187602

.218942

.000516

CORR SIG=

.000000

.003218

.005654

.010470

.020115

-.000001

CORR SIG=

-.000003

.004836

.008021

.013551

.023835

-.000003

MICRO-WATTS CM-2

.095281

1.347361

1.467764

1.647143

2.347057

.309922

MICRO-WATTS CM-2

.000186

.036815

.058347

.091925

.215632

-.000793

MICRO-WATTS CM-2

-.000062

.055323

.082774

.118981

.255310

-.001596

LOG MICRO-WATTS

-.048041

.129484

.166656

.216731

.370524

-.508748

LOG MICRO-WATTS

-3.730390

-1.433971

-1.233978

-1.036367

-.666287

0.000000

LOG MICRO-WATTS

0.000000

-1.257097

-1.062105

-.924524

-.592592

0.000000

Best Available Copy

Sta. 40, Dn/W

DEPT	DEPT	DEPT
1.0	94.0	52.0
RD=	RD=	RD=
E00= .000289	E00= .000289	E00= .000206
E01= .000010	E01= .000010	E01= .000010
E02= .000120	E02= .000600	E02= .000890
.000150	.000630	.000980
RAW SIG =	RAW SIG =	RAW SIG =
1.284000	.000040	.069200
1.859000	.028400	.157800
.000289	.022300	.139400
2.249000	.005170	.066200
.000289	.001520	.031400
.051500	.000289	.000289
NET SIG=	NET SIG=	NET SIG=
1.233711	.000551	.068914
1.858711	.028111	.157514
-.000001	.021911	.139114
2.248711	.004881	.065914
0.000000	.001231	.031114
.051211	-.000001	.000002
CORR SIG=	CORR SIG=	CORR SIG=
1.266990	.007804	.062182
1.835469	.025898	.142333
-.000001	.020170	.125888
2.222936	.004489	.059733
0.000000	.001131	.028237
.050937	-.000001	.000002
MICRO-WATTS CM-2	MICRO-WATTS CM-2	MICRO-WATTS CM-2
1506.450938	9.374620	73.934704
1486.729743	20.977708	115.289716
-.000733	14.965952	93.408757
1344.876275	2.716087	36.138610
0.000000	.744057	18.571490
1026.379635	-.018594	.036335
LOG MICRO-WATTS	LOG MICRO-WATTS	LOG MICRO-WATTS
3.177955	.971954	1.868848
3.172232	1.321758	2.061791
0.000000	1.175104	1.970388
0.128682	.432944	1.557971
0.000000	-.128394	1.268847
0.11308	.000000	.99674

Sta. 40, Dn/w

DEPTH 48.0

RD#
E00# .000286
E01# .008010
E02# .009080
E03# .008980

RAW SIG =
.077100
.178500
.163300
.084500
.044200
.000286

NET SIG =
.076814
.178214
.163014
.084214
.043914
.000002

CORR SIG =
.067655
.156718
.143125
.073822
.038434
.000002

MICRO-WATTS CM-2
80.442285
126.941438
106.198582
44.662376
25.278083
.033518

LOG MICRO-WATTS
1.905484
2.103603
2.026119
1.649942
1.402744
449551

DEPTH 48.0

RD#
E00# .000286
E01# .008010
E02# .009080
E03# .008980

RAW SIG =
.088100
.196800
.184600
.102000
.056400
.000286

NET SIG =
.087814
.196514
.184314
.102514
.056114
.000000

CORR SIG =
.078590
.176459
.166054
.092664
.050890
0.000000

MICRO-WATTS CM-2
93.444059
142.902066
123.212188
56.061604
37.470086
0.000000

LOG MICRO-WATTS
1.970552
2.155130
2.090654
1.748666
1.574057
0.000000

DEPTH 48.0

RD#
E00# .000286
E01# .008010
E02# .009280
E03# .009190

RAW SIG =
.111300
.246300
.233400
.140000
.081400
.000286

NET SIG =
.111014
.246014
.233114
.139714
.081114
0.000000

CORR SIG =
.095688
.211757
.200374
.119925
.069528
0.000000

MICRO-WATTS CM-2
113.773580
171.523291
148.677799
72.554428
45.728420
0.000000

LOG MICRO-WATTS
2.056041
2.234323
2.172246
1.860664
1.660186
000000

Sta. 40, Dn/W

	22.0	27.5	
PD=	.000286	RD=	.000286
E00=	.008010	E00=	.008010
E01=	.009260	E01=	.009190
E02=	.009230	E02=	.009230
RAW SIG =	RAW SIG =	RAW SIG =	
	.135700		.178500
	.290200		.322700
	.277000		.322530
	.174900		.313400
	.111900		.141600
	.000286		.000289
			.190000
			.000287
NET SIG=	NET SIG=	NET SIG=	
	.135414		.178214
	.290200		.322414
	.275814		.322214
	.174914		.319114
	.111614		.141514
	.000000		.000003
			.189714
			.000000
CORR SIG=	CORR SIG=	CORR SIG=	
	.117201		.155428
	.253911		.316273
	.238922		.316443
	.151596		.190031
	.097069		.123324
	.000000		.000000
			.165869
			.000001
MICRO-WATTS CM-2	MICRO-WATTS CM-2	MICRO-WATTS CM-2	
139.423560	162.186422	184.803803	
205.676467	232.588955	256.181213	
177.260048	238.092991	232.099200	
91.776142	115.452540	140.675998	
63.842380	81.109910	109.092197	
0.000000	.052567	.017583	
LOG MICRO-WATTS	LOG MICRO-WATTS	LOG MICRO-WATTS	
2.144336	2.210014	2.266711	
2.313103	2.366589	2.408547	
2.248660	2.318257	2.365674	
1.962730	2.062403	2.148220	
1.805109	1.909074	2.037794	
0.000000	-1.279289	-1.754905	

Sta. 40, Dn/W

DEPI	24.0	DEPTI	20.0	DEPI..	16.5
RD=		RD=		RD=	
E00=	.000286	E00=	.000286	E00=	.000288
E01=	.008010	E01=	.008010	E01=	.008010
E02=	.009430	E02=	.009410	E02=	.009580
	.009380		.009310		.009830
RAW SIG =		RAW SIG =		RAW SIG =	
	.211500		.2297		.249300
	.400000		.46650		.443900
	.365200		.514100		.460400
	.340600		.426800		.397500
	.231600		.337100		.311500
	.000288		.000289		.000288
	.211214	NET SIG=	.229414	NET SIG=	.249012
	.399710		.406214		.443612
	.364914		.513814		.460112
	.340514		.426514		.397212
	.231314		.336814		.311212
	.000002		.000003		0.000000
CORR SIG=		CORR SIG=		CORR SIG=	
	.179273		.194986		.208980
	.339009		.395646		.373680
	.309259		.435376		.389014
	.288361		.360851		.337073
	.195737		.284525		.265065
	.000002		.000003		0.000000
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	213.155216		231.837766		248.477342
	274.597211		320.472857		302.680622
	229.470181		323.048899		288.648610
	174.458450		218.315003		203.929248
	128.736295		187.132134		174.333106
	.034170		.051223		0.000000
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	2.328696		2.365184		2.395287
	2.438696		2.505791		2.480985
	2.360726		2.509268		2.460369
	2.241692		2.339084		2.309480
	2.109701		2.272148		2.241380
	1.466359		-1.290534		0.000000

Sta. 40, Dn/W

DEPTH	12.0	DEPTH	8.0	DEPTH	4.0
RD=	.000288	RD=	.000288	RD=	.000288
E00=	.008010	E00=	.008010	E00=	.008010
E01=	.009430	E01=	.009650	E01=	.009960
E02=	.009750	E02=	.009960	E02=	.009750
PPW SIG =		RAW SIG =		RAW SIG =	
	.324900		.292000		.494600
	.561800		.530600		.887100
	.699600		.579400		.964500
	.656400		.843100		1.214000
	.588000		.691700		1.319000
	.000288		.000288		.008220
NET SIG=		NET SIG=		NET SIG=	
	.324612		.291712		.494601
	.661312		.530312		.88691
	.699312		.579112		.9643
	.656112		.842812		1.21371
	.58771		.691412		1.31871
	0.000000		0.000000		.000000
		CORR SIG=		CORR SIG=	
	.27700		.243240		.390035
	.567352		.444231		.768839
	.602655		.487310		.768422
	.568130		.712432		.964316
	.511325		.587090		1.044543
	0.000000		0.000000		.006216
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	329.434902		289.222342		471.242861
	459.555703		359.826850		574.199727
	447.169837		361.589631		570.168827
	343.718759		431.021637		583.411065
	336.298325		386.128976		606.995680
	0.000000		0.000000		125.248498
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	2.517770		2.461232		2.673245
	2.662338		2.556094		2.759063
	2.650473		2.558216		2.756003
	2.536203		2.634499		2.765975
	2.526725		2.586732		2.836354
	0.000000		0.000000		0.97773

