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MANUAL FOR MONO-HULL OR TWIN-HULL SHIP
MOTION PREDICTION COMPUTER PROGRAM

DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Md. 20084



MANUAL FOR MONO-HULL OR TWIN-HULL SHIP
MOTION PREDICTION COMPUTER PROGRAM

by

K. K. McCreight

and

C. M. Lee

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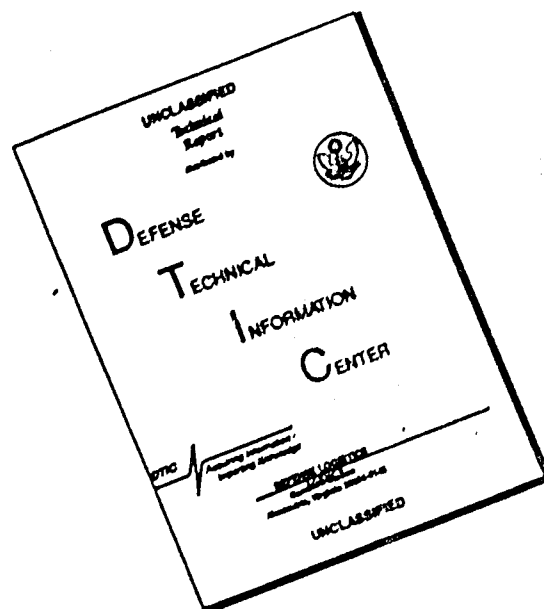
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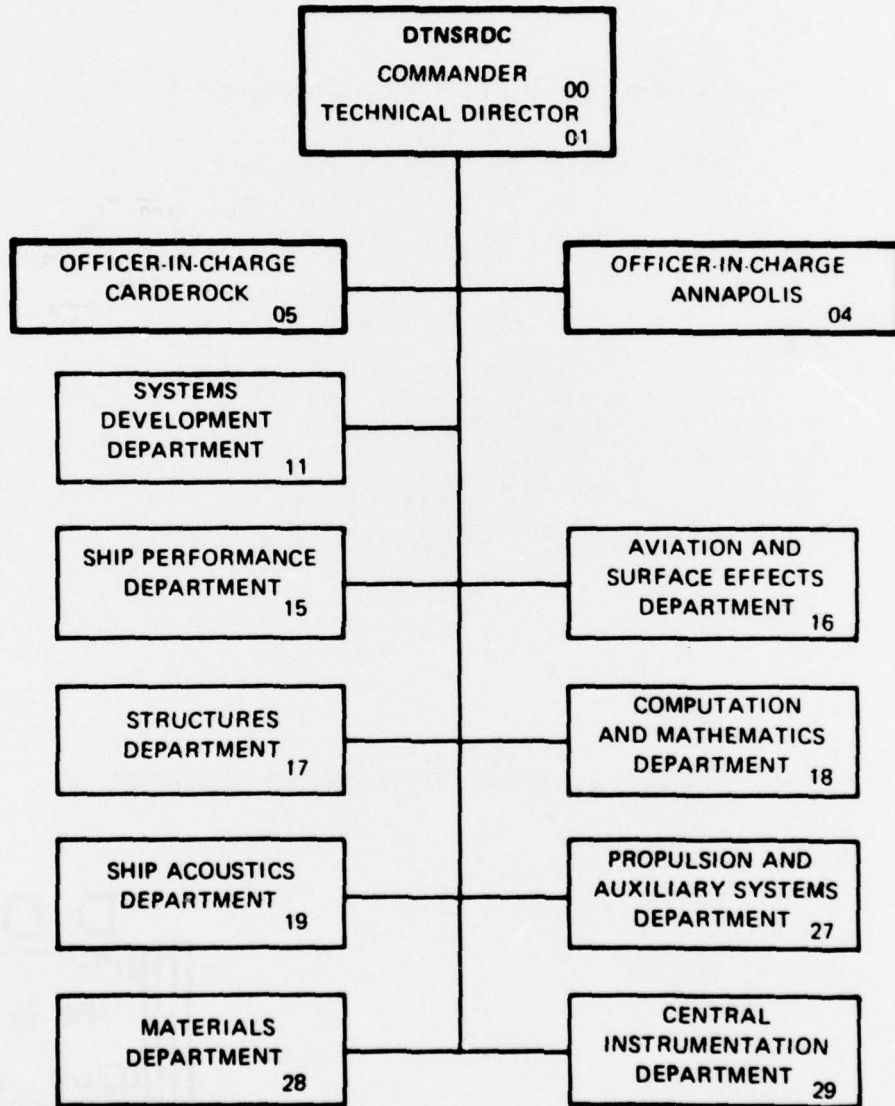
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ABSTRACT

Descriptions of two digital computer programs which calculate the motion of a mono-hull ship or a twin-hull ship are given. The ship is assumed to be advancing at constant speed with arbitrary heading in regular waves. The heave and pitch motion equations are solved in the program MOT35; the sway, roll and yaw motion equations are solved in the program MOT246. Computer input and output and program usage are described. Listings of the programs as well as sample input and output are given.

