With the expansion of testing conducted under project BIFI, it is clear that a high degree of automation is required in the data acquisition and reduction. When a Hewlett-Packard digital scanning system became available for use in October 1968 it became possible to automate to a high degree the daily propagation tests conducted over the BIFI range (described in reference a). This memorandum deals with the BIFI data acquisition system located in Building 36, which is used in this testing and the two FORTRAN V programs, S1298 and S1357, which are used to reduce the data.

DATA ACQUISITION SYSTEM

The daily propagation tests are conducted over the BIFI range, shown in Figure 1. The range has a length of approximately 19 nautical miles and has a depth of about 120 feet through most of its extent. At Block Island, a projector tuned at 1702 Hz is bottom mounted at a 55 foot depth at point S. The receiving hydrophone is bottom mounted near Fishers Island in 155 feet of water at point H. The receiving station at Fishers Island is connected by means of data transmission lines to the Data Acquisition and Reduction Center in Building 36 at the...
laboratory, where the signals are recorded and analyzed. A reference signal corresponding to the signal transmitted at Block Island is received at the Laboratory from the Block Island station by means of the Block Island telephone data line. Several frequency sensitive reed relays are connected in the receiving circuits at Fishers Island and these permit remote control and calibration of the receiving system from the Laboratory via the data transmission lines.

The receiving system in Building 36 is shown in Figure 2. The signal from the receiving hydrophone is received via the Fishers Island telephone data line, the CW signal is passed through either a 2 Hz or 0.1 Hz bandwidth filter prior to digitizing. The 2 Hz bandwidth filter is used in the winter, spring, and fall when the signal to noise ratio of the received signal is large and there is a large amount of frequency smear in the signal. The 0.1 Hz bandwidth filter will be used in the summer months when the signal to noise ratio of the received signal is smaller than in other seasons and due to a lack of dependence of the received signal upon the sea surface, thus, there is very little frequency smear. The envelope of the filtered signal is then sampled by the Hewlett-Packard scanner and digital voltmeter system and the digital value punched in IBM cards at a rate of approximately 3.5 samples per second. The entire receiving system has a dynamic range of better than 50 db. Over a range greater than 40 db the system is linear to at least .2 db per 10 db step. The system noise is low enough to permit measurement of signals of as low as -60 db relative to a 1 Dyne per square cm.

During the daily propagation tests, pulses 45 seconds long are transmitted from Block Island. During each one minute interval the signal is on for about 45 seconds and off for approximately 15 seconds. The recording sequence during the tests is shown in Figure 3. First the Block Island reference signal is recorded on IBM cards, prior to the first signal sequence being received at Fishers Island, for more than one minute or one cycle. Then the received signal at Fishers Island is recorded for 15 minutes on cards. Finally, a calibration of the system is performed. The calibration level is changed in equal increments and a same number of values are recorded at each level. The format of the data on the cards is four digits representing an integer followed by one digit which represents a negative exponent of the number 10 by which the first number is to be multiplied. Next the data is reduced by means of a USL FORTRAN V Program, S1298 on the UNIVAC 1108 computer.
USL Program S1298

USL Program S1298, written in FORTRAN V language, is designed to determine propagation loss and variance of signals received during the daily propagation runs. The data obtained is arranged as follows:

1. One input data card.

2. Calibration cards with higher calibration levels preceding lower levels.

3. The signal data cards in the order in which the data is taken, as described previously.

The format of the input data card and the quantities inputted are shown in Table 1. As seen in Figure 3 the first data recorded consists of the Block Island reference signal. This signal is used in program S1298 for two purposes. First, since a complete signal cycle is one minute in length from point A to B, we can compute the sampling rate per minute as the number of samples in the period, EMIN. The reference signal is also used to establish the time at which the signal is first transmitted from Block Island (point B). From the known propagation time (input parameter PROT which is 24 seconds for the present BIFI range) and the time after the beginning of the received pulse at which analysis is to commence (input parameter ENC which is 5 seconds for present analysis) the program determines point C and the signal is analyzed from point C to point D (DUR seconds long which is 30 seconds for the daily propagation runs). The ambient noise is analyzed commencing at point E. The distance from point B to point E is the input parameter RAME (74 seconds in the present analysis). The analysis of ambient is conducted from point E to F (DURA seconds long which is 5 seconds in the present case). Analysis of succeeding pulses is accomplished by incrementing points C and E by one minute (EMIN). The number of pulses to be analyzed is given by INUM.

For each pulse analyzed, calculations are performed to measure the maximum, minimum and average values of voltages over the pulse, and the variance of the log of the voltage over the pulse. Also calculated is the average value of the voltage representing the background noise.

A number of calibration levels (input parameter NCAL is the number of levels) are analyzed. Each level has CAL measured values and the total number of calibration values analyzed equals ICAL. The calibration
equivalent level in db relative to 1 DYNE per square cm of the highest calibration level is given by $E_{quv}$ and each level is decreased by $E_{cdp}$ db in each of the other calibration levels. The calibration equivalent loss of the highest calibration level is given by $E_{quv}$,

$$E_{quv} = N_S - E_{qu}$$

where $N_S$ is the source level and $E_{qu}$ is the calibration equivalent level, both in db relative to 1 DYNE per square cm. Each loss level is incremented by $E_{cdp}$ db in each of the other calibration levels. For each calibration level an average voltage level is calculated and an array $S_I(g_j)$ is set up such that

$$S_I(g_j) = 20 \log (V)$$

where $V$ is an average voltage and $g_j = (1..N_{cal})$ where $S_I(1)$ is the highest calibration and each succeeding value at the array represents a level with a calibration equivalent level of

$$E_{qu} = (g_j-1) * E_{cdp}$$

or a calibration equivalent loss of

$$E_{quv} + (g_j-1) * E_{cdp}$$

Having calculated the calibration levels and the maximum, minimum, and average of each pulse received level it is possible to calculate the propagation loss associated with the later three quantities. For a given level of one of these quantities propagation loss is calculated by either interpolating between or extrapolating beyond calibration levels associated with distinct calibration levels equivalent losses. Let $x$ be the quantity whose associated propagation loss $P_x$ is desired to be measured.