Sta. 40, Dn/W

DEPTH

RD=

E00=

E01=

E02=

RAW SIG =

NET SIG=

CLR SIG=

MICRO-WATTS CM-2

LOG MICRO-WATTS

NOI 10-01

5.0
0.0

UP/L

DEPTH 0.0

PD= .000288
E00= .000010
E01= .000020
E02= .000010

RAW SIG =
1.222000
1.889000
1.000293
1.511000
1.000192
1.083979

NET SIG=
1.222000
1.889000
1.000293
1.511000
1.000192
1.083979

CORR SIG=
1.219971
1.886884
1.000095
1.505793
1.000004
1.086283

MICRO-WATTS CM-2
29.636861
51.931746
1.000130
50.986135
1.000110
60.402599

LOG MICRO-WATTS
1.598099
1.715433
1.886330
1.770013
1.572291
1.81271

DEPTH 1.0

PD= .000288
E00= .000010
E01= .000150
E02= .000260

RAW SIG =
1.010000
1.015900
1.019200
1.015500
1.013100
1.000338

NET SIG=
1.009711
1.019512
1.013912
1.015217
1.012811
0.000000

CORR SIG=
1.009564
1.019251
1.013695
1.015066
1.012713
0.000000

MICRO-WATTS CM-2
31.0721
53.0168
1.86624
35.4054
35.1399
0.000000

LOG MICRO-WATTS
1.507629
1.275586
1.312806
1.450931
1.454199
1.0000

DEPTH 94.0

PD= .000288
E00= .000010
E01= .000770
E02= .000740

RAW SIG =
1.000286
1.000287
1.000285
1.000287
1.000286
0.000000

NET SIG=
1.000002
1.000001
1.000001
1.000001
1.000001
1.000028

CORR SIG=
1.000002
1.000001
1.000003
1.000001
1.000002
1.000263

MICRO-WATTS CM-2
1.000059
1.000025
1.000071
1.000021
1.000050
1.184235

LOG MICRO-WATTS
0.000000
0.000000
0.000000
0.000000
0.000000
1.0000

Sta. 40, Up/w

DEP...	DEPTH-	DEPTn-
52.0	44.0	27.5
RD=	RD=	RD=
.000286	.000286	.000286
E00=	E00=	E00=
.008010	.008010	.008010
E01=	E01=	E01=
.008860	.009170	.009370
E02=	E02=	E02=
.009000	.009180	.009330
RAW SIG =	RAW SIG =	RAW SIG =
.000900	.000900	.003340
.002100	.003340	.008220
.002100	.002730	.007010
.000900	.001520	.003960
.000287	.000287	.002130
.000287	.000288	.000288
NET SIG=	NET SIG=	NET SIG=
.000614	.000614	.003054
.001914	.003054	.007934
.001814	.002444	.006724
.000614	.001234	.003674
.000001	.000001	.001844
.000001	.000002	.000002
CORR SIG=	CORR SIG=	CORR SIG=
.000556	.000536	.002609
.001647	.002669	.006774
.001651	.002136	.005738
.000560	.001079	.003133
.000001	.000001	.001572
.000001	.000002	.000002
MICRO-WATTS CM-2	MICRO-WATTS CM-2	MICRO-WATTS CM-2
.018076	.017428	.084771
.045369	.073491	.186560
.042978	.055596	.149348
.013163	.025346	.073627
.000025	.000024	.043437
.000633	.001224	.001197
LOG MICRO-WATTS	LOG MICRO-WATTS	LOG MICRO-WATTS
-1.742903	-1.758751	-1.071754
-1.343242	-1.133768	-.729182
-1.366756	-1.254958	-.825801
-1.880657	-1.596083	-1.132962
-4.597384	-4.616860	-1.362136
8451	12360	21738

Sta. 40, Up/W

DEPin-

20.0

22.0

22.0

RD=

RD=

RD=

E00= .000286

E00= .000286

E00= .000286

E01= .008010

E01= .008010

E01= .008010

E02= .009440

E02= .009440

E02= .009440

E02= .009460

E02= .009450

E02= .009450

RAW SIG =

RAW SIG =

RAW SIG =

.004570

.007610

.009460

.011300

.015500

.018600

.009460

.013100

.017400

.005170

.008220

.012500

.003340

.005170

.010000

.000286

.000292

.000292

NET SIG=

NET SIG=

NET SIG=

.004284

.007324

.009172

.011014

.015214

.018312

.009174

.012814

.017112

.004884

.007934

.013212

.003054

.004884

.009712

.000002

.000006

.000006

CORR SIG=

CORR SIG=

CORR SIG=

.003636

.005990

.007500

.009351

.012389

.015000

.007791

.010388

.014025

.004149

.006403

.010015

.002595

.003924

.007960

.000002

.000005

.000003

MICRO-WATTS CM-2

MICRO-WATTS CM-2

MICRO-WATTS CM-2

.118138

.194630

.243950

.257533

.341190

.413100

.202809

.270406

.365070

.097506

.150479

.205352

.071734

.108463

.220270

.001189

.003452

.002292

LOG MICRO-WATTS

LOG MICRO-WATTS

LOG MICRO-WATTS

-.927609

-.710789

-.612680

-.509167

-.467003

-.383940

-.692912

-.567984

-.437610

-1.010970

-.822524

-.628280

-1.144275

-.964720

-.657000

.924959

.161981

.397200

MOBIL: 00-01

SIG

13

DN/M

DEPTH=

0.0

DEP

1.0

DEPTI.