ADMINISTRATIVE INFORMATION

This project was funded by the High Performance Vehicle Hydrodynamic Program of the Ship Performance Department, David W. Taylor Naval Ship Research and Development Center, under Work Unit 1507-200.

INTRODUCTION

This report describes the data input required for the implementation of the computer programs MOT35 and MOT246. The programs are written in FORTRAN IV for use on the CDC 6700 at the David W. Taylor Naval Ship Research and Development Center (DTNSRDC). These programs calculate the motions of a mono-hull ship or a twin-hull ship moving in a regular wave train of arbitrary heading. The ships can have stationary stabilizing fins at two arbitrary longitudinal locations. The amplitudes and phases of the motions are given as functions of encounter frequency.

The theoretical development for the solved equations is described in a separate report.^{(1)*} These equations of motion are formulated in linear second-order differential equations. These are separated into three independent groups representing, respectively, the motion of surge, heave-pitch, and sway-roll-yaw. The hydrodynamic coefficients in the equations of motion are divided into three categories. The coefficients which can be obtained under the potential-flow assumption for a non-lifting body belong to the first category. These coefficients are obtained by strip theory based on the solution of the two-dimensional hydrodynamic problem of cylinders oscillating on the free surface. The wave exciting coefficients are obtained by the Haskind relation. The hydrodynamic coefficients associated with the viscous nature of the fluid belong to the second category. These are obtained by the cross-flow approach for slender bodies with moderate angle of attack. The hydrodynamic coefficients contributed by the control surfaces belong to the third category. These are obtained by slender body theory for low-aspect ratio wing-body combination. For mono-hull ships without horizontal stabilizing fins, only the hydrodynamic coefficients in the first category are used.

Motion calculations are given for five degrees of freedom. Computation of surge is not made in the programs. Since the heave and pitch motion equations are assumed to be independent of the sway, roll and yaw motion equations, the solution of the equations is implemented in two separate computer programs: MOT35 for heave and pitch, MOT246 for sway, roll and yaw.

* References are listed on page 235.

Both programs can be used for calculating the motions of either a mono-hull or a twin-hull ship. This choice is determined by the value given by the input variable MONO.

The degree of reliability of the mathematical model is checked by comparing the computations with experimental results for SWATH configurations in Reference 1. In general, the agreement between the two results are found to be as good as in the case of mono-hull ships.⁽²⁾ For roll motion, the correlation for SWATH configurations appears to be better than that for mono-hull ships. The computation of roll in MOT246 does not include the bilge keel effects as does the mono-hull ship program⁽³⁾ but the bilge keel effect may be represented by choosing proper values for the viscous lift coefficients (XZVL) and the cross-flow drag coefficient (XZF0).

For computations of motion in irregular seas, the transfer functions computed by MOT35 and MOT246 are used for input to another program called SMOTION which has been developed at the Center. The output of SMOTION provides the significant amplitudes of displacement, velocity and acceleration of the modes of motion desired as well as the absolute and relative vertical or lateral motion at any given point of the hull. It also provides the percentage of exceedance of a given motion for ships operating in the North Atlantic Ocean.

The data card input deck used for the two programs MOT35 and MOT246 is the same. A listing of data input, calculated geometric information and motions (transfer functions) as functions of non-dimensional encounter frequency are given in the computer output. If requested, added mass and damping coefficients and wave exciting forces and moments are also printed.

Program usage is described in this manual. Included are discussions of program structure, input, output and program implementation.

GENERAL BACKGROUND FOR PROGRAM USAGE

The two motion programs presented here have evolved from the Center's efforts in developing analytical prediction methods for mono-hull and twin-hull ships. The main theoretical basis is the source-distribution method for solving the boundary-value problem for oscillating two-dimensional cylinders. Once the method is developed for single cylinders⁽⁴⁾, this can

be extended to twin cylinders⁽⁵⁾. With the slender body assumptions, these basic two-dimensional solutions can be integrated to obtain the hydrodynamic coefficients involved in the equations of motion. This approach is now widely accepted as a practical tool to compute ship motions induced by ocean waves.