If $x$ lies between two calibration levels then we interpolate between those values and

$$P_x = E_{qu} + E_{cdp} * \frac{MM - (10.0 * \log(x) - S_I(LL)) * E_{cdp}}{(S_I(MM) - S_I(LL))}$$

where $S_I(MM)$ and $S_I(LL)$ are the values of $S_I$ corresponding to calibration values above and below $x$ respectively.
If $x$ is greater than any calibration level then we extrapolate beyond the upper calibration value and

$$P_x = \text{EQU} - (10.0 \times \log(x) - \text{SIGJ}(1)) \times \text{ECDP}/(\text{SIGJ}(1) - \text{SIGJ}(2))$$

If $x$ is less than any calibration level then we extrapolate below the lowest calibration value and

$$P_x = \text{EQU} + (\text{NCAL}-1) \times \text{ECDP} - (10.0 \times \log(x) - \text{SIGJ}(\text{NCAL})) \times \text{ECDP}/\text{SIGJ}(\text{NCAL}-1) - \text{SIGJ}(\text{NCAL})$$

If the number of calibration values $\text{NCAL}$, is one it is assumed that the recording system is linear between $x$ and the calibration level and

$$P_x = \text{EQU} - 10.0 \times \log(x) + \text{SIGJ}(1)$$

If $x$ is the average background noise level, $P_x$ is the propagation loss which would be measured for a signal with a level equal to the background noise. This quantity $\text{AMB}_2$, is a measure of the maximum propagation loss which can be measured for a given level of background noise. The background noise level $\text{AMB}_2$ is related to $\text{AMB}_2$ by the relationship

$$\text{AMB} = -\text{AMB}_2 + \text{EQU} + \text{EQUV}$$

If the maximum or minimum level of signal plus noise falls below the background noise the quantity is set equal to 200 db propagation loss. If the average value of signal plus noise does not exceed the background noise then the average value of propagation loss is set equal to $\text{AMB}_2$ and $\text{GTR}$ is set equal to one. This effectively states that the average propagation loss is greater than $\text{AMB}_2$.

For each pulse the maximum, minimum, and average values of propagation loss in db are printed out. Also printed out is the variance of the propagation loss in db over the pulse length as well as the ambient in db relative to 1 dyne per square cm, and $\text{AMB}_2$ is db.

Also printed out are the average of the number of pulses analyzed of the maximum, and average propagation losses and the average variance over a pulse. The variance of the maximum and average propagation loss measurements of the number of pulses analyzed is also printed out. These quantities are also punched on one output card, the format of which is shown in Table 2. Also punched out on this card are sea state, and
wind speed at the time of the tests and the value of GTR. This card can be used as data input to Program S1357.

There are two printed outputs in program S1298 which can be used as a check of the accuracy of the measurements taken. First the voltage level in db of each calibration level is printed out so that the linearity of the data acquisition and reduction system can be verified. The second check concerns the exponents of all input data. Due to the nature of the Hewlett Packard system the exponents of all data, taken with a given maximum input level setting, have the same value for the exponent. This value is inputted as the quantity EXP. If the value of the exponent of any data point differs from EXP, then the value of the exponent and its location in the data deck is printed out. Thus it is insured that a faulty alignment of data card columns in the data can be detected.

PROGRAM S1357

USL Program S1357, written in FORTRAN V language, is designed to measure averages of the propagation loss and variance data obtained from program S1298 and to plot these as well as theoretical predictions when applicable on the calcomp plotter in a form such that the graphs may be used in technical reports. The data is arranged as follows:

1. One input data card.
2. Input cards containing data of theoretical predictions.
3. Output cards from Program S1298.
4. Cards containing a list of sea states to be used as input parameters.
5. Cards containing a list of wind speeds to be used as input parameters.

The format of these cards is shown in Tables II to V.

Program S1357 is designed to generate as many as ten Calcomp plots from a set of data generated by many propagation tests whose data has been analyzed by means of program S1298.
A sample plot of one of the ten graphs which can be obtained is shown in Fig. 4. All values of propagation loss are plotted versus sea state and wind speed. Average values of propagation loss are also plotted against sea state and wind speed. The values are compared with those predicted by the COLOSSUS equations. In the second set of curves standard deviations of each average value are plotted. A special symbol is generated for data whose value for GRT is one. This symbol indicates that the value plotted is an indication of a minimum propagation loss which could be measured.

Average propagation loss determined by measuring an average pressure level in a single pulse is compared to that determined by measuring a maximum pressure level in a pulse in two graphs. Both are plotted versus sea state and wind speed.

The average of the variances of propagation loss measured over individual pulses is plotted versus sea state and wind speed. Values for which GTR equals one are not plotted.

The variance between pulses of measured propagation loss in a given run determined by measuring an average pressure level in a single pulse is compared with that of propagation loss determined by measuring maximum pressure level in a pulse. This is done in two graphs where both are plotted versus sea state and wind speed. Values for which GTR equals one are not plotted.

If ISZ (see Table III) is set equal to one, only the four graphs in which propagation loss is determined from average pressure levels are plotted. If ISZ equals zero, all ten graphs are plotted. If ISEA is set equal to one, labels pertinent to "winter data" (small positive to weak negative velocity gradients) are put on the graphs while an ISEA of zero corresponds to "summer data" (weak negative to large negative velocity gradients).

Tables are also printed out which list sea state or wind speed, average propagation loss, number of values at the particular wind speed or sea state considered and standard deviation of these values.
SUMMARY

The current BIFI system of data acquisition and reduction of the daily propagation tests brings a high degree of automation to the processing of the acoustic data. In the future it is planned to transmit signals at least in three different frequencies and to receive these signals with hydrophone arrays located at Fishers Island and Watch Hill and connected via telephone data links to the data reduction laboratory at USL. It is planned to purchase Kennedy 1406 digital tape recorder to replace the IBM card punch. This will increase the sampling rate attainable from about 35 samples per second to 100 samples per second. Since the Hewlett Packard System can scan through a maximum of 100 channels with small modifications to the receiving systems and programs one will be able to process data, in a manner similar to that described in this report, at many frequencies and many receiving hydrophones.

WILLIAM G. KANABIS

REFERENCES

a. Schumacher, W.R. "Shallow Water Acoustic Studies; information concerning; USL Technical Memorandum No. 2211-18-68
FORMAT (2IS, FS.1, 6F5.0, F5.1, 2IS, 2FS.0, FS.1, FJ.0)