27.0

RD=

RD=

RD=

.000293

.000293

.000293

E00=

E00=

E00=

.000768

.000768

.000768

E01=

E01=

E01=

.000724

.000685

.000863

E02=

E02=

E02=

.000768

.000828

.000843

RAW SIG =

RAW SIG =

RAW SIG =

.191700

1.169000

.039950

1.832000

1.799000

.141200

2.144000

1.923000

.157800

2.616000

2.165000

.130900

3.015000

2.316000

.110100

.094900

.046500

.000292

NET SIG=

NET SIG=

NET SIG=

.191400

1.168700

.039657

1.831700

1.798700

.140900

2.143700

1.922700

.157500

2.615700

2.164700

.130600

3.014700

2.315700

.109800

.094600

.046200

-.000001

CORF SIG=

CORR SIG=

CORR SIG=

.192511

1.182654

.039219

1.843601

1.824448

.139307

2.159181

1.954793

.155668

2.636484

2.205977

.129040

3.040838

2.365360

.108455

.096339

.048311

-.000001

MICRO-WATTS CM-2

MICRO-WATTS CM-2

MICRO-WATTS CM-2

228.895718

1406.175643

46.631710

1493.316653

1477.802753

112.838422

1602.112015

1450.456176

115.505570

1595.072591

1334.615894

78.069373

1999.959250

1555.697240

71.330683

1941.221798

973.471651

-.019928

LOG MICRO-WATTS

LOG MICRO-WATTS

LOG MICRO-WATTS

2.359638

3.148040

1.668681

3.174152

3.169616

2.052457

3.204693

3.161505

2.062603

3.202700

3.125356

1.892481

3.301021

3.191925

1.853276

3.330000

3.88323

0.000000

Sta. 43, Dn/w

DE

...5

21.0

DE 10-

18.0

RD=

.000293

RD=

.000293

RD=

.000293

E00=

.000768

E00=

.000768

E00=

.000768

E01=

.0009070

E01=

.0009140

E01=

.0009260

E02=

.0006370

E02=

.0009120

E02=

.0009170

RAW SIG =

.058260
.186500
.205400
.177900
.130300
.000293

RAW SIG =

.075920
.221800
.244400
.221200
.198100
.000291

RAW SIG =

.107700
.292000
.323100
.305400
.280000
.000294

NET SIG=

.057947
.186207
.205107
.177607
.130007
0.000000

NET SIG=

.07562
.22150
.24410
.22090
.19780
-.00000

NET SIG=

.10740
.29170
.32280
.30510
.27970
-.00000

CORR SIG=

.053651
.164682
.172956
.142458
.098928
0.000000

CORR SIG=

.072526
.212359
.223952
.211651
.189459
-.000002

CORR SIG=

.101559
.275440
.304381
.287290
.263005
.000001

MICRO-WATTS CM-2

63.791595
133.392052
128.333538
86.187156
65.065136
0.000000

MICRO-WATTS CM-2

86.233727
172.010494
173.592360
128.048730
124.607400
-.038641

MICRO-WATTS CM-2

120.753568
223.106631
225.850890
173.810476
172.978520
.019023

LOG MICRO-WATTS

1.804763
2.125136
2.108340
1.935443
1.813348
0.000000

LOG MICRO-WATTS

1.935677
2.235555
2.239531
2.107375
2.095544
0.000000

LOG MICRO-WATTS

2.081900
2.348511
2.353822
2.240076
2.237992
2.00725

Sta. 43, Dn/w

Der. = 1.0

RD= .000299
 E00= .000768
 E01= .0009170
 E02= .0009220

RAW SIG =
 .043870
 .360900
 .400000
 .402400
 .384700
 .000291

NET SIG=
 .043571
 .360601
 .399701
 .402101
 .384401
 -.000000

CORR SIG=
 .041693
 .345330
 .383073
 .385673
 .368982
 -.000000

MICRO-WATTS CM-2
 49.573443
 279.717654
 284.239888
 233.331908
 242.679671
 -154471

LOG MICRO-WATTS
 1.693249
 2.446720
 2.453685
 2.367974
 2.385033
 2.000000

Der. = 2.0

RD= .000299
 E00= .000768
 E01= .0009360
 E02= .0009270

RAW SIG =
 .217000
 .494000
 .548300
 .573300
 .566600
 .000293

NET SIG=
 .216701
 .493701
 .548001
 .573001
 .566301
 -.000006

CORR SIG= 0
 .202716
 .461204
 .511224
 .533808
 .526837
 -.000006

MICRO-WATTS CM-2
 241.029332
 373.574964
 379.327893
 322.953678
 346.500430
 -.112629

LOG MICRO-WATTS
 2.382070
 2.572378
 2.579015
 2.509140
 2.539704
 2.000000

Der. = 1.0

RD= .000299
 E00= .000768
 E01= .0009340
 E02= .0009534

RAW SIG =
 .309100
 .650300
 .730200
 .802300
 .823000
 .000908

NET SIG=
 .308801
 .650001
 .729901
 .802001
 .822701
 .000601

CORR SIG=
 .299750
 .613818
 .691306
 .761830
 .783787
 .000581

MICRO-WATTS CM-2
 345.702295
 497.192982
 512.949085
 460.907066
 515.496703
 11.711729

LOG MICRO-WATTS
 2.538702
 2.696525
 2.710074
 2.660613
 2.712226
 1.068621

Sta. 43, Dn/W

6.0
RD=
E00=.000299
E01=.008768
E02=.009730
E02=.009830

RAW SIG =
.461000
.904200
1.040000
1.154000
1.20600
.00396

NET SIG=
.46070
.90390
1.03970
1.15370
1.20570
.00366

CORR SIG=
.41576
.81692
.94103
1.04574
1.09447
.00334

MICRO-WATTS CM-2
494.34086
661.71086
698.24957
63.67682
71.83816
67.37408

LOG MICRO-WATTS
2.69402
2.82066
2.84401
2.80118
2.83723

3.0
RD=
E00=.000299
E01=.008768
E02=.010060
E02=.010340

RAW SIG =
.707000
1.131000
1.300000
1.556000
1.754000
.01555

NET SIG=
.70670
1.13070
1.29870
1.55570
1.75370
.01251

CORR SIG=
.61839
.99333
1.14630
1.37749
1.55889
.01386

MICRO-WATTS CM-2
735.26727
804.59764
850.55976
833.38135
1025.28309
279.43774

LOG MICRO-WATTS
2.86644
2.90557
2.92970
2.92084
3.01084

DEPTH= 1.0
RD=
E00=.000299
E01=.008768
E02=.010230
E02=.009730

RAW SIG =
.759500
1.392000
1.589000
1.832000
1.966000
.046100

NET SIG=
.75920
1.39170
1.58870
1.83170
1.96570
.04580

CORR SIG=
.64615
1.17613
1.33310
1.52603
1.62590
.03574

MICRO-WATTS CM-2
768.27638
952.66948
989.16327
923.25219
1069.35453
720.18237

LOG MICRO-WATTS
2.88551
2.97894
2.99526
2.96582
3.02812
2.85440

NOBACZOS 80-01

SIG = 1.1

4.0

UP.W

DEPTH=

1.0

DEPT

27.0

DEPT

24.5

RD=

.000293

RD=

.000293

RD=

.000293

E00=

.008768

E00=

.008768

E00=

.008768

E01=

.008910

E01=

.008910

E01=

.008910

E02=

.008950

E02=

.008950

E02=

.008950

RAW SIG =

.014348

.040000

.045000

.044000

.043000

.000000

RAW SIG =

.000908

.006400

.008230

.001530

.005790

.000293

RAW SIG =

.000908

.007020

.006350

.007620

.006410

.000293

NET SIG=

.014348

.000000

.000000

.000000

.000000

.000000

NET SIG=

.000615

.006107

.007537

.001237

.005497

0.000000

NET SIG=

.000615

.006720

.008550

.007320

.006110

0.000000

CORR SIG=

.014348

.040746

.046357

.045809

.044640

.000005

CORR SIG=

.000606

.006017

.007826

.001220

.005427

0.000000

CORR SIG=

.000581

.006336

.008039

.006865

.005716

0.000000

MICRO-WATTS CM-2

.467633

1.122156

1.206674

1.076507

1.233857

.003585

MICRO-WATTS CM-2

.019676

.165719

.203699

.028680

.149996

0.000000

MICRO-WATTS CM-2

.018970

.174497

.209243

.161324

.157989

0.000000

LOG MICRO-WATTS

-.330095

.050053

.091590

.032017

.091165

-.45561

LOG MICRO-WATTS

-1.706074

-.780628

-.691011

-1.542426

-.923922

0.000000

LOG MICRO-WATTS

-1.724227

-.758210

-.679349

-.792301

-.891372

0.000000

Sta. 43, Up/W

DEPTH=	21.0	DEPTH=	18.0	DEPTH=	15.0
RD=		RD=		RD=	
E00=	.000293	E00=	.000293	E00=	.000293
E01=	.0008768	E01=	.0008768	E01=	.0008768
E02=	.0009120	E02=	.0009190	E02=	.0009240
	.0009220		.0009220		.0009210
RAW SIG =		RAW SIG =		RAW SIG =	
	.000906		.001520		.002730
	.007610		.009460		.012500
	.009460		.011300		.014300
	.007610		.009460		.012500
	.006400		.007610		.010100
	.000291		.000293		.000294
NET SIG=		NET SIG=		NET SIG=	
	.000613		.001227		.002407
	.007317		.009167		.012200
	.009167		.011000		.014000
	.007317		.009167		.012200
	.006107		.007317		.009837
	-.000001		0.000000		.000001
CORR SIG=		CORR SIG=		CORR SIG=	
	.000590		.001171		.002311
	.007057		.008754		.011573
	.008855		.010516		.013273
	.007079		.008762		.011562
	.005917		.006997		.009284
	-.000002		0.000000		.000001
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	.019178		.038052		.075099
	.194340		.241091		.318712
	.230486		.273739		.345496
	.166350		.205916		.271705
	.163555		.193405		.256622
	-.001347		0.000000		.000665
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	-1.717204		-1.419618		-1.124368
	-.711438		-.617819		-.496602
	-.637355		-.562664		-.461557
	-.778978		-.686310		-.865902
	-.786337		-.713531		-.877007
	0.000000		0.000000		0.000000

Sta. 43, Up/W

DEPTH= 12.0

RD= .000293
E00= .008768
E01= .009310
E02= .009470

RAW SIG =
.003970
.016800
.019200
.016800
.014900
.0002

NET SIG=
.003677
.016507
.018907
.015307
.014607
.000001

CORR SIG=
.003471
.015622
.017938
.015699
.013926
.000001

MICRO-WATTS CM-2
.112787
.430242
.466915
.368923
.384905
.000660

LOG MICRO-WATTS
-.947740
-.366288
-.330762
-.433065
-.411346

DEPTH= 9.0

RD= .000293
E00= .008769
E01= .009450
E02= .009580

RAW SIG =
.005790
.021700
.024700
.022900
.020400
.000294

NET SIG=
.005497
.021407
.024407
.022607
.020107
.000001

CORR SIG=
.005110
.019940
.022779
.021141
.018839
.000001

MICRO-WATTS CM-2
.166034
.549154
.592943
.496802
.520721
.000650

LOG MICRO-WATTS
-.779802
-.260306
-.226987
-.303916
-.222205

DEPTH= 6.0

RD= .000293
E00= .008768
E01= .009730
E02= .009760

RAW SIG =
.008230
.027700
.030000
.028400
.025300
.000293

NET SIG=
.007930
.027400
.030500
.028100
.025000
.000002

CORR SIG=
.007155
.024719
.027527
.025373
.022584
.000002

MICRO-WATTS CM-2
.232480
.680763
.716532
.596260
.624229
.001262

LOG MICRO-WATTS
-.633615
-.167004
-.144765
-.224565
-.224565

Sta. 43, Up/vi

DEPTH= 3.0

RD= .000293
E00= .000768
E01= .009950
E02= .010500

RAW SIG =
.010700
.021400
.031500
.035100
.035100
.000294

NET SIG= .03407
.03407
.03407
.03407
.03407
.000001

CORR SIG=
.009243
.025160
.030317
.032733
.031884
.000001

MICRO-WATTS CM-2
.300312
.692896
.789150
.769221
.881284
.000618

LOG MICRO-WATTS
-.532428
-.159332
-.102840
-.113949

DEPTH= 1.0

RD= .000293
E00= .000768
E01= .009230
E02= .009530

RAW SIG =
.012490
.035100
.036300
.035100
.033200
.000294

NET SIG= .012197
.034807
.026007
.034807
.032907
.000001

CORR SIG=
.011640
.033372
.034682
.030679
.031986
.000001

MICRO-WATTS CM-2
.370195
.919068
.902763
.791468
.884102
.000666

LOG MICRO-WATTS
-.422285
-.036652
-.044426
-.101561

090000 80-01

SIG NO. -

47

DN TM

DEPTH:

6.0

DEPTH-

1.0

DEPT

90.0

RD=

.000299

RD=

.000289

RD=

.000285

E00=

.002230

E00=

.002230

E00=

.002230

E01=

.002020

E01=

.004480

E01=

.004570

E02=

.002230

E02=

.004860

E02=

.004790

RAW SIG =

.190100
.313400
.346900
.422600
.469000
.011900

RAW SIG =

.341400
.551400
.615400
.732600
.811400
.016150

RAW SIG =

.000901
.005167
.004000
.001518
.000285
.000287

NET SIG=

.109011
.313111
.346611
.422311
.468711
.011611

NET SIG=

.341111
.551111
.615111
.732011
.811111
.015861

NET SIG=

.000011
.00480
.00371
.00123
0.000000
.000002

CORR SIG=

.212659
.355940
.399710
.493938
.555900
.013381

CORR SIG=

.171654
.280980
.317324
.382207
.428231
.008386

CORR SIG=

.000303
.002415
.001850
.000618
0.000000
.000001

MICRO-WATTS CM-2

252.851522
288.311079
296.585114
298.832631
365.615724
269.624015

MICRO-WATTS CM-2

204.333934
227.593946
235.454388
231.235023
281.647553
168.967928

MICRO-WATTS CM-2

.359858
1.956186
1.372869
.374028
0.000000
.019666

LOG MICRO-WATTS

2.402866
2.459861
2.472149
2.475428
2.563625
2.430759

LOG MICRO-WATTS

2.310340
2.357161
2.371907
2.364054
2.449706
1.7804

LOG MICRO-WATTS

-.443869
.291410
.137629
-.427096
0.000000
.36281

Sta. 47, Dn/W

DEPT.	44.0	DEPT	40.0	DEPTH	36.0
RD=		RD=		RD=	
E00=	.000285	E00=	.000285	E00=	.000291
E01=	.002230	E01=	.002230	E01=	.002230
E02=	.003910	E02=	.002620	E02=	.002540
	.003250		.002430		.002910
RAW SIG =		RAW SIG =		RAW SIG =	
	.011890		.009457		.014330
	.036290		.028360		.039940
	.035060		.028360		.041000
	.020420		.017580		.030190
	.011690		.011280		.021040
	.006287		.000290		.000291
NET SIG=		NET SIG=		NET SIG=	
	.011905		.009457		.014330
	.036605		.028071		.039940
	.034775		.028071		.041000
	.020135		.017695		.029987
	.011635		.010395		.020740
	.000602		.000605		0.000000
CORR SIG=		CORR SIG=		CORR SIG=	
	.006459		.007726		.012582
	.019543		.023400		.036260
	.018397		.023152		.038720
	.010375		.014436		.028428
	.005820		.008873		.020114
	.000001		.000004		0.000000
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	7.679686		9.185911		14.960390
	15.830217		18.954231		29.370746
	13.650645		17.179140		28.730491
	6.276797		8.733941		17.198707
	3.827744		5.835837		13.228958
	.022906		.085643		0.000000
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	.385343		.963122		1.174943
	1.199487		1.277706		1.467915
	1.135153		1.235001		1.458343
	.797738		.941210		1.235496
	.582943		.706193		1.111526
	.340045		.667303		.0000