The Center has developed a comprehensive computer program⁽³⁾ to compute the motion of mono-hull ships in six degrees of freedom and various structural loadings induced by the ship motion and waves. The present program is developed to compute the motion of twin-hull ships following the same approach as used in the mono-hull motion program. However, one of the major deficiencies in the prior programs has been the underestimated damping coefficients in the heave, pitch and roll modes. The necessity of introducing viscous damping coefficients was almost imperative if any realistic prediction of motion was to be made. The degree of difficulty in obtaining reliable damping coefficients is well known to those who have attempted to predict the roll motion of mono-hull ships. The aforementioned difficulty was resolved by using an empirical approach borrowed from the method used for airships. Another difficulty was encountered with a twin-hull ship with stabilizing foils. Here, the hydrodynamic effects contributed by the foils should be properly accounted for in order to obtain a reliable prediction of motion. The foregoing additional hydrodynamic effects made the programs much more complex than the mono-hull program.

The required computer memory is reduced by dividing the solution of the equations of motion into two programs: one for heave-pitch motion and one for sway-roll-yaw. This also saves unnecessary computation when only certain modes of motion are of interest. Thus roll motion in beam waves, and heave and pitch in head waves can be calculated without solving all the equations. Results from both programs are sometimes needed. For example, when computing the absolute or relative vertical motion of a point on the hull in oblique waves, the heave, pitch and roll motions are required. For this and similar computations the results from the two programs can be stored on tape. Then these results can be used in a third program to make the desired computations.

In the development of these programs, the option of computing motions for a mono-hull ship has been included. The mono-hull ships can have asymmetric sections.* In the computations for mono-hull ships, the effects of stationary stabilizing fins can be included. The roll damping contributed by bilge keels is not included in the present programs. However, the bilge keel effect can be included if proper viscous damping coefficients, one depending on the forward speed and the other being independent of the speed, are given as input in the MOT246 program. Computations using this approach should be correlated with available experimental data in order to determine the proper values of the viscous damping coefficients for the bilge keel effects.

In the input data the wave heading angles, β , must be given values in the range from 0 through 180 degrees. Since the transfer functions for $\beta = -\alpha$ are the same as those for $\beta = +\alpha$, results for all headings can be calculated.

A part of the input data to the present program is a set of nondimensional encounter frequencies. These frequencies for given ship speeds can be used to compute the incoming wave lengths or frequencies. When the wave heading β , is in the quarter between the beam ($\beta = \pi/2$) and the stern, ($\beta = 0$) there can exist three different wave lengths for a given frequency of encounter, depending on the speed of the ship. Thus, when the motion results are to be obtained at reasonable intervals of the wave frequency so that the motions in irregular seas can be computed, an adjustment of the intervals of frequencies of encounter should be made for each given speed. In the present programs for the computation of motions for $0 < \beta < \frac{\pi}{2}$, the ratios of wave length to ship length and the desired increment of the wave length to ship length ratio between the neighboring ratios are to be chosen as input data instead of the nondimensional frequencies of encounter which should be given if the waves are approaching the ship from the bow quarter $90 < \beta < 180$.

*In the computation for a conventional catamaran ship in head waves, the computed motion of its demihull (which is treated as a mono-hull) showed better agreement with the model experimental results than the twin-hull results did.(7)

PROGRAM ORGANIZATION

The programs presented in this report are organized with the use of overlays. These overlays consist of programs, subroutines and functions. The structure of MOT35 is very similar to that of MOT246. With the exception of the program PGM5, both MOT35 and MOT246 have programs with the same names which are used for the same purposes. The structure of these programs resembles that of the Frank Close-Fit Computer Program.⁽⁶⁾ The close-fit technique utilized in computing the base hull two-dimensional added mass and damping coefficients has been revised to be applicable for both twin cylinders and a single cylinder. (The alternative Lewis form method for a single cylinder is not included in the present programs). In addition, the option of calculating motions in an irregular seaway by the Pierson-Moskowitz formula has been retained in MOT35. For a mono-hull ship travelling in head seas the heave and pitch motion calculations from MOT35 are equivalent to those obtained from the Frank program. However, there are many differences between the Frank program and the present programs. The program user should note that the form used for the input differs.

The program MOT35 and MOT246 are organized with the use of overlays. To facilitate program alteration and usage the DTNSRDC program EDIT* is used.

A general flow chart for both MOT35 and MOT246 is given in Figure 1. Listings of the programs are given in Appendices A and B. Brief descriptions of the overlay programs, subroutines and functions are given below.

Programs

MAIN is used to initiate program execution.