<table>
<thead>
<tr>
<th>INPUT</th>
<th>PARAMETER</th>
<th>COLUMNS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>INUM</td>
<td></td>
<td>1-5</td>
<td>Number of pulses to be analyzed</td>
</tr>
<tr>
<td>ICAL</td>
<td></td>
<td>6-10</td>
<td>Total number of Cal values to be read in</td>
</tr>
<tr>
<td>EQUV</td>
<td></td>
<td>11-15</td>
<td>Cal equivalent loss of first (highest value) calibration (source level - cal equivalent level (DB))</td>
</tr>
<tr>
<td>PROJ</td>
<td></td>
<td>16-20</td>
<td>Propagation time in sec between source and receiver</td>
</tr>
<tr>
<td>ENC</td>
<td></td>
<td>21-25</td>
<td>Time after leading edge of received pulse at which summation should begin (SEC)</td>
</tr>
<tr>
<td>DUR</td>
<td></td>
<td>26-30</td>
<td>Length of signal sample to be analyzed (sec)</td>
</tr>
<tr>
<td>CAL</td>
<td></td>
<td>31-35</td>
<td>Number of values in individual calibrations</td>
</tr>
<tr>
<td>RAMB</td>
<td></td>
<td>36-40</td>
<td>Time after leading edge of transmitted pulse at which noise should be sampled (sec)</td>
</tr>
<tr>
<td>DURA</td>
<td></td>
<td>41-45</td>
<td>Length of ambient desired to analyze</td>
</tr>
<tr>
<td>EQUIL</td>
<td></td>
<td>46-50</td>
<td>Cal equivalent level of first (highest) calibration level (db)</td>
</tr>
<tr>
<td>ISIG</td>
<td></td>
<td>51-55</td>
<td>Total number of values of signal</td>
</tr>
<tr>
<td>NCAL</td>
<td></td>
<td>56-60</td>
<td>Number of calibration levels</td>
</tr>
<tr>
<td>ECDP</td>
<td></td>
<td>61-65</td>
<td>Increment in levels of calibrations (db)</td>
</tr>
<tr>
<td>SS</td>
<td></td>
<td>66-70</td>
<td>Sea state</td>
</tr>
<tr>
<td>WSPD</td>
<td></td>
<td>71-75</td>
<td>Wind speed (mph)</td>
</tr>
<tr>
<td>EXP</td>
<td></td>
<td>76-80</td>
<td>Value of exponent in all data</td>
</tr>
</tbody>
</table>

**TABLE I**

**INPUT CARD FOR PROGRAM S1298**
### FORMAT 80 (Flo.5)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>COLUMNS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS</td>
<td>1-10</td>
<td>Sea State</td>
</tr>
<tr>
<td>WSPD</td>
<td>11-20</td>
<td>Wind Speed</td>
</tr>
<tr>
<td>AVE</td>
<td>21-30</td>
<td>Average propagation loss measured over pulses</td>
</tr>
<tr>
<td>EMAX2</td>
<td>31-40</td>
<td>Average of maximum propagation loss measured</td>
</tr>
<tr>
<td>AVAR</td>
<td>41-50</td>
<td>Average variances over pulses</td>
</tr>
<tr>
<td>VMAX</td>
<td>51-60</td>
<td>Variance of maximum propagation loss between pulses</td>
</tr>
<tr>
<td>VAV</td>
<td>61-70</td>
<td>Variance of average propagation loss between pulses</td>
</tr>
</tbody>
</table>
| GTR        | 71-80    | 1=propagation loss greater than AVE  
|            |          | 0=propagation loss equal to AVE |

**TABLE II**

OUTPUT CARD FROM PROGRAM S1298
INPUT

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>COLUMN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td>1-5</td>
<td>Number of prediction values</td>
</tr>
<tr>
<td>ND</td>
<td>6-10</td>
<td>Number of data cards from program S1298</td>
</tr>
<tr>
<td>NS</td>
<td>11-15</td>
<td>Number of sea states inclusive between lower and highest values in increments 0, 0.5, 1, 2, 3 .......</td>
</tr>
<tr>
<td>EST</td>
<td>16-20</td>
<td>Propagation loss value at origin of graphs</td>
</tr>
<tr>
<td>NW</td>
<td>21-25</td>
<td>Number of wind speeds inclusive between lowest and highest values in increments 0, 2.5, 5, 10, 15 ....</td>
</tr>
<tr>
<td>ISZ</td>
<td>26-30</td>
<td>Number of graphs 0 = 10 1 = 4</td>
</tr>
<tr>
<td>ISEA</td>
<td>31-35</td>
<td>Season data was taken 0 = summer; 1 = winter</td>
</tr>
</tbody>
</table>

TABLE III
INPUT CARD PROGRAM S1357
FORMAT 5F10.5

NC = NUMBER OF CARDS

<table>
<thead>
<tr>
<th>INPUT PARAMETER</th>
<th>COLUMNS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSS</td>
<td>1-10</td>
<td>Sea State</td>
</tr>
<tr>
<td>CWS</td>
<td>11-20</td>
<td>Wind Speed</td>
</tr>
<tr>
<td>COLU</td>
<td>21-30</td>
<td>Upper Propagation loss prediction</td>
</tr>
<tr>
<td>COLL</td>
<td>31-40</td>
<td>Lower Propagation loss prediction</td>
</tr>
<tr>
<td>CW2</td>
<td>41-50</td>
<td>Wind Speed (2)</td>
</tr>
</tbody>
</table>

TABLE IV
INPUT CARDS WITH THEORETICAL PREDICTIONS
PROGRAM S1357
**USL Tech Memo**  
No. 2211-91-69

**TABLE V**  
INPUT CARD LISTING SEA STATES OR WIND SPEEDS  
PROGRAM S1357

- **NS** = NUMBER OF SEA STATE VALUES
- **NW** = NUMBER OF WIND SPEED VALUES

**FORMAT 8F10.5**

**INPUT PARAMETERS** | **COLUMNS**  
--- | ---  
Z or ZZ | 1-10  
 | 11-20  
 | 21-30  
 | 31-40  
 | 41-50  
 | 51-60  
 | 61-70  
 | 71-80  

ZZ is wind speed (mph)

They are inputed in ascending order of magnitude
Recording Sequence

FIG. 3
USL Tech Memo
No. 2211-91-69
PROPAGATION LOSS
VERSUS
SEA STATE
FREQUENCY 1700 Hz

x PREDICTION FOR NEGATIVE GRADIENT.
• PREDICTION FOR ISOTHERMAL WATER
☆ MEASURED LOSS
△ MINIMUM LOSS

SAMPLE PLOT

FIG. 4
USL Tech Memo
No. 2211-91-69
**APPENDIX A**

**DATE 170369 PAGE**

**INTEGRITY CALCULATION FOR LONG PULSES**

**DIMENSION SIG(1000), SIGC(1000), ESIG(1000), ESIGC(1000)**

1 WRITE (4,19)  

19 FORMAT(10H MAX, MIN, AVER ARE PROP LOSS IN DB, AMB IN DB REL DYN  
1 FOR SQUARE CM, VAR IS VARIANCE OF LOG PRES SQUARED)  
1 READ (3) INUM, ICAL, EQUL, PROT, ENC, DUR, CAL, RAMB, DURA, EQU, ISIG  
1 WRITE (4) INUM, ICAL, EQUL, PROT, ENC, DUR, CAL, RAMB, DURA, EQU, ISIG  
1 READ (3) (SIG(J), J=1,10)  
1 WRITE (4) (SIG(J), J=1,10)  
1 CONTINUE  