Sta. 47, Dn/w

DEPTH-	32.0	DI	23.5	DEPTH-	24.0
RD=	.000291	RD=	.002230	RD=	.000294
E00=	.002230	E00=	.002230	E00=	.002230
E01=	.003600	E01=	.003150	E01=	.002270
E02=	.003980	E02=	.002820	E02=	.002110
RAW SIG =	.025920 .069830 .074100 .057020 .041170 .000292	RAW SIG =	.028360 .068600 .071040 .055200 .040000 .000292	RAW SIG =	.026540 .062520 .064340 .053370 .041180 .000294
NET SIG=	.02562 .06953 .07380 .05672 .04037 .000001	NET SIG=	.02613 .06637 .06881 .05337 .03777 -.001938	NET SIG=	.026246 .062236 .064046 .053076 .040886 0.000000
CORR SIG=	.016115 .044376 .047791 .037362 .027233 .000001	CORR SIG=	.016221 .045578 .046524 .035252 .024736 -.001364	CORR SIG=	.025524 .059897 .061015 .050039 .038141 0.000000
MICRO-WATTS CM-2	9.161183 35.944520 35.460889 22.543611 17.911405 .012557	MICRO-WATTS CM-2	21.665075 36.918151 34.520663 21.327636 16.268802 -27.492005	MICRO-WATTS CM-2	30.347603 48.516750 45.273090 30.273336 25.685559 0.000000
LOG MICRO-WATTS	1.282422 1.555633 1.549750 1.353623 1.253108	LOG MICRO-WATTS	1.335760 1.567240 1.538079 1.328943 1.211356 00	LOG MICRO-WATTS	1.482124 1.685892 1.655840 1.481060 1.399424 30

Sta. 47, Dn/w

DE: ...

RD= .000294
E00= .002230
E01= .001310
E02= .001760

RAW SIG =
.027750
.060100
.063.00
.057.30
.046650
.000296

NET SIG=
.027456
.059806
.062606
.056736
.044.36
.000002

CORR SIG=
.033693
.073101
.076463
.068797
.055995
.000002

MICRO-WATTS CM-2
40.061428
59.212210
56.735363
41.622029
36.821063
.049574

LOG MICRO-WATTS
1.602726
1.772411
1.753854
1.619323
1.566096
-1.604150

RD= .000294
E00= .002230
E01= .001750
E02= .001780

RAW SIG =
.933850
.071040
.075930
.072280
.064340
.000296

NET SIG=
.033556
.070746
.075636
.071986
.064046
.000002

CORR SIG=
.042865
.090593
.097091
.092630
.082613
.000003

MICRO-WATTS CM-2
50.966193
73.380016
72.041295
58.041281
54.334730
.051417

LOG MICRO-WATTS
1.707282
1.865579
1.857582
1.748508
1.735078
1.735078

RD= .000294
E00= .002230
E01= .001630
E02= .001700

RAW SIG =
.041770
.083900
.090600
.091830
.086340
.000295

NET SIG=
.341476
.063606
.090307
.061511
.086011
.000001

CORR SIG=
.057092
.115786
.125824
.128306
.121334
.000001

MICRO-WATTS CM-2
67.882038
93.786716
93.361131
77.625397
79.801378
.027676

LOG MICRO-WATTS
1.831755
1.972141
1.970166
1.890004
1.902010
1.902010

Sta. 47, Dn/W

DEPT	8.0	DLF	1.0
RD=		RD=	
E00=	.000294	E00=	.000297
E01=	.002230	E01=	.002230
E02=	.001560	E02=	.002160
	.001490		.002280
RAW SIG =		RAW SIG =	
	.052760		.146700
	.099150		.249300
	.105200		.276200
	.113800		.331700
	.113800		.362200
	.000297		.007020
NET SIG=		NET SIG=	
	.052760		.146700
	.099150		.249300
	.105200		.276200
	.113800		.331700
	.113800		.362200
	.000003		.007020
CORR SIG=		CORR SIG=	
	.074518		.152348
	.139500		.261157
	.147075		.291633
	.158091		.353015
	.157050		.388473
	.000004		.007069
MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	88.602173		181.142158
	112.994889		211.537282
	109.129663		216.391753
	95.644944		213.574349
	103.291574		255.498564
	.085972		142.433607
LOG MICRO-WATTS		LOG MICRO-WATTS	
	1.947444		2.258020
	2.053059		2.325387
	2.037943		2.335241
	1.980662		2.329549
	2.014065		2.407388
	.065641		.53612

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ACZCS 80-0

SIG NO.=

47

UP. H

DEPTH=

1.0

DEPTH=

90.0

DEPTH=

44.0

PD=

.000285

PD=

.000285

PD=

.000285

E00=

.0002230

E00=

.0002230

E00=

.0002230

E01=

.0005130

E01=

.0004690

E01=

.0003020

E02=

.0005370

E02=

.0004430

E02=

.0002740

RAW SIG =

.0004570
.010790
.011300
.010000
.000840
.002850

RAW SIG =

.000287
.000287
.000288
.000287
.000287
.000288

RAW SIG =

.000288
.000904
.000288
.000289
.000289
.000289

NET SIG=

.0004285
.010415
.011015
.000715
.000555
.002555

NET SIG=

.000000
.000000
.000000
.000000
.000000
.000000

NET SIG=

.000000
.0000
.0000
.0000
.0000
.0000

CORR SIG=

.0001875
.0004588
.0004884
.0004336
.0003843
.0001116

CORR SIG=

.000000
.000000
.000000
.000000
.000000
.000000

CORR SIG=

.000000
.000445
.000000
.000000
.000000
.000000

MICRO-WATTS CM-2

.060923
.136352
.127138
.101898
.106227
.781301

MICRO-WATTS CM-2

.000031
.000026
.000036
.000022
.000025
.000999

MICRO-WATTS CM-2

.000071
.012254
.000055
.000066
.000076
.002069

LOG MICRO-WATTS

-1.215216
-.898417
-.895724
-.991833
-.973765
-.07182

LOG MICRO-WATTS

-4.513545
-4.588815
-4.440726
-4.664765
-4.597865
-.00401

LOG MICRO-WATTS

-4.148628
-1.911719
-4.256734
-4.182339
-4.117893
-.64296

Sta. 47, Up/w

1.0	20.0	30.3
RD=	RD=	RD=
.000291	.000291	.000291
E00=	E00=	E00=
.002230	.002230	.002230
E01=	E01=	E01=
.002390	.003190	.004030
E02=	E02=	E02=
.002400	.003300	.003790
RAW SIG =	RAW SIG =	RAW SIG =
.000290	.000292	.000907
.000910	.001522	.002140
.000290	.001523	.002140
.000290	.000906	.001520
.000290	.000907	.000907
.000290	.000292	.000292
NET SIG=	NET SIG=	NET SIG=
-.000001	.000001	.000001
.000019	.001231	.001231
-.000001	.001232	.001232
.000001	.000015	.001232
-.000001	.000016	.000061
.000001	.000001	.000060
CORR SIG=	CORR SIG=	CORR SIG=
-.000001	.000001	.000338
.000578	.000869	.001006
-.000001	.000874	.000997
-.000001	.000438	.000657
-.000001	.000441	.000326
-.000001	.000001	.000001
MICRO-WATTS CM-2	MICRO-WATTS CM-2	MICRO-WATTS CM-2
-.000030	.000023	.010980
.015925	.023933	.027697
-.000024	.022750	.025952
-.000022	.010302	.015437
-.000026	.012196	.009020
-.000654	.000490	.000388
LOG MICRO-WATTS	LOG MICRO-WATTS	LOG MICRO-WATTS
0.000000	-4.641600	-1.959384
-1.797919	-1.621002	-1.557560
0.000000	-1.643023	-1.585829
0.000000	-1.987060	-1.911432
0.000000	-1.913789	-2.044779
0.000000	-2.310130	-2.311686

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Sta. 47, Up/W

	24.5	24.0	23.0
RD=			
E00=	.000294	.000294	.000294
E01=	.002230	.002230	.002230
E02=	.002720	.002050	.001700
	.002470	.001920	.001820
RAW SIG =			
	.000908	.000909	.000910
	.001530	.001530	.001530
	.001530	.001530	.001530
	.000908	.000909	.001530
	.000908	.000295	.000911
	.000293	.000294	.000296
NET SIG=			
	.000614	.000615	.000616
	.001236	.001236	.001237
	.001236	.001236	.001237
	.000614	.000615	.000616
	.000614	.000001	.000001
	.000001	0.000000	.000000
CORR SIG=			
	.000497	.000663	.000774
	.000987	.001320	.001558
	.000973	.001308	.001563
	.000477	.000645	.001568
	.000470	.000001	.000785
	-.000001	0.000000	.000003
MICRO-WATTS CM-2			
	.016140	.021539	.025154
	.027174	.036357	.042919
	.025337	.034046	.040695
	.011208	.015151	.036857
	.012999	.000029	.021709
	-.000574	0.000000	.001755
LOG MICRO-WATTS			
	-1.792092	-1.666780	-1.599391
	-1.565851	-1.439416	-1.367350
	-1.596242	-1.467935	-1.390456
	-1.950482	-1.819552	-1.433482
	-1.886079	-4.542063	-1.663369
	-.000000	0.000000	-2.255727

Sta. 47, Up/w

.0	12.0	...
RD=	RD=	RD=
E00= .000294	E00= .000294	E00= .000294
E01= .002230	E01= .002230	E01= .002230
E02= .001770	E02= .001720	E02= .001450
E03= .001700	E03= .001640	E03= .001400
RAW SIG =	RAW SIG =	RAW SIG =
.000000	.000911	.000912
.001530	.002140	.002140
.001530	.002140	.002140
.000911	.001530	.001530
.000911	.000911	.001530
.000296	.000296	.000296
NET SIG=	NET SIG=	NET SIG=
-.000294	.000617	.000617
.001236	.001846	.001846
.001236	.001846	.001846
.000617	.001236	.001236
.000617	.000617	.001236
.000002	.000002	.000002
CORR SIG=	CORR SIG=	CORR SIG=
-.000368	.000795	.000946
.001540	.002362	.002811
.001531	.002346	.002797
.000760	.001560	.001863
.000755	.000773	.001854
.000003	.000003	.000003
MICRO-WATTS CM-2	MICRO-WATTS CM-2	MICRO-WATTS CM-2
-.011966	.025817	.030728
.042401	.065036	.077416
.039847	.061056	.072807
.017854	.036657	.043790
.020078	.021375	.051245
.001765	.001816	.002154
LOG MICRO-WATTS	LOG MICRO-WATTS	LOG MICRO-WATTS
0.000000	-1.588087	-1.512472
-1.372626	-1.186844	-1.111172
-1.399607	-1.214271	-1.137830
-1.740253	-1.435848	-1.358628
-1.680303	-1.670039	-1.290348
-2.753203	-2.400372	-2.446706