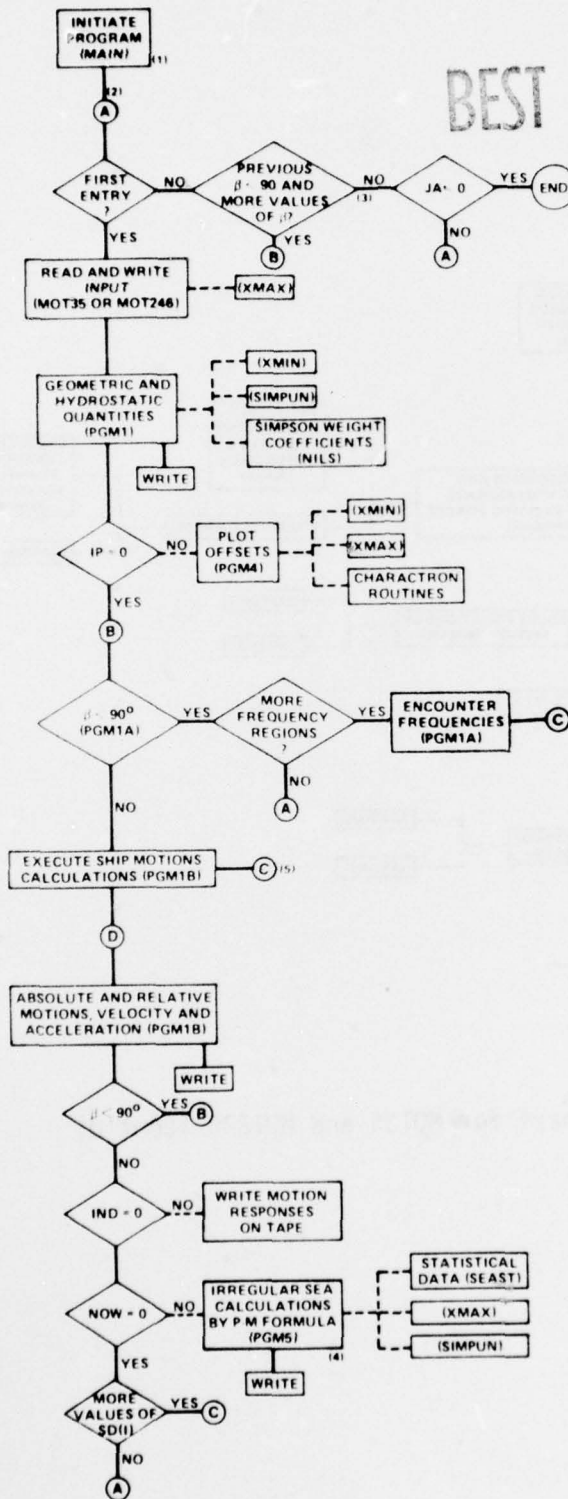
MOT35 (or MOT246) is used to read and write all the input data.

PGM1 is used to calculate geometric and hydrostatic quantities.

PGM1A is used to determine non-dimensional frequencies for calculations where the heading angle is $0 < B < 90$. See Appendix C for further discussion of the technique used.

* The Edit Control Card Program was described in a technical note by M.E. Hass and P.E. Buttey of the Center's Computation and Applied Mathematics Department.

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⁽¹⁾ PROGRAM NAMES ARE GIVEN IN PARENTHESES
⁽²⁾ ENTRY POINTS ON THE FLOW CHART ARE INDICATED WITH SINGLE LETTERS
⁽³⁾ β = WAVE (H) = WAVE HEADING ANGLE
⁽⁴⁾ NOT GIVEN IN MOT246
⁽⁵⁾ SEE NEXT PAGE