72 WRITE (4,75) J, ESIGC(J)  
75 FORMAT (15X, 5F5.0)  
70 CONTINUE  

60 SIG(J,JJ) = 0.0  
ICAL = ICAL/NCAL  
DO 61 JJ = 1, NCAL  
DO 3 J = 1, ICAL  
JL = J + ICAL*(JJ-1)  
3 SIG(J,JJ) = SIG(J,JJ) + (SIGC(JL))/10.0**ESIGC(JL)**2.0  
SIG(J,JJ) = 10.0**LOG10(SIG(J,JJ)/CAL)  
15 FORMAT(F10.5)  
61 WRITE (4,15) SIG(J,JJ)  
40 CONTINUE  

55 TIN = J + 1  
90 CONTINUE  

7 ISIP = J + 1  
90 CONTINUE  

9 ISP = J + 1  
WRITE (4,10) 1STP, ISP, 1STP  
10 FORMAT(3I10)  
1 Write (4,10) 1STP, ISP, 1STP  
10 FORMAT(3I10)  
1 Write (4,10) 1STP, ISP, 1STP  
10 FORMAT(3I10)
BEC = 0.0
LBEC = 0.0
AVR = 0.0
VAVR = 0.0
VAR = 0.0
DO 10 K=1,1NUR
ELMAX = 0.0
ELMIN = 0.0
TOTS = 0.0
TOL = 0.0
TOC = 0.0
DO 10 L = 1,1UR
M = L + (K-1)*IMIN
J = 15TO + 10*SSG + M
F(J) = SIG(J)/10.0** E SIG(J)
IF ( F(J) > 0.0 ) EMAX = ( F(J) )**2.0
IF ( F(J) < 0.0 ) EMIN = ( F(J) )**2.0
TOL = TOL + ( F(J) )**2.0
TOC = TOC + G0.0*ALOG10(F(J))**2.0
TOTS = TOTS + G0.0*ALOG10(F(J))**2.0
10 CONTINUE
DO 12 M = 1,1DUR
N = M + (K-1)*IMIN
J = 15TO + 10*SSG + N
F(J) = SIG(J)/10.0** E SIG(J)
TOTA = TOTA + ( F(J) )**2.0
12 CONTINUE
DO 14 DUR
DO 14 1DURA
DURA = 1DURA
NCAL = nCAL - 1
IF ( NCAL = 1 ) 97,97,97
97 AERR = AERR - 10.0*ALOG10(TOTA/DUR) + SIG(J)
GO TO 36
98 DO 49 LL = 1,1NCAL
IF ( LUG*ALOG10(TOTA/DURA) > SIGJ(LL) ) GO TO 45
49 CONTINUE
AERR = AERR + ALOG10(TOTA/DUR) - SIGJ(NCAL)
100 GO TO ( SIGJ(NCAL-1) - SIGJ(NCAL) )
36 GO TO 36
45 DO 53 NCAL = 1,1NCAL
IF ( LUG*ALOG10(TOTA/DUR) > SIGJ(LL) ) GO TO 46
53 CONTINUE
AERR = AERR + (TOTA/DUR) - SIGJ(LL)
100 GO TO 100,100
46 AERR = AERR + (TOTA/DUR) - SIGJ(LL)
51 END
36 IF (EMAX - TOTA/DURA ) 20,20,21
30 EMAX = 4+200.0
GO TO 22
31 IF (NCAL = 1 ) 91,91,92
91 EMUL = EQOL - 10.0*ALOG10(EMAX - TOTA/DURA) + SIGJ(1)
GO TO 22
92 DU 3E LL = 1, NCAL
IF (10.0*ALOG10(EMAX), GT, SIGJ(LLL)) GO TO 33
32 CONTINUE
EMAX = EOUL + ECAL*ECDP - 10.0*ALOG10(EMAX-TOTA/DURA)-SIGJ(NCAL)*)
1+ ECDP/(SIGJ(NCAL - 1) - SIGJ(NCAL) )
GO TO 22
33 IF (NCAL = 1,1) 1,1,1
34 CONTINUE
EMAX = EOUL - (10.0*ALOG10(EMAX - TOTA/DURA) -SIGJ(1)) *ECDP/(SIGJ(1)
1 - SIGJ(2))
GO TO 22
35 EMUL = EQOL + ECDP*MM - (10.0*ALOG10(EMAX-TOTA/DURA) -SIGJ(LLL)
1) *ECDP/ (SIGJ(MM) - SIGJ(LLL))
22 IF (EMIN - TOTA/DURA ) 23,23,24
23 EMIN = 2000.0
GO TO 25
24 IF (NCAL = 1 ) 93,93,94
93 EMUL = EQOL - 10.0*ALOG10(EMIN - TOTA/DURA ) + SIGJ(1)
GO TO 25
94 DU 37 LL = 1, NCAL
IF (10.0*ALOG10(EMIN), GT, SIGJ(LLL)) GO TO 43
37 CONTINUE
EMIN = EQUL + ECAL*ECDP - 10.0*ALOG10(EMIN-TOTA/DURA)-SIGJ(NCAL)*)
1+ ECDP/(SIGJ(NCAL - 1) - SIGJ(NCAL) )
GO TO 25
43 IF (NCAL = 1,1,-1
44 CONTINUE
EMIN = EOUL - (10.0*ALOG10(EMIN - TOTA/DURA) -SIGJ(1)) *ECDP/(SIGJ(1)
1 - SIGJ(2))
GO TO 25
46 EMIN = EOUL + ECDP*MM - (10.0*ALOG10(EMIN-TOTA/DURA) -SIGJ(LLL)
1) *ECDP/ (SIGJ(MM) - SIGJ(LLL))
25 IF (TOT/DURA - TOTA/DURA ) 26,26,27
26 AULR = AMDB
30 YN = 1.0
GO TO 28
27 IF (NCAL = 1 ) 95,95,96
95 AULR = EOUL - 10.0*ALOG10(TOT/DUR - TOTA/DURA) +SIGJ(1)
GO TO 28
96 DU 3B LL = 1, NCAL
IF (10.0*ALOG10(TOT/DUR), GT, SIGJ(LLL)) GO TO 44
38 CONTINUE
AULR = EOUL + ECAL*ECDP - 10.0*ALOG10(TOT/DUR-TOTA/DURA)-SIGJ(NCAL)*)
1+ ECDP/(SIGJ(NCAL - 1) - SIGJ(NCAL) )
GO TO 28
44 IF (NCAL = 1,1,-1
45 CONTINUE
AULR = EOUL - (10.0*ALOG10(TOT/DUR-TOTA/DURA) -SIGJ(1)) *ECDP/
1(SIGJ(1) - SIGJ(2) )