Sta. 47, Up/w

RD=
E00=
E01=
E02=

RAW SIG =
E00=
E01=
E02=

NET SIG=
E00=
E01=
E02=

CORR SIG=
E00=
E01=
E02=

MICRO-WATTS CM-2
E00=
E01=
E02=

LOG MICRO-WATTS
E00=
E01=
E02=

RD=
E00=
E01=
E02=

RAW SIG =
E00=
E01=
E02=

NET SIG=
E00=
E01=
E02=

CORR SIG=
E00=
E01=
E02=

MICRO-WATTS CM-2
E00=
E01=
E02=

LOG MICRO-WATTS
E00=
E01=
E02=

NOV 20 23-01

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RD=

DEPT= 0.0

RD= .000304
E00= .000304
E01= .005000
E02= .005100
E03= .004730

RAW SIG =
.659500
1.019000
1.206000
1.358000
1.472000
0.42400

RD= .659196
1.018696
1.205696
1.357696
1.471696
0.423696

CORR SIG=
.639566
.977999
1.145265
1.275838
1.367995
.937205

MICRO-WATTS CM-2
760.443793
792.179251
849.786765
771.881704
839.730619
749.689925

LOG MICRO-WATTS
2.881067
2.900323
2.929910
2.907551
2.924113
0.874882

DEPT 1.0

RD= .000304
E00= .005000
E01= .004980
E02= .005190

RAW SIG =
.428000
.678400
.873100
1.106000
1.101000
.022560

RD= .427696
.678096
.872796
1.105696
1.100696
.022196

CORR SIG=
.432003
.689030
.892154
1.136914
1.138436
.024375

MICRO-WATTS CM-2
513.651651
558.114399
661.978127
687.832713
748.749616
491.156868

LOG MICRO-WATTS
2.710669
2.746723
2.820844
2.837483
2.874337
2.691220

DEPT= 24.0

RD= .000290
E00= .005000
E01= .008440
E02= .008910

RAW SIG =
.270100
.567900
.594700
.480000
.365800
.000289

RD= .269910
.567610
.59441
.47971
.36551
-.000360

CORR SIG=
.161113
.341617
.360551
.293241
.225156
-.000091

MICRO-WATTS CM-2
191.563234
276.710042
267.528954
177.410602
148.085080
-.012256

LOG MICRO-WATTS
2.282312
2.442025
2.427371
2.248980
2.170511
0.00

Sta. 51, Dn/W

DEP=	21.0	DEP	18.0	DEP=	15.5
RD=		RD=		RD=	
E00=	.000290	E00=	.000290	E00=	.000289
E01=	.005000	E01=	.005000	E01=	.005000
E02=	.008190	E02=	.006870	E02=	.008560
	.005730		.007390		.008760
RAW SIG =		RAW SIG =		RAW SIG =	
	.415500		.348100		.549600
	.846200		.626900		.905300
	.054100		.655800		1.008500
	.486700		.572700		.849300
	.283500		.493900		.749700
	.000289		.000280		.000289
	.415610		.347110		.549310
	.845510		.626710		.905010
	.053010		.655510		1.008210
	.486410		.572410		.849010
	.283210		.493610		.749410
	-.000001		-.000002		0.000000
CORR SIG=		CORR SIG=		CORR SIG=	
	.242832		.255377		.321931
	.472065		.473356		.549801
	.454085		.462573		.594811
	.245934		.434638		.502545
	.135768		.382529		.445053
	-.000001		-.000002		0.000000
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
288.727063		304.237453		382.776267	
382.372567		393.418375		445.338649	
336.930732		365.489256		441.349864	
148.790158		262.956060		304.039921	
89.294331		251.589136		292.711216	
-.010504		-.030601		0.000000	
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
2.460487		2.483213		2.582945	
2.582487		2.583673		2.648690	
2.527541		2.562875		2.644783	
2.172574		2.419883		2.482931	
1.950824		2.400692		2.466439	
.000000		.000000		.000000	

Sta. 51, Dn/W

1.0

RD=
E00=
E01=
E02=

RAW SIG =
1.008000
1.605000
1.680000
1.541000
1.970000
.05640

NET SIG=
1.008000
1.605000
1.680000
1.541000
1.970000
.05640

CORR SIG=
.440092
.697816
.727288
.664221
.845485
.023478

MICRO-WATTS CM-2
523.269625
565.230833
539.647676
401.853753
556.075208
473.081211

LOG MICRO-WATTS
2.718726
2.752226
2.732110
2.604068
2.745134
2.674936

1.0

RD=
E00=
E01=
E02=

RAW SIG =
.528500
1.406000
1.514000
1.777000
1.952000
.019800

NET SIG=
.828208
1.405708
1.513708
1.776708
1.951708
.019508

CORR SIG=
.461333
.789397
.856917
1.013868
1.122591
.011878

MICRO-WATTS CM-2
548.525136
639.411409
635.832707
613.390386
738.328123
239.345429

LOG MICRO-WATTS
2.739197
2.805780
2.803343
2.767737
2.868249
2.379023

Sta. 51, Dn/W

DEFI	12.6				
RD=	0.00289	RD=	.000289	RD=	.000292
	005000	E00=	.005000	E00=	.05000
	008570	E01=	.008240	E01=	.009210
RD=	010440	E02=	.009260	E02=	.009460
RAW SIG	530600	RAW SIG =	.382500	RAW SIG =	.714400
	843200		.896900		1.201000
	908300		1.017000		1.292000
	000500		1.063400		1.42800
	0.7000		1.141500		1.48800
	000131		.000900		.003960
NET SIG	.530611	NET SIG=	.382211	NET SIG=	.714108
	.843511		.896611		1.200700
	.908301		1.016711		1.29170
	1.008211		1.063111		1.42770
	966711		1.141311		1.48770
	000062		.000117		.00390
CORE SIG	319054	CORE SIG=	.359537	CORE SIG=	.309106
	.522842		.563321		.656311
	.598493		.649698		.709419
	.661638		.690768		.787120
	.652003		.753772		.823334
	.000001		.000424		.002068
MICRO-WATTS CM-2	379.355037	MICRO-WATTS CM-2	427.489498	MICRO-WATTS CM-2	462.741706
	423.503028		456.290321		532.097644
	441.121964		482.076138		526.388930
	406.191144		417.914562		476.207736
	426.822158		495.755935		541.506980
	.028685		8.536807		41.679988
LOG MICRO-WATTS	2.579046	LOG MICRO-WATTS	2.630925	LOG MICRO-WATTS	2.665339
	2.626855		2.659241		2.725991
	2.647463		2.683116		2.721307
	2.602376		2.621088		2.677796
	2.632277		2.695268		2.733604
	2.62348		9.1295		9.128

NOA 1-01

SEP 20

51

11 0

DEPTH-

1.0

1.0

24.0

DEPTH

21.0

RD=

.000290

RD=

.000290

RD=

.000290

E00=

.005000

E00=

.005000

E00=

.005000

E01=

.010360

E01=

.009450

E01=

.005210

E02=

.010450

E02=

.009410

E02=

.005990

PAU SIG =

.011280

PAU SIG =

.003350

PAU SIG =

.002130

.026540

.013720

.009460

.030180

.014930

.010050

.021150

.009460

.007020

.016160

.006400

.004590

.000294

.000290

.000289

NET SIG=

.011280

NET SIG=

.000060

NET SIG=

.001140

.026540

.013430

.009110

.030180

.014640

.009760

.021150

.009170

.006700

.016160

.006110

.004140

.000294

0.000000

-.000001

CORR SIG=

.005211

CORR SIG=

.001618

CORR SIG=

.001904

.012700

.007037

.009177

.014479

.007732

.009968

.010651

.004840

.007012

.007707

.003223

.004558

.000002

0.000000

-.000001

MICRO-WATTS CM-2

.172543

MICRO-WATTS CM-2

.052571

MICRO-WATTS CM-2

.058600

.349769

.195457

.252740

.376900

.201263

.259472

.250301

.113742

.164778

.213017

.009084

.125977

.061352

0.000000

-.000673

LOG MICRO-WATTS

-.703163

LOG MICRO-WATTS

-1.279254

LOG MICRO-WATTS

-1.232101

-.456219

-.708948

-.597326

-.423774

-.696236

-.511010

-.601537

-.944077

-.311011

-.715556

-1.050199

-.944077

-.003901

0.000000

-.000000

Sta. 51, Up/w

DEP	18.0	DEPT	15.5	DEPT	12.0
RD=		RD=		RD=	
E00=	.000289	E00=	.000289	E00=	.000289
E01=	.005000	E01=	.005000	E01=	.005000
E02=	.007570	E02=	.007600	E02=	.008020
	.009150		.007970		.008960
RAW SIG =		RAW SIG =		RAW SIG =	
	.003340		.003960		.005790
	.011900		.011890		.017370
	.014930		.011890		.018000
	.010660		.010050		.012500
	.007610		.008220		.008840
	.000289		.000288		.000290
NET SIG=		NET SIG=		NET SIG=	
	.003051		.003051		.005500
	.011611		.011601		.017000
	.014841		.011601		.017700
	.010301		.009000		.012000
	.007301		.007000		.008300
	0.000000		-.000000		.000001
CORR SIG=		CORR SIG=		CORR SIG=	
	.002375		.002432		.003126
	.008127		.007739		.009727
	.010536		.007792		.010109
	.007668		.006601		.006985
	.005557		.005399		.004903
	0.000000		-.000001		.000001
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	.067428		.079014		.101549
	.223914		.213118		.267983
	.274260		.202816		.263127
	.180195		.155113		.164152
	.153600		.149239		.135506
	0.000000		-.000461		.000397
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	-1.171161		-1.102296		-.993323
	-.650112		-.671379		-.572054
	-.561838		-.692897		-.579034
	-.744257		-.009353		-.784754
	-.813609		-.826117		-.868042
	-.000000		.000000		.1068