Figure 1 - Flow Chart for MOT35 and MOT246

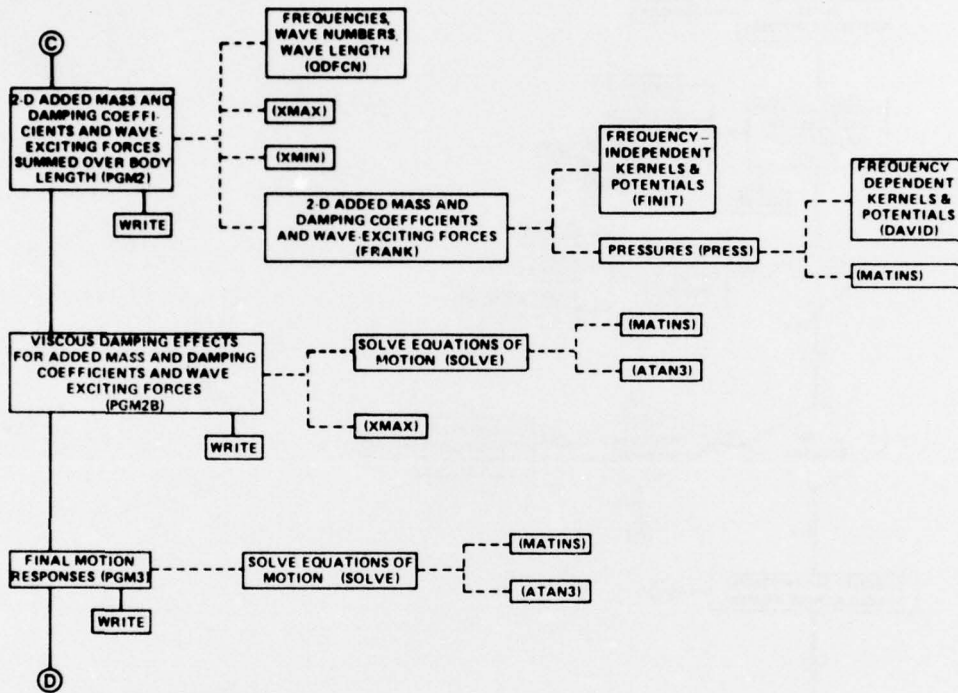


Figure 1 - Flow Chart for MOT35 and MOT246 (Cont'd)

PGM1B calculates absolute and relative motions, velocity and acceleration.

PGM2 is used to calculate added mass and damping coefficients.

PGM2B is used to calculate cross-flow viscous damping contributions to the damping coefficients and wave-exciting forces.

PGM3 is used to determine and to write the final motion responses (transfer functions).

PGM4 is used to plot the cross-sectional offsets.

PGM5 is used only in MOT35 to calculate the responses in irregular seas based on the Pierson-Moskowitz spectra formula.

Functions

ATAN3 is used to set the value of the arctangent of (0,0) to 0.

SIMPUN is used to evaluate an integral using the trapezoidal method.

XMAX is used to determine the maximum value in a given array.

XMIN is used to determine the minimum value in a given array.

Subroutines

DAVID is used to calculate the two-dimensional frequency-dependent velocity potential and its normal derivatives on the body due to a pulsating source of unit strength. (See Appendix A of Reference 4).

FINIT is used to calculate the logarithmic terms in the expression of a pulsating source of unit strength.

FRANK is used to calculate the added mass, damping and complex amplitudes of exciting forces and moments for a section.

MATINS is used for matrix inversion and for solution of linear equations by the pivot method.

NILS is used for evaluating Simpson's weight coefficients for an array of station numbers.

PRESS is used to calculate the pressures on the cross-section contours.

SEAST is used to calculate statistical sea state data for a given significant wave height.

SOLVE is used to solve the equations of motion.

QDFCN is used to calculate non-dimensional wave frequencies, wave numbers, and wave length to ship length for a given array of non-dimensional encounter frequencies.

INPUT

All data input for MOT35 and MOT246 are provided on digital computer cards. The same data deck form is utilized for both computer programs. Ship geometry and particular operating conditions must be specified. FORTRAN variable names, definitions and card formats for the input are listed in Appendix D. More detailed discussion of some input requirements and options are given below and in a section on output

GRAV

The input variable GRAV is used to indicate the length units used in the input. GRAV is the gravitational acceleration. If 9.807 is given then it is assumed in the program that all input with length dimensions are being given in meters; if 32.174 or 0. are given it is assumed that feet are the units used. All data must be given in the same units.

NOW

For irregular sea calculations in MOT35, NOW should be given a non-zero value. This option should be used only if all length units in the input are given in feet (that is, when GRAV = 0. or GRAV = 32.174).

WANG (I)

When any of the wave heading angles (denoted WANG (I)) is less than 90 degrees certain restrictions are placed on program input. (Note that WANG (I) = 180 degrees for head seas). In this case JA must be defined as 2, IND as 0. The values of WANG (I) must be given in ascending order.

OMEN (I)

The values for non-dimensional frequency are defined in the program differently, depending on the values of the wave heading angle. For all values of WANG (I) less than 90 degrees, motion calculations are made for non-dimensional encounter frequency values based on the input (using RWS(1,I,1) and RWS(2,I,1). For other values of WANG (I) the calculations are made for all values of OMEN (I) which are defined by $\omega\sqrt{L/g}$ where ω is the encounter frequency in radians per second, L is the ship length given by the input EL and g is the gravitational acceleration. The technique used for calculations for the heading angle less than 90 degrees is discussed in Appendix C.