USL Tech Memo
Nr. 2211-91-69
GO TO 20

47 AVR = LGUL + ECUP*MM-(10.0)ALG10(TOT/DUR-TOTA/DURA) -SIGJ(LL
1))* ECUP/ (SIGJ(MM) - SIGJ(LL))

28 VAR = TOT6/DUR = (TOC/DUR)**2.0

AM0 =-AMB2 +EWUL +LGUV

AVE = AVE + AVER

AVAM = AVAM + AMB2

AVAR = AVAR + VAR

EMAX2 = EMAX2 + EMAA

VMAX = VMAA + EMAX**2.0

VAR = VAV + AVER**2.0

WRITE (4,13) EMAA, EMIN, AVER, VAR, AMB, AMB2

13 FORMAT (6(F10.5))

10 CONTINUE

AVL = AVE / FLOAT(INUM)

AVAR = AVAR / FLOAT(INUM)

AVAM = AVAM / FLOAT(INUM)

EMAX2 = EMAX2 / FLOAT(INUM)

VMAX = VMAX / FLOAT(INUM) - EMAX2**2.0

VAR = VAV / FLOAT(INUM) - AVE**2.0

WRITE (4,14) EMAX2, AVE, AVAR, AVAM

14 FORMAT (F10.5,10X,2F10.5,10X, F10.5)

WRITE (4,31) VMAX, VAV

31 FORMAT (F10.5,10X,F10.5)

WRITE (9,65) SS, WSPD, AVE, EMAX2, AVAR, VMAX, VAV, STR

65 FORMAT (8F10.5)

END
APPENDIX B

BIFI PLOTS

DIMENSION COLU(100), COLL(100), X(2000), Y(2000), DATA(1024),
CSS(100), CWS(100), FN(100), V(100), Z(100), S(100), XL(3), XXL(3),
1 SE(100), #1(100), CW2(100), XX(2000), ZZ(100), FM(100),
WWW(100), #W1(100), WW2(100), GTR(2000), GTA(100), WL(3),
1 XL(3), YL(3), ZZ(3), XXL(3), ZLL(3)

CALL PLOTS (DATA(1), 1024, 0)
CALL PLOT (0.0, 0.0, 0.0, -3)
CALL SYMBOL (5.0, 1.0, 0.0, 0.21, 15)
KANABIS S1357, 90.0, 15
READ (3, 1) NC, ND, NS, EST, NW, IS2, SEA
1 FORMAT (315, F5.0, 315)
READ (3, 2) (CSS(i), CWS(i), COLU(i), COLL(i), CW2(i), i=1, NC)
2 FORMAT (5F10.5)
READ (3, 3) (X(i), Y(i), Y1(i), Y2(i), GTR(i), I(i), i=1, ND)
3 FORMAT (8F10.5)
WRITE (4, 96) XX(7)
WRITE (4, 96) XX(8)
90 FORMAT (F10.5)
DO 30 I = 1, 2
CALL PLOT (20.0, 0.0, 0.0, -3)
Y(NO +1) = EST
Y(NO +2) = 0.0
COLU(NC+1) = EST
COLU(NC+2) = 0.0
COLL(NC+1) = EST
COLL(NC+2) = 0.0
IF(I, EQ, 2) GO TO 13
X(NO +1) = 0.0
X(NO +2) = 1.0
CSS(NC+1) = 0.0
CSS(NC+2) = 1.0
GO TO 21
13 XX(NO +1) = 0.0
XX(NO +2) = 5.0
CWS(NC+1) = 0.0
CWS(NC+2) = 5.0
CW2(NC+1) = 0.0
CW2(NC+2) = 5.0
CALL LINE (XX, Y, NO, 1, 1, 5)
DO 71 L = 1, ND
IF (GTR(L), LT, 0.5) GO TO 71
XXL(1) = XX(L)
XXL(2) = 0.0
XXL(3) = 5.0
YL(1) = Y(L) +1.0
YL(2) = EST
YL(3) = 10.0
CALL LINE (XXL, YL, 1, 1, 2)
71 CONTINUE
CALL LINE (CWS, COLL, NC, 1, 1, 60)
CALL LINE (CWS, COLU, NC, 1, 1, 4)
CALL LINE (CWS, COLL, NC, 1, 1, 10)
CALL LINE (CWS, COLU, NC, 1, 1, 14)
GO TO 22
21 CALL LINE (X, Y, ND, 1, 1, 5)
DO 72 L = 1, ND
B-1
IF (GTR(L), LT, 0.5) GO TO 72
XL(1) = X(L)
XL(2) = U(0)
XL(3) = 1.0
YL(1) = Y(L) + 1.0
YL(2) = EST
YL(3) = 10.0
CALL LINE (XL, YL, 1, 1, 21)

CONTINUE
CALL LINE (CSS, COLL, NC, 1, 1, 28)
CALL LINE (CSS, COLU, NC, 1, 1, 4)

22 CALL AXIS (0.0, 0.0, 22HPROPAGATION LOSS IN DB, 22.10, 0.0, 90.0,
Y(ND+1), Y(ND+2), 10.0)
IF (I, EQ, 2) GO TO 15
CALL AXIS (0.0, 0.0, 9HSEA STATE, 9.12, 0.0, 0.0, X(ND+1), X(ND+2), 10.0)
GO TO 23

15 CALL AXIS (0.0, 0.0, 27HWIND SPEED (MILES PER HOUR), 27, 12, 0.0,
1 XX(ND+1), XX(ND+2), 10.0)

23 CALL SYMBOL (2.0, 0.0, 0.14, 18HPROPAGATION LOSS, 0.0, 18)
CALL SYMBOL (3.0, 0.8, 0.10, 16HVERSUS, 0.0, 6)
IF (I, EQ, 2) GO TO 14
CALL SYMBOL (2.0, 0.8, 0.14, 18HSEA STATE, 0.0, 18)
GO TO 24

14 CALL SYMBOL (2.0, 0.8, 0.14, 18HWIND SPEED, 0.0, 18)

24 CALL SYMBOL (2.0, 0.7, 0.14, 18HFREQUENCY 1700 Hz, 0.0, 18)
IF (I, EQ, 2) GO TO 61
CALL SYMBOL (1.5, 7.00, 10, 4.0, 0.0, -1)
CALL SYMBOL (1.5, 6.75, 10, 2.6, 0.0, -1)
IF (ISEA, EQ, 1) GO TO 100
CALL SYMBOL (2.0, 7.0, 1.32HPREDICTION FOR NEGATIVE GRADIENT, 0.0, 32)
CALL SYMBOL (2.0, 6.75, 1.31HPREDICTION FOR ISOTHERMAL WATER, 0.0, 31)
GO TO 104

100 CALL SYMBOL (2.0, 7.00, 1, 37HLOWER PREDICTION FOR ISOTHERMAL WATER,
1 0.0, 37)
CALL SYMBOL (2.0, 6.75, 1, 37HUPPER PREDICTION FOR ISOTHERMAL WATER,
1 0.0, 37)