Sta. 51, Up/w

9.0	6.0	3.0
RD=	RD=	RD=
.000292	.000292	.000292
E00=	E00=	E00=
.005000	.005000	.005000
E01=	E01=	E01=
.007630	.009260	.009760
E02=	E02=	E02=
.008290	.008800	.010540
RAW SIG =	RAW SIG =	RAW SIG =
.005170	.007610	.009460
.014930	.013250	.024700
.016160	.022900	.026530
.012500	.018000	.021660
.009460	.013720	.018080
.000292	.000393	.000292
NET SIG=	NET SIG=	NET SIG=
.00487	.007318	.009460
.01463	.021958	.024700
.01586	.022608	.026530
.01230	.017708	.021660
.00916	.013438	.018080
.00000	.000001	0.000000
CORR SIG=	CORR SIG=	CORR SIG=
.003231	.005923	.004750
.009830	.011688	.013790
.010784	.011947	.013902
.008396	.009290	.011447
.006379	.006993	.009590
.000001	.000001	0.000000
MICRO-WATTS CM-2	MICRO-WATTS CM-2	MICRO-WATTS CM-2
.105142	.127469	.154340
.270710	.321885	.352234
.280715	.310985	.361981
.197302	.218312	.269008
.176328	.193227	.265070
.000459	.000378	0.000000
LOG MICRO-WATTS	LOG MICRO-WATTS	LOG MICRO-WATTS
-.373224	-.894595	-.811530
-.517496	-.492299	-.453169
-.51734	-.507260	-.491425
-.51869	-.560933	-.570236
-.51869	-.560933	-.570236
59		

Sta. 51, Up/w

RD=
 EP0= .003299
 EC1= .005000
 E12= .011500
 .003750

CFM STD =
 .003299
 .005000
 .011500
 .003750

G=
 .003299
 .005000
 .011500
 .003750
 0.000000

CORR STD=
 .005138
 .012687
 .013138
 .010653
 .008508
 0.000000

MICRO-WATTS CM-2
 .168560
 .349402
 .341984
 .250346
 .235167
 0.000000

LOG MICRO-WATTS
 .271244
 .543775
 .533775
 .398775
 .371244
 .000000

000

0-01

55

DEPT

DEPT

0.0

RD=

.000315

E00=

.0003590

E01=

.004060

E02=

.010710

RAW SIG

.583300

1.022000

1.044000

3.344000

3.543000

.107100

NET SIG=

.682985

1.021685

1.943685

3.343685

3.542685

.106785

CORR SIG=

.745373

1.326613

2.926344

5.726644

6.801190

.611553

MICRO-WATTS CM-2

336.248414

1074.556127

2171.347351

3464.619717

4473.142785

1.232279444E 04

LOG MICRO-WATTS

2.947555

1.031229

3.036729

3.539656

.50613

2.569

DEPT

1.5

RD=

.000315

E00=

.0003590

E01=

.0003590

E02=

.004910

RAW SIG =

.599000

8413.000000

.909700

1.078000

1.137000

.026600

NET SIG=

.598685

8412.999685

.909385

1.077685

1.136685

.026285

CORR SIG=

.630163

9297.700421

1.052830

1.304341

1.435516

.036700

MICRO-WATTS CM-2

749.264390

7.531137341E 06

781.199651

789.126346

944.138876

739.514678

LOG MICRO-WATTS

2.874635

6.876861

2.892762

2.897147

2.975036

.68947

DEPT

48.0

RD=

.000302

E00=

.0003590

E01=

.010500

E02=

.006250

RAW SIG =

.005130

.028400

.024100

.019200

.010700

.000303

NET SIG=

.004878

.028098

.023798

.018898

.010398

.000001

CORR SIG=

.001571

.008495

.006724

.004965

.002526

.000000

MICRO-WATTS CM-2

1.868243

6.880734

4.989044

3.004047

1.661518

.006837

LOG MICRO-WATTS

.271435

.837635

.698017

.477707

.220505

.5155

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Sta. 55, Dn/W

DEP	24.0	DEPTH=	21.0	DEPTH=	19.0
PI=		RI=		RI=	
E00=	.000302	E00=	.000302	E00=	.000300
E01=	.003590	E01=	.003590	E01=	.003590
E02=	.009950	E02=	.009460	E02=	.007390
E03=	.003220	E03=	.008270	E03=	.009030
RAW SIG =		RAW SIG =		RAW SIG =	
	.069000		.008200		.106500
	.196300		.264000		.313400
	.227900		.302400		.374400
	.151000		.279000		.342600
	.115600		.255400		.328600
	.000001		.000003		.000002
NET SIG=		NET SIG=		NET SIG=	
	.069490		.067890		.106200
	.195090		.253690		.313100
	.227590		.302090		.374100
	.150690		.277690		.342300
	.115290		.255690		.328300
	-.000001		.000001		.000002
CORR SIG=		CORR SIG=		CORR SIG=	
	.022671		.032757		.053220
	.057130		.096471		.161755
	.058503		.108457		.199037
	.033524		.097802		.187395
	.021661		.088101		.184792
	-.000000		.000000		.000001
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	26.956349		38.947608		63.288449
	46.275157		78.141668		131.021678
	43.408949		80.475228		147.685132
	20.281904		59.169947		112.373808
	14.246471		57.943850		121.537403
	-.006536		.007380		.021065
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	1.430661		1.590481		1.801324
	1.565348		1.892883		2.117343
	1.637579		1.905662		2.169327
	1.307109		1.772101		2.054513
	-.53707		1.763007		2.084710
	.00000		-.001964		-1.676447

Sta. 55, Dn/w

DEPTH=	13.0	DEPTH=	12.0	DEPTH=	9.0
RT=	.000300	RT=	.000300	RT=	.000300
E00=	.003590	E00=	.003590	E00=	.003590
E01=	.005620	E01=	.005730	E01=	.009750
E02=	.009980	E02=	.003860	E02=	.009450
RAW SIG =		RAW SIG =		RAW SIG =	
	.115000		.116200		.282900
	.201100		.199900		.586800
	.202300		.229200		.657600
	.183400		.243800		.752200
	.286500		.258500		.743600
	.000300		.000299		.000916
NET SIG=		NET SIG=		NET SIG=	
	.114700		.115900		.292600
	.200800		.199600		.586500
	.202000		.228900		.657300
	.183100		.2-3500		.751900
	.286200		.253200		.743300
	0.000000		-.000001		.000616
CURR SIG=		CURR SIG=		CURR SIG=	
	.081393		.069226		.103597
	.156729		.113383		.214052
	.171981		.123334		.238827
	.168865		.124081		.271981
	.284232		.124022		.267666
	0.000000		-.000001		.000222
MICRO-WATTS CM-2		MICRO-WATTS CM-2		MICRO-WATTS CM-2	
	96.781827		82.309336		123.176748
	126.950689		91.939891		173.382061
	127.609916		91.513535		177.209301
	142.163616		75.068720		164.548393
	145.939685		81.569076		176.043771
	0.000000		-.011621		4.464573
LOG MICRO-WATTS		LOG MICRO-WATTS		LOG MICRO-WATTS	
	1.985794		1.915449		2.090529
	2.103635		1.963031		2.239004
	2.105884		1.961485		2.248487
	2.009296		1.875459		2.216294
	2.271702		1.911526		2.245621
	2.000000		0.000000		649790