NLOOP

For the heave, pitch and roll motions for twin-hulls and for the roll motion for mono-hulls, the effects of nonlinear viscous damping should be included in the computation. Although the computation is performed with the method of equivalent linearization of the nonlinear damping coefficients, it requires prior knowledge of the motion amplitudes. Hence, the computation is carried out iteratively, with the first amplitude of motion obtained without the nonlinear damping, until a reasonable convergence of the motion amplitude is obtained.

NLOOP is the maximum number of such iterations to be used in Program PGM2B. NLOOP may be defined as 0 if inclusion of the nonlinear damping is deemed unnecessary. The iteration continues until the value of the maximum roll motion (in MOT246) or the maximum heave motion (in MOT35) converges with an absolute error for the last two values of less than 10% or until the iteration has been repeated NLOOP times.

The iterative technique is not used if the heave amplitude divided by wave amplitude is less than 0.9 or the maximum roll amplitude divided by wave amplitude and multiplied by one-half of the centerline to centerline distance for twin-hulls or one-half beam for mono-hulls is less than 0.8. If these magnitudes are too small or the convergence criteria is not met within NLOOP iterations, appropriate diagnostic statements are printed and normal calculation continues. The program user should check for such diagnostics.

$X(I,J)$, $Y(I,J)$

Several variables are used to describe the hull shape. Data should be given for about twenty stations which span the length of the ship at regular (not necessarily even) intervals, starting at the bow. The number of stations to be described is denoted by NOS. The station number to be associated with I^{th} set of offsets is denoted by ST(I). Note that the distance between the Station Numbers 0 and 20 is assumed to equal the value given by EL which can be any length within the overall length of the ship. All stations are spaced according to this scale. Values of

ST(I) can be negative or greater than 20, in which case the stations should be selected in pairs of even intervals. The value of ST(I) = 10.0 (i.e., the station located at the middle of EL) should always be included.

The variable MPS (I) indicates whether the Ith station described is part of a parallel body section. A value of 0 indicates that the station is not part of a parallel section; 1 and 2 indicate that the station is, respectively, the first or one of the subsequent stations (including the last one) in the parallel section. All offset data must be given for stations in a parallel section and stations must be distributed along the parallel section. However, for the stations having MPS(I) = 2, the sectional added mass and damping computations will not be repeated but will be replaced by the values obtained at the first station of the parallel body. If a ship has a substantial parallel middle body, the foregoing scheme would save considerably in the computational time and cost.

The variable NM(I) indicates the number of pairs of x and y coordinates that will be used to describe the Ith station. This value may be 0 for the bow or stern.

The x and y coordinates are defined using the arrays X(I,J) and Y(I,J), respectively. Each cross section is approximated by a polygon with corners defined by these x and y values. These coordinates should be evenly distributed since pressures are assumed to be constant over a linear segment between the neighboring points. A set of values of x for the Ith station are given first and then followed by a set of the corresponding values of y for that station. This is repeated for each station for which NM(I) is greater than 0. The origin of the x-y coordinate system is at the point of maximum draft of all stations at the longitudinal centerplane of one hull. Figure 2 indicates the coordinate system and the order data should be given in for each of the four types of hull configurations, with the appropriate value of MONO indicated. Also indicated are the coordinate points which must be included.

For the hydrodynamic computations, the origin of the coordinate system at each cross section is shifted to the midpoint of the overall beam of the cross section (of two hulls) at the calm waterline.