104 CALL SYMBOL (1.5, 6.50, 10, 5.0, 0.0, -1)
CALL SYMBOL (2.0, 6.50, 10, 13HMEASURED LOSS, 0.0, 13)
CALL SYMBOL (4.0, 6.50, 1.5, 0.0, -1)
CALL SYMBOL (4.0, 6.60, 1.21, 0.0, -1)
CALL SYMBOL (4.50, 6.50, 1.12MINIMUM LOSS, 0.0, 12)
GO TO 69

61 CALL SYMBOL (1.5, 7.00, 10, 4.0, 0.0, -1)
CALL SYMBOL (1.5, 6.75, 10, 28, 0.0, -1)
CALL SYMBOL (1.5, 6.50, 10, 14, 0.0, -1)
CALL SYMBOL (1.5, 6.25, 10, 15, 0.0, -1)
IF (ISEA, EQ, 1) GO TO 102
CALL SYMBOL (2.0, 7.00, 1.47HPREDICTION FOR NEGATIVE GRADIENT (REFEREE
1CLE), 0.0, 47)
CALL SYMBOL (2.0, 6.75, 1.40HPREDICTION FOR ISOTHERMAL WATER (REFEREN
1CLE), 0.0, 46)
CALL SYMBOL (2.0, 6.25, 1.51HPREDICTION FOR NEGATIVE GRADIENT (BLOCK I
ISLAND DATA), 0.0, 51)
CALL SYMBOL (2.0, 6.25, 1.50HPREDICTION FOR ISOTHERMAL WATER (BLOCK I
ISLAND DATA), 0.0, 50)
GO TO 105

102 CALL SYMBOL (2.0, 7.00, 1.52HPREDICTION FOR ISOTHERMAL WATER (REFERE
ENCE), 0.0, 52)
CALL SYMBOL(2.0, 6.75, 1.52, HUPPER PREDICTION FOR ISOTHERMAL WATER(K = REFERENCE ))
CALL SYMBOL(2.0, 6.50, 1.56, LOWER PREDICTION FOR ISOTHERMAL WATER(BLOCK ISLAND DATA))
CALL SYMBOL(2.0, 6.25, 1.56, HUPPER PREDICTION FOR ISOTHERMAL WATER(BLOCK ISLAND DATA))

CALL SYMBOL(1.9, 7.25, 10.5, 0.0, 0.5, 1)
CALL SYMBOL(2.0, 7.25, 10.13, HOPED LOSS, 0.0, 13)
CALL SYMBOL(4.0, 7.25, 1.5, 0.0, 1)
CALL SYMBOL(4.0, 7.35, 1.21, 0.0, 1)
CALL SYMBOL(4.5, 7.25, 1.12, HOPED LOSS, 0.0, 12)

IF(I, EQ, 2 ) GO TO 20

DO 7 K = 1, N5
FN(K) = 0.0
FM(K) = 0.0
V(K) = 0.0
WWW(K) = 0.0
WWW1(K) = 0.0
WWW2(K) = 0.0
GTA(K) = 0.0
7 W(K) = 0.0
GO TO 28