Sta.55, Dn/W

DEPTH= 6.0

RD= .000300
E00= .003590
E01= .008330
E02= .011370

RAW SIG =
.392700
.621500
.506800
.605700
.65820
.00215

NET SIG=
.392400
.621200
.506500
.605400
.657900
.001850

CORR SIG=
.177939
.295663
.292339
.315376
.357522
.000973

MICRO-WATTS CM-2
211.569639
239.487198
216.915318
190.802211
235.142076
19.615074

LOG MICRO-WATTS
2.325453
2.379282
2.336290
2.280583
2.371330
-70

DEPTH= 3.0

RD= .000300
E00= .003590
E01= .009580
E02= .008810

RAW SIG =
.605700
1.135000
1.237900
1.442000
1.674200
.014350

NET SIG=
.605400
1.134700
1.236700
1.441700
1.673700
.014050

CORR SIG=
.224259
.415442
.447460
.515423
.591156
.004655

MICRO-WATTS CM-2
266.644504
336.507800
332.015176
311.830780
388.803518
93.797794

LOG MICRO-WATTS
2.425933
2.526995
2.521158
2.493919
2.589730
-70

DEPTH= 1.0

RD= .003010
E00= .003590
E01= .003610
E02= .007910

RAW SIG =
.570300
1.049000
1.172000
1.517000
1.657000
.029570

NET SIG=
.567290
1.045900
1.168900
1.513900
1.653900
.026560

CORR SIG=
.233786
.425992
.470418
.601912
.649554
.009711

MICRO-WATTS CM-2
277.971061
345.053443
349.050442
364.156884
427.211510
195.681661
246

LOG MICRO-WATTS
2.444000
2.537886
2.542888
2.561289
2.630643
2.291550

WIND 200 20 00

WIND 200 20 00

25

WIND 200 20 00

DEPTH

1.5

24.0

24.0

RD=

.000304

RD=

.000304

RD=

.000303

ED0=

.003590

ED0=

.003590

ED0=

.003590

ED1=

.009890

ED1=

.010490

ED1=

.009630

ED2=

.009900

ED2=

.009640

ED2=

.008390

RAW SIG =

.007030

.019230

.021670

.022880

.022880

.000303

RAW SIG =

.000303

.003360

.003360

.002740

.001540

.000303

RAW SIG =

.000918

.003360

.003970

.002740

.002740

.000304

NET SIG=

.000726

.018926

.021006

.022576

.022576

.000002

NET SIG=

-.000001

.003056

.003056

.002436

.001236

-.000001

NET SIG=

.000615

.003056

.003661

.002436

.002436

.000001

CORR SIG=

.002442

.006872

.007759

.008200

.008201

.000001

CORR SIG=

-.000000

.001022

.001010

.000795

.000398

-.000000

CORR SIG=

.000225

.001098

.001292

.000342

.000825

.000000

MICRO-WATTS CM-2

.079335

.189255

.201009

.192692

.226672

.000508

MICRO-WATTS CM-2

-.000011

.028135

.026277

.018683

.011014

-.000240

MICRO-WATTS CM-2

.007312

.030230

.033618

.019777

.022799

.000261

LOG MICRO-WATTS

-1.100532

-.722953

-.694716

-.715136

.44603

.93716

LOG MICRO-WATTS

0.000000

-1.550747

-1.580419

-1.728546

.58044

100000

LOG MICRO-WATTS

-2.135978

-1.519568

-1.473425

-1.703835

.42084

.03322

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Sta. 55, Up/W

DEPTH= 18.0

RD= .000303
E00= .003590
E01= .009220
E02= .009155

RAW SIG =
.000917
.004590
.005180
.004590
.003970
.000301

NET SIG=
.000614
.004287
.004877
.004287
.003667
-.000002

CORR SIG=
.000239
.001666
.001893
.001663
.001421
-.000001

MICRO-WATTS CM-2
.007760
.045878
.049280
.039069
.039266
-.000545

LOG MICRO-WATTS
-2.110156
-1.338396
-1.307325
-1.408170
-1.405982
100000

DEPTH= 18.0

RD= .000300
E00= .003590
E01= .010500
E02= .009820

RAW SIG =
.001530
.005800
.007030
.006410
.005180
.000303

NET SIG=
.001130
.005500
.006730
.006110
.004880
.000003

CORR SIG=
.000417
.001846
.002237
.002012
.001591
.000001

MICRO-WATTS CM-2
.013537
.050829
.058231
.047274
.043982
.000718

LOG MICRO-WATTS
-1.868481
-1.293888
-1.234842
-1.325379
-1.356727
3799

DEPTH= 18.0

RD= .000300
E00= .003590
E01= .002990
E02= .003940

RAW SIG =
.000914
.002150
.002740
.002740
.002740
.000299

NET SIG=
.000614
.001850
.002440
.002440
.002440
-.000006

CORR SIG=
.000771
.002423
.003329
.003462
.003595
-.000001

MICRO-WATTS CM-2
.025040
.066732
.086653
.081358
.099370
-.000842

LOG MICRO-WATTS
-1.601362
-1.175668
-1.062218
-1.089597
-1.002743
1000

Sta. 55, Up/w

DEPTH= 9.0

RD= .000300
E00= .003590
E01= .006440
E02= .004210

RAW SIG =
.001530
.006410
.004590
.003360
.003360
.000300

NET SIG=
.001230
.006110
.004290
.003060
.003060
0.000000

CORR SIG=
.000652
.003069
.002036
.001368
.001283
0.000000

MICRO-WATTS CM-2
.021174
.004513
.053003
.032147
.035475
0.000000

LOG MICRO-WATTS
-1.674192
-1.073078
-1.275701
-1.492865
-1.450075
10

DEPTH= 6.0

RD= .000301
E00= .003590
E01= .005990
E02= .004480

RAW SIG =
.002150
.006410
.014350
.006420
.005180
.000301

NET SIG=
.001849
.006109
.014049
.006119
.004879
0.000000

CORR SIG=
.001068
.003397
.007509
.003139
.002397
0.000000

MICRO-WATTS CM-2
.034706
.093563
.195471
.073755
.066256
0.000000

LOG MICRO-WATTS
-1.459591
-1.028896
-.708019
-1.132209
-1.170779
0

DEPTH= 3.0

RD= .000301
E00= .003590
E01= .006970
E02= .006200

RAW SIG =
.003360
.008240
.008240
.007030
.005800
.000301

NET SIG=
.003059
.007939
.007939
.006729
.005499
0.000000

CORR SIG=
.001551
.003960
.003895
.003247
.002609
0.000000

MICRO-WATTS CM-2
.050382
.109056
.101395
.076301
.072102
0.000000

LOG MICRO-WATTS
-1.297725
-.962352
-.993985
-1.117469
-1.140779
0

Sta. 55, Up/w

RD= .000301
E00= .003590
E01= .008425
E02= .006260

RAW SIG =
.004590
.011900
.013730
.014340
.016170
.000299

NET SIG=
.004280
.011590
.013420
.014030
.015860
-.000002

JRR SIG=
.001760
.004579
.005091
.005103
.005520
-.000001

MICRO-WATTS CM-2
.057197
.126112
.132530
.119918
.152561
-.000595

LOG MICRO-WATTS
-1.242629
-.899243
-.877685
-.921117
-.816557
0.000000

APPENDIX D

LOG SHEETS

- (a) Daily Log**
- (b) Data Printout Supplement**

OCEANOGRAPHIC RESEARCH LOG
FORM NO. 1 (REV. 6-73)

Flyover Time = 11:43 EST

15 Feb. 80 Friday All Day		0630 ~ 1630	
21.5°C	1107 EST		
1107 EST	20.1°C, Bkt.		
SWELL HEIGHT DATA, METEOROLOGICAL DATA			
TIME 1107 EST	MAXIMUM HEIGHT (Meters)	AVERAGE HEIGHT (Meters) 0.7	PERIOD (Sec)
VISIBILITY (mi) 4	WEATHER 100% overcast	WIND SPEED (Knot) 4	WIND DIRECTION (Deg) 090°
SEA STATE 4	WINDS ☐ MANY ☐ NONE	SECCHI (Meters) 22	PRESSURE (mb) 1017.3 @ 1107 EST

Time	Water Temp.	Sta.	EQUIPMENT CHECKED	Lat. Long.	Sea State	Time
GMT 0157	ARRAY-BUOY 17.5°C	44		26°14'N; 82°30'W	0-1	0900
0715	ANEMOMETER 20.2	45		26°05'N; 83°20'W	0-1	1000
1403	TIDE-GAUGE 20.2	46		26°44'N; 84°13'W	0-1	1500
1607	WAVE-HEIGHT 20.1	47		26°46'N; 84°07'W	OTHER	
	CABLES				OTHER	

PERSONNEL ON BOARD

- Computed Satellite Flyover time + discussed scheduling @ Marak + Bill
- Brennan, later @ Chr. Fleming.
 - Started Deck Cell monitoring; 100% overcast + not encouraging.
 - Took H(X) data from ~1100hrs → 1230 hrs. EST; Hydrocast taken after H(X) this station (#47).

STUDIES IN PROGRESS

- Determined relation between Secchi reading/depth + $Z_u(0.1)$.
- Terminated Deck Cell @ 1520 hrs.

EQUIPMENT CHANGES REMARKS

(a) Daily log.

DATA SHEET
1:ND NOSC 5220 1 (4-77)

NOAA CZCS Water Irradiance Measurements

DATE

2/15/80 Friday

Station: 47

Lat. 26°46'N, Long. 84°07'W

@ 1107 hrs. EST

Data Period = 10 Sec.

Flyover Time = 1143 hrs. EST

T_{air} = 21.5°C, Secchi = 22 m

Wind: 4 kn @ 090°

Z_u ≈ 88 m

Z_{bot.} = 121 m

Time (hrs.)	T (°C)	Depth (m)	P (°)	R (°)	H.V. (kV)	Filter Set		TEST	Bkg.	Comments
						DN/W	Up/W			
t. 1054	24	—	✓	✓	1.05	—	—	430,078	363	Turn On
1111	29	—	—	—	1.06	—	—	421,377	606	
1115	30	—	—	—	1.05	—	—			
1116		Air ✓						Air Reference ✓		
					.19	.131	.135	.142	.147	.012
1118		+ 1			F1 .34	F2 .55	F3 .615	F4 .73	F5 .811	F6 .016
1125	27									105 kv
1130		26				.123	.131	.103		
1136		52				.03	.029	.017		
1138		72				.014	.014	.005		
		93				.003	.0027	TEST	Bkg.	← Record/Printer
1143	29	90	✓	✓	1.05					
		44				✓	✓			
1158		40				✓	✓			
1200	29	36	1	0	1.05	✓	✓			
1204		32				✓	✓			
1213		28.5				✓	✓			
1218	29	24			1.05	✓	✓			
	29	20			1.05	✓	✓			
1230		16				✓	✓			
1235		12				✓	✓			
1238		8				✓	✓			
1244	28	4			1.05	✓	✓			
1248		1				✓	✓			
1254						Off + Out				