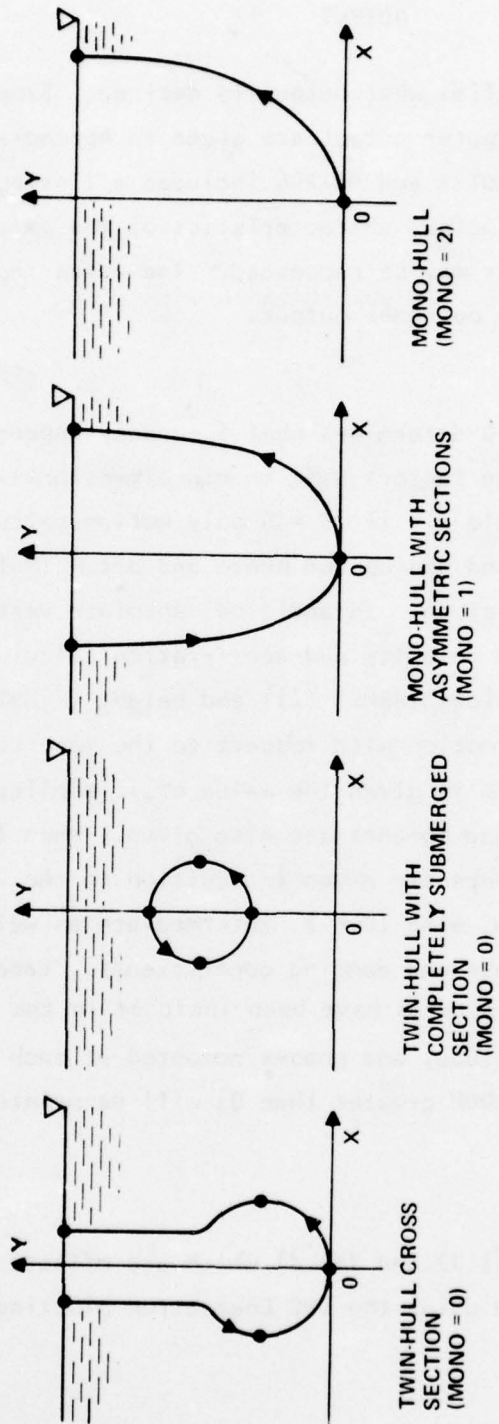


Figure 2 - Offset Data

OUTPUT

The program user specifies what output is desired. Sample input data and the resulting computer output are given in Appendix E. The printed output from both MOT35 and MOT246 includes a listing of the input data, a table of principal characteristics of the ship and motion results. Additional output may be requested. The three input variables IG, IP and IND control the optional output.

IG

The control variable IG determines what frequency-dependent hydrodynamic variables are printed. The factors used to non-dimensionalize these variables are given in Table 1. If IG = 0 only motion calculations are printed. The amplitudes and phases for heave and pitch (MOT35) and sway, roll and yaw (MOT246) are given. In addition, absolute vertical (MOT35) or lateral (MOT246) motion velocity and acceleration calculations are given at specified station locations (RBMST (I)) and height (RBMHT(I) for MOT246 only.) Relative vertical motion with respect to the wave surface is also calculated in MOT35. If IG is given the value of 1, amplitudes and phases for wave exciting forces and moments are also given. When IG is 2 the added mass and damping coefficients are given in addition to the information printed with IG = 1. Also, with IG = 2, intermediate as well as final results are given for the added mass and damping coefficients. Labels are used to indicate which contributing terms have been included in the results. In addition, the motion amplitudes and phases computed at each cycle of the iterative calculations (NLOOP greater than 0) will be printed if IG is defined as 3.

IP

The input variables X(I,J) and Y(I,J) which are offsets for cross-sections of the hull can be plotted using the CDC Charactron plotting routine if IP is defined as 1.

TABLE I
NON-DIMENSIONALIZATION FACTORS FOR
COMPUTER OUTPUT VARIABLES

<u>VARIABLE</u>	<u>DIVIDING FACTORS</u>
A ₂₂	m
A ₂₄	mℓ
A ₂₆	mℓ
A ₃₃	m
A ₃₅	mℓ
A ₄₄	mℓ ²
A ₄₆	mℓ ²
A ₅₃	mℓ
A ₅₅	mℓ ²
A ₆₂	mℓ
A ₆₄	mℓ ²
A ₆₆	mℓ ²
B ₂₂	m√g/ℓ
B ₂₄	m√gℓ
B ₂₆	m√gℓ
B ₃₃	m√g/ℓ
B ₃₅	m√gℓ
B ₄₄	mℓ√gℓ
B ₄₆	mℓ√gℓ
B ₅₃	m√gℓ

TABLE 1 (Cont'd)

NON-DIMENSIONALIZATION FACTORS FOR
COMPUTER OUTPUT VARIABLES

<u>VARIABLE</u>	<u>DIVIDING FACTORS</u>
B_{55}	$m b / g \ell$
B_{66}	$m b / g \ell$
$F_2^{(e)}$	mgA
$F_3^{(e)}$	$\rho g A_w A$
$F_4^{(e)}$	mgA
$F_5^{(e)}$	$\rho g I_w A / \ell$
$F_6^{(e)}$	mgA
ϵ_2	A
ϵ_3	A
ϵ_4	$\frac{2A}{B}$
ϵ_5	$\frac{2A}{\ell}$
ϵ_6	$\frac{2A}{\ell}$
ω	$\sqrt{g/\ell}$

where

- A wave amplitude
- A_w waterplane area
- A_{ij} added mass coefficient
- B_{ij} damping coefficient
- B beam for monohull and separation distance between the centerplanes of twin-hull

$F_i^{(e)}$	wave exciting force or moment in the i th mode
g	acceleration due to gravity
I_w	waterplane area moment of inertia about the y -axis
l	ship length given by EL
m	displaced mass of ship
ξ_i	motion displacement in the i th mode
ω	encounter frequency

IND

The values of the motion amplitudes and phases can be transferred to a tape if IND is defined as 1. When JA is defined as 1, this option will facilitate use of a modified version of the program SMOTION which is used for seakeeping calculations in irregular seas using Pierson-Moskowitz and Station INDIA sea spectra. SMOTION is briefly discussed and listed in Appendix F.