DO 47 K = 1, NW
FN(K) = 0.0
FM(K) = 0.0
V(K) = 0.0
WWW(K) = 0.0
WWW1(K) = 0.0
WWW2(K) = 0.0
GTA(K) = 0.0
47 W(K) = 0.0

DO 4 J = 1, ND
IF(I, EQ, 2 ) GO TO 16
K = 2.0*X(J) + 1.0
WRITE(4, 95) K
GO TO 25

XX(J) = XX(J)/5.0
WRITE(4, 95) XX(J)
WRITE(4, 95) XX(J)
K = 2.0*XX(J) + 1.0
WRITE(4, 95) K

IF(K, GT, 3) K = K - K/3
WRITE(4, 95) K
IF(K, GT, 6) K = K - 1
WRITE(4, 95) K
IF(K, GT, 10) K = K - 1
WRITE(4, 95) K

F0HMT(15)
FN(K) = FN(K) + 1.0
IF(GTR(J), GT, 0.5) GTA(K) = 1.0
W(K) = W(K) + Y(J)
WWW(K) = WWW(K) + YYY(J)
V(K) = V(K) + Y(J)**2.0
IF(GTR(J), GT, 0.3) GO TO 99
FM(K) = FM(K) + 1.0
WWW(K) = WWW(K) + YYY(J)
*Please note that the content of this document is not fully transcribed due to the image quality and text density.*

```
**W**1(K) = **W**1(K) + **Y**1(K)
**W**2(K) = **W**2(K) + **Y**2(K)
**Y**1 = TE (4, 11) FN(K), **W**(K), V(K), K

11 FORMAT (3F10.1, 10)

4 CONTINUE
IF(I, EQ, 2) GO TO 18
READ (3, 6) (Z(K), K = 1, NS)
GO TO 20
10 READ (3, 6) (Z(K), K = 1, NW)
20 IF(I, EQ, 2) GO TO 17
DO 5 K = 1, NS
IF (FN(K), GT, 0.5) GO TO 200
FN(K) = FN(K-1)
**W**(K) = **W**(K-1)
**WW**(K) = **WW**(K-1)
**Z**(K) = **Z**(K-1)
**V**(K) = **V**(K-1)
GO TO 5

200 **W**(K) = **W**(K)/FN(K)
**WW**(K) = **WW**(K)/FN(K)

5 **S**(K) = SQRT( **V**(K)/FN(K) - **W**(K)**2, 0)
GO TO 60

17 DO 45 K = 1, NW
IF (FN(K), GT, 0.5) GO TO 201
FN(K) = FN(K-1)
**W**(K) = **W**(K-1)
**WW**(K) = **WW**(K-1)
**Z**(K) = **Z**(K-1)
**V**(K) = **V**(K-1)
GO TO 45

201 **W**(K) = **W**(K)/FN(K)
**WW**(K) = **WW**(K)/FN(K)
45 **S**(K) = SQRT( **V**(K)/FN(K) - **W**(K)**2, 0)

60 CALL PLOT (20.0, 0.0, -3)
6 FORMAT (8F10.5)

IF(I, EQ, 2) GO TO 19
DO 12 K = 1, NS
**S**1(K) = **W**(K) + **S**(K)
12 **S**2(K) = **W**(K) - **S**(K)
GO TO 27

19 DO 42 K = 1, NW
**S**1(K) = **W**(K) + **S**(K)
42 **S**2(K) = **W**(K) - **S**(K)

IF(I, EQ, 2) GO TO 62

27 **W**(NS+1) = **ES**1
**W**(NS+2) = 10.0
**S**1(NS+1) = **ES**1
**S**1(NS+2) = 10.0
**S**2(NS+1) = **ES**1
**S**2(NS+2) = 10.0
**CSS**(NS+1) = 0.0
**CSS**(NS+2) = 1.0
**Z**(NS+1) = 0.0
**Z**(NS+2) = 1.0
CALL LINE (**Z**, **W**, NS, 1, 1, 5)

DO 81 L = 1, NS
IF (**GL**(L).GT, 0.5) GO TO 81
81 **Z**1 = **Z**(L)

B-4
```
ZL(2) = 0.0
ZL(3) = 1.0
WL(1) = W(L) + 1.0
WL(2) = EST
WL(3) = 10.0
CALL LINE ( ZL, WL, 1, 1, 1, 21)
81 CONTINUE
CALL LINE (Z, S1, NS, 1, 1, 23)
CALL LINE (CSS, CLO, NC, 1, 1, 24)
CALL LINE (CSS, CLO, NC, 1, 1, 25)
CALL AXIS (0.0, 0.0, 0.0, 0.0, X(NS+1), X(NS+2) + 1.0)
CALL AXIS (0.0, 0.0, 0.0, 0.0, 2.0)
GO TO 101
101 CALL SYMBOL (2.0, 7.00, 1.0, 32, PREDICTION FOR NEGATIVE GRADIENT, 0.0, 32)
CALL SYMBOL (2.0, 6.75, 1.0, 31, PREDICTION FOR ISOTHERMAL WATER, 0.0, 31)
GO TO 106
106 CALL SYMBOL (2.0, 7.00, 1.0, 37, LOWER PREDICTION FOR ISOTHERMAL WATER, 0.0, 37)
CALL SYMBOL (2.0, 6.75, 1.0, 36, HIGHER PREDICTION FOR ISOTHERMAL WATER, 0.0, 36)
100 CALL SYMBOL (1.5, 6.50, 1.0, 10, STANDARD VALUES, 0.0, 14)
CALL SYMBOL (2.0, 6.50, 1.0, 14, AVERAGE VALUES, 0.0, 14)
CALL SYMBOL (4.0, 6.50, 1.0, 21, 0.0, 1.0)
CALL SYMBOL (4.5, 6.50, 1.0, 21, 0.0, 1.0)
CALL SYMBOL (1.5, 6.25, 1.0, 22, 0.0, 0.5)
CALL SYMBOL (2.0, 6.25, 1.0, 24, STANDARD DEVIATION, 0.0, 0.24)
CALL SYMBOL (1.5, 6.00, 1.0, 23, 0.0, 0.25)
CALL SYMBOL (2.0, 6.00, 1.0, 24, HIGHER STANDARD DEVIATION, 0.0, 0.24)
WRITE (4, 10)
10 FORMAT (5H SEA STATE AVERAGE LOSS NUM VALUES STANDARD DEVIATION)
DO 8 M = 1, NS
9 FORMAT (4F10.5)
WRITE (4, 9) Z(M), W(M), FN(M), S(M)
IF (ISEA, EQ, 1) GO TO 30
WRITE (4, 9) Z(M), W(M), FN(M), S(M)
IF (ISEA, EQ, 1) GO TO 30
WW(N5 +1) = EST
WW(N5 +2) = 10.0
WWW1(N5 +1) = 0.0
WWW1(N5 +2) = 10.0
WWW1(N5 +1) = 0.0
WWW1(N5 +2) = 10.0
WWW1(N5 +1) = 0.0
WWW1(N5 +2) = 10.0
CALL PLOT (20.0, 0.0, 0.0, 0.0)
CALL LINE (Z, W, NS, 1, 1, 2)
CALL LINE (Z, WW, NS, 1, 1, 4)
DO 82 L = 1, NS
IF (GE(A(L), LT, 0.5)) GO TO 82
ZL(1) = Z(L)
ZL(2) = 0.0
ZL(3) = 1.0
WL(1) = W(L) + 1.0
WL(2) = WST
WL(3) = 10.0
CALL LINE (ZL, WL, 1, 1, 1, 21)

2 CONTINUE
CALL AXIS (0.0, 0.0, 0.0, 22, 10.0, 90.0, 0.0, 10.0, 10.0)
CALL AXIS (0.0, 0.0, 0.0, 9.0, 12.0, 0.0, 0.0, 10.0, 10.0)
CALL AXIS (0.0, 0.0, 0.0, 8.5, 10.0, 6.0, 6.0, 6.0, 6.0)
CALL AXIS (2.0, 2.0, 2.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL AXIS (2.0, 2.0, 2.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL AXIS (2.0, 2.0, 2.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL AXIS (2.0, 2.0, 2.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL SYMBOL (2.0, 2.0, 9.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0)
CALL LINE (ZZ +W, NW , 1,1,5)  
DO 83 L = 1*NW  
IF (GTA(L),LT,0.5) GO TO 83  
ZZL(1) = ZZ(L)  
ZZL(2) = 0.0  
ZZL(3) = 5.0  
WL(1) = W(L)+1.0  
WL(2) = EST  
WL(3) = 10.0  
CALL LINE (ZZL, WL , 1 ,1,1,21)  
83 CONTINUE  
CALL LINE (ZZ +S1, NW , 1,-1,22)  
CALL LINE (ZZ +S2, NW , 1,-1,23)  
CALL LINE (CWS + COLU, NC , 1,1,4)  
CALL LINE (CWS + COLU, NC , 1,1,28)  
CALL LINE (CW2 + COLU, NC , 1,1,14)  
CALL LINE (CW2 + COLU, NC , 1,1,15)  
CALL AXIS (0.0,0.0,27H WIND SPEED (MILES PER HOUR),27,12,0.,0.,0.0)  
CALL AXIS(0.0,0.0,0.0,22H PROPAGATION LOSS IN DB,22,10,0.90,0.0)  
CALL SYMBOL(2.0,9.0,0.0,14,18H PROPAGATION LOSS,0.0,18)  
CALL SYMBOL(3.0,8.5,0.10,6H VERSUS,0.0,6)  
CALL SYMBOL(2.0,8.0,0.14,18H WIND SPEED,0.0,18)  
CALL SYMBOL(2.0,7.5,0.14,18H FREQUENCY,1700 HZ,0.0,18)  
CALL SYMBOL(1.5,7.00,10,4.0,0.0,-1)  
CALL SYMBOL(1.5,6.75,10,28,0.0,0.0,-1)  
CALL SYMBOL(1.5,6.50,10,14,0.0,0.0,-1)  
CALL SYMBOL(1.5,6.25,10,15,0.0,0.0,-1)  
IF (ISEA,EQ,1) GO TO 103  
CALL SYMBOL(2.0,7.0,0.0,1,47H PREDICTION FOR NEGATIVE GRADIENT (REFERENCE),0.0,47)  
CALL SYMBOL(2.0,6.75,1,46H PREDICTION FOR ISO THERMAL WATER (REFERENCE),0.0,46)  
CALL SYMBOL(2.0,6.5,1,51H PREDICTION FOR NEGATIVE GRADIENT (BLOCK I ISLAND DATA),0.0,51)  
CALL SYMBOL(2.0,6.25,1,50H PREDICTION FOR ISO THERMAL WATER (BLOCK I ISLAND DATA),0.0,50)  
GO TO 107  
103 CALL SYMBOL(2.0,7.00,0.0,1,52H LOWER PREDICTION FOR ISO THERMAL WATER (REFERENCE),0.0,52)  
CALL SYMBOL(2.0,6.75,1,52H LOWER PREDICTION FOR ISO THERMAL WATER (REFERENCE),0.0,52)  
CALL SYMBOL(2.0,6.50,1,50H LOWER PREDICTION FOR ISO THERMAL WATER (BLOCK I ISLAND DATA),0.0,56)  
CALL SYMBOL(2.0,6.25,1,50H LOWER PREDICTION FOR ISO THERMAL WATER (BLOCK I ISLAND DATA),0.0,56)  
107 CALL SYMBOL(1.5,6.00,10,23,0.0,0.0,-1)  
CALL SYMBOL(2.0,6.00,10,24H LOWER Standard Deviation,0.0,24)
CALL SYMBOL (1.5,5.75,.10,22.0,0,—i)
CALL SYMBOL (2.0,5.75,.10,24.0,0,—i)
CALL SYMBOL (1.5,5.50,.10,5.0,0,—i)
CALL SYMBOL (2.0,5.50,.10,14.0,0,—i)
CALL SYMBOL (4.25,5.55,.1,5.0,0,—i)
CALL SYMBOL (4.25,5.65,.1,21.0,0,—i)
CALL SYMBOL (4.50,5.55,.1,12.0,0,—i)
CALL SYMBOL (5,00,6.75,.1,12.0,0,—i)