OBSERVERS

SHEET

OF

SHEETS

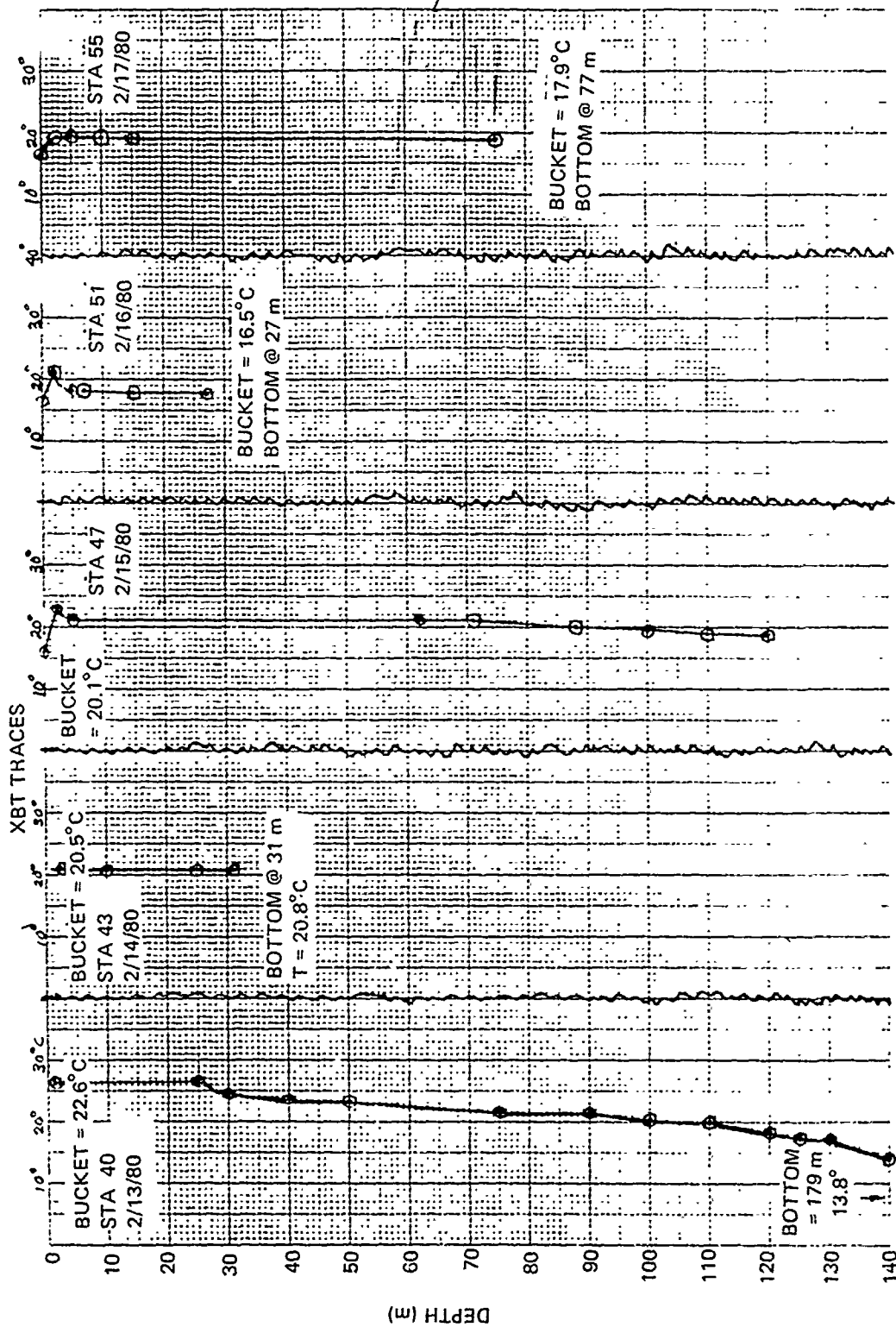
(b) Data printout supplement.

APPENDIX E

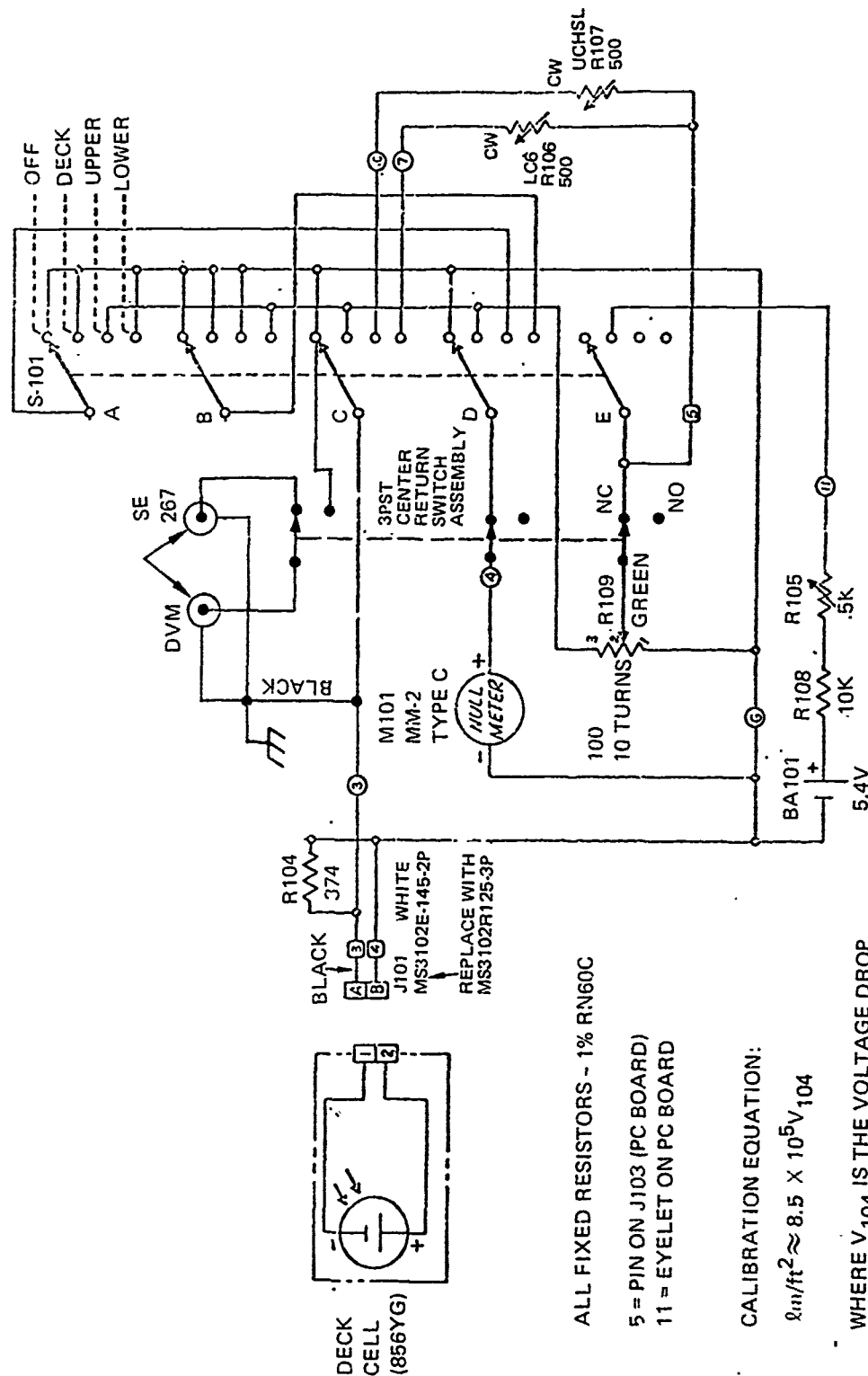
XBT TRACE COPIES

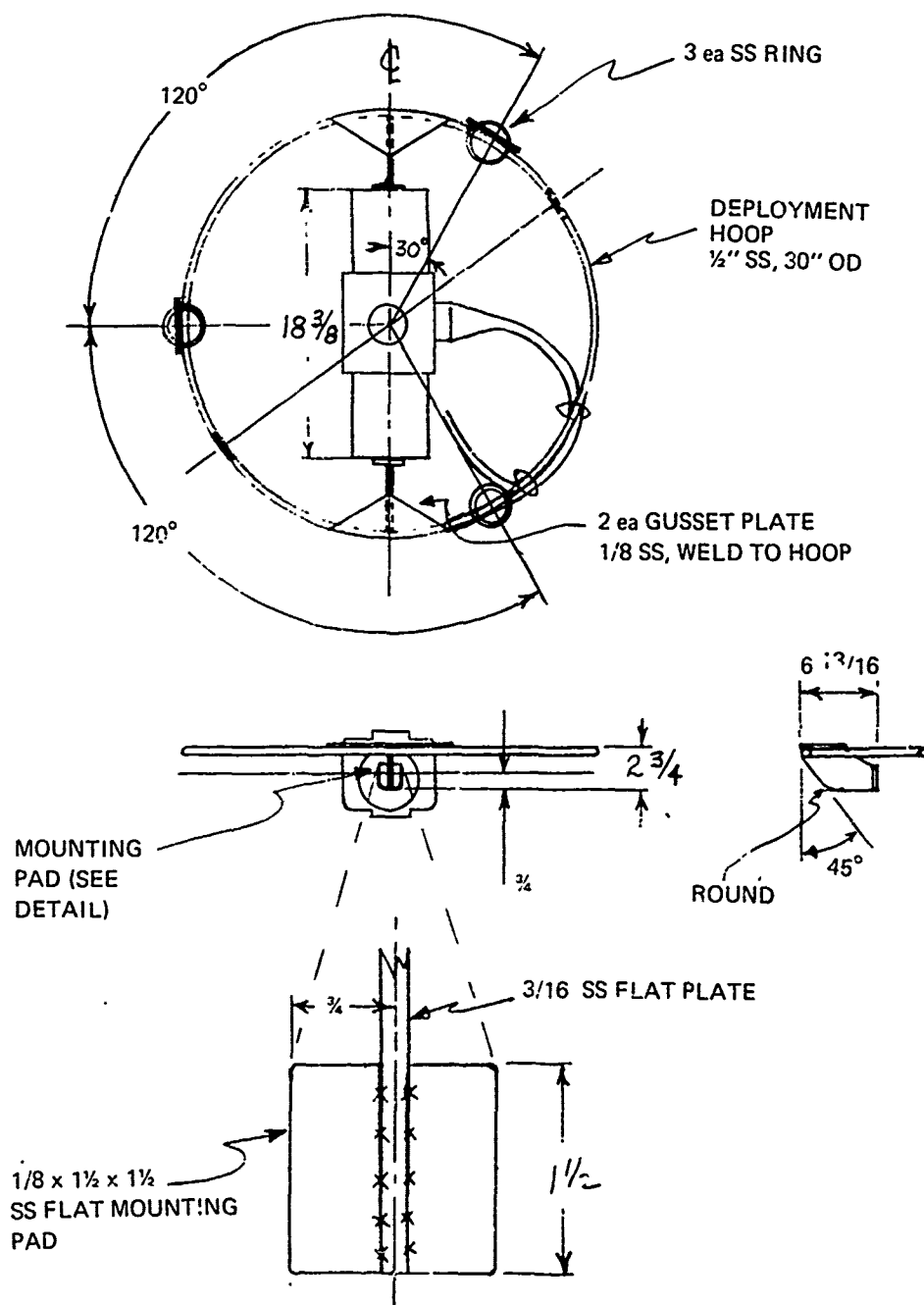
K-Σ 10 X 10 TO 1/4 INCH / 5 X 10 MM MIN
NEUPHEL & ISSIN CO. 4610-0-511

46 1322



APPENDIX F
EQUIPMENT ITEMS





Underwater unit deployment hoop.