WRITE (4,90)
90 FORMAT (50H WIND SPEED AVERAGE LOSS NUM VALUES STANDARD DEVIATION)

DO 80 M= 1,NW
80 WRITE (4,9) ZZ(M),WM(M),FM(M),SM(M)

IF (ISZ,E4,1) GO TO 30

WW(NW+1) = EST
WW(NW+2) = 10.0
WWW(NW+1) = 0.0
WWW(NW+2) = 10.0
WWW1(NW+1) = 0.0
WWW1(NW+2) = 5.0
WWW2(NW+1) = 0.0
WWW2(NW+2) = 5.0

CALL PLOT (20.0,0.0,—i)
CALL LINE (ZZ,WM,NW,1,1,5)
CALL LINE (ZZ,WW,NW,1,1,4)

DO 84 L= 1,NW
84 CONTINUE

CALL AXIS (0.0,0.0,22.0,10.0,90.0,1)
CALL AXIS (0.0,0.0,27.0,12.0,0,1)

1 Y(ND+1) = Y(ND+2)= 10.0

CALL SYMBOL (2.0,9.0,0.14,18.0,PROPAGATION LOSS,0.0,18)
CALL SYMBOL (3.0,8.5,0.10,6.0,VERSUS,0.0,6)
CALL SYMBOL (2.0,8.0,0.14,18.0,WIND SPEED,0.0,18)
CALL SYMBOL (2.0,7.5,0.14,18.0,FREQUENCY,1700,0.0,18)
CALL SYMBOL (2.0,7.00,10,4.0,0,0,—i)
CALL SYMBOL (2.5,7.00,1.32,MAXIMUM OVER PULSE,0.0,32)
CALL SYMBOL (2.0,6.75,10,5.0,0,0,—i)
CALL SYMBOL (2.5,6.75,1.31,MAXIMUM OVER PULSE,0.0,31)
CALL SYMBOL (4.5,6.75,1.5,0.0,0,—i)
CALL SYMBOL (4.5,6.85,1.21,0.0,0,—i)
CALL SYMBOL (5.00,6.75,1.12,MINIMUM LOSS,0.0,12)

CALL PLOT (20.0,0.0,—i)

DO 245 K= 1,NW
245 CONTINUE

IF (FM(K).GT.0.5) GO TO 203

WWW(K) = WWW(K-1)
WWW1(K) = WWW1(K-1)
WWW2(K) = WWW2(K-1)
ZZ(K) = ZZ(K-1)

GO TO 245

203 WWW(K) = WWW(K)/FM(K)
WWW1(K) = WWW1(K)/FM(K)

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WWW2(K) = WWW2(K)/FM(K)

245 CONTINUE
CALL LINE (ZZ, WWW1, NW, 1, 1, 4)
CALL AXIS (0.0, 0.0, 8, 0.0, 10, 90, WWW1(NW+1), WWW1(NW+2), 10, 0)
CALL AXIS (0.0, 0.0, 27, 0.0, 12, 0, WWW1(NW+1), WWW1(NW+2), 10, 0)
CALL SYMBOL (2.0, 0.0, 9, 0.0, 14, 18, H, VARIANCE, 0.0, 18)
CALL SYMBOL (3.0, 0.0, 8, 0.0, 10, 6, H, VERSUS, 0.0, 6)
CALL SYMBOL (2.0, 0.0, 8, 0.0, 14, 18, WIND, SPEED, 0.0, 18)
CALL SYMBOL (2.0, 0.0, 7, 0.0, 14, 18, FREQUENCY, 1700, Hz, 0.0, 18)
CALL SYMBOL (2.0, 0.0, 0, 0, 4, 0, 0, -1)
CALL SYMBOL (2.0, 0.0, 7, 0.0, 0, 0, 32, H, VARIANCE OVER PULSE, 0.0, 32)
CALL PLOT (20.0, 0.0, 0.0, -3)
CALL LINE (ZZ, WWW1, NW, 1, 1, 5)
CALL LINE (ZZ, WWW2, NW, 1, 1, 4)
CALL AXIS (0.0, 0.0, 8, 0.0, 10, 90, WWW1(NW+1), WWW1(NW+2), 10, 0)
CALL AXIS (0.0, 0.0, 27, 0.0, 12, 0, WWW1(NW+1), WWW1(NW+2), 10, 0)
CALL SYMBOL (2.0, 0.0, 9, 0.0, 14, 18, H, VARIANCE, 0.0, 18)
CALL SYMBOL (3.0, 0.0, 8, 0.0, 10, 6, H, VERSUS, 0.0, 6)
CALL SYMBOL (2.0, 0.0, 8, 0.0, 14, 18, WIND, SPEED, 0.0, 18)
CALL SYMBOL (2.0, 0.0, 7, 0.0, 14, 18, FREQUENCY, 1700, Hz, 0.0, 18)
CALL SYMBOL (2.0, 0.0, 7, 0.0, 0, 0, -1)
CALL SYMBOL (2.0, 0.0, 0, 0, 4, 0, 0, -1)
CALL SYMBOL (2.0, 0.0, 7, 0.0, 0, 0, 32, H, VARIANCE OVER PULSE, 0.0, 32)
CALL PLOT (20.0, 0.0, 0.0, -3)
CALL PLOT (20.0, 0.0, 0.0, 900)

END