APPENDIX A

PROGRAM LISTING OF MOT35

```
OVERLAY(OVFILE,0,0)
PROGRAM MAIN(INPUT=512,OUTPUT=512,TAPE22=512,TAPE48=512,
X TAPE5=INPUT,TAPE6=OUTPUT)
```

C

```
COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBT,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,OME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X H33(4,30,3),H35(4,30,3),H53(4,30,3),H55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ HLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP
```

C

C

```
END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)
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C

```
COMMON/ENDCOM/ENDCOM
```

C

```
DATA PATT/6HMOT35,6H HEA,6HVE AND,6H PITCH,6H MOTIO,6HNS OF ,
X 6HPAGE /
DATA ISTART/0/
NBTAS=0
JC=0
GO TO 1001
CALL FLAGSV
CALL PLOTDD
1001 CONTINUE
CALL AETSKC(5LMOT35)
END
```

OVERLAY(1,0)
PROGRAM MOT35

C
C
C HPM - CATAMARAN VERSION OF YF17 FOR ARBITRARY HEADING
C OFFSETS MUST BE READ IN. THE X AXIS IS THE TRANVERSE BASE LINE OF
C STATION 10. THE Y AXIS IS THE VERTICAL CENTER LINE OF STATION 10.
C Y IS POSITIVE UP AND X IS POSITIVE TO THE RIGHT.
C LOOKING FORWARD ON THE STARBOARD HULL AND STARTING AT THE BOW THE
C OFFSETS ARE READ IN COUNTER-CLOCK WISE A STATION AT A TIME.
C HULL SEPARATION DISTANCE MUST ALSO BE GIVEN. IT IS IDENTIFIED AS
C SU(NSD) WHERE NSD IS THE NUMBER OF HULL SEPARATIONS TO BE RUN.
C THE HULL SEPARATION IS THE DISTANCE FROM THE CENTER LINE OF THE
C CATAMARAN TO THE CENTER LINE OF STATION 10.
C

COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,RAM,URT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DOME,UWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFR,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RP55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

C
C
C END OF COMMON DECK
C (MAKE ALL CHANGES ABOVE THESE CARDS)
C

COMMON/ENDCOM/ENDCOM

C
C DIMENSION YJK(20),YBG(30)
C 1 FORMAT(8A6)
C 2 FORMAT(12I5)
C 3 FORMAT(8F10.5)
C 4 FORMAT(4F9.4,2I9)
C 5 FORMAT(1H1,14A6,18X,A6,I4/)
C 6 FORMAT(1H0,5X,54HSTATION 10.0 NOT GIVEN - READ INPUT DATA FOR NEXT
C 1 SHIP)

```

7 FORMAT(4F10.5,2I5)
8   FORMAT(1H0,5X,23HCOMPUTED FROUDE NUMBERS)
9   FORMAT(/* DATA INPUT CARDS*/ 10X,*1*,9X,*2*,9X,*3*,9X,*4*,9X,
X    *5*,9X,*6*,9X,*7*,9X,*8*/1X,8(*1234567890*))
40  FORMAT(8F9.4)
51  FORMAT(1X,8A6)
52  FORMAT(1X,12I5)
53  FORMAT(1X,8F10.5)
54  FORMAT(1X,4F9.4,2I9)
57  FORMAT(1X,4F10.5,2I5)
200 FORMAT(1H0,11)
3000 FORMAT(12H1 END OF JOB)
335 FORMAT(30X,9HSTATION ,F9.4)
78  NPAG=0
    IF(JC.EQ.2 .AND. NBTAS.GT.0) CALL AETSKC(5LPGM1A)
    ID = 1
    READ(5,1) (TITLE(I),I=1,8)
    READ(5,2) MONU,JA
    IF(JA.LE.0) GO TO 77
    READ(5,3) SCALE,GRAV
    READ(5,2) NFR,NBTA,NFN,NSD,NSTR,NOS,NLOOP,IG,LP,IND
    READ(5,3) (OMEN(I),I=1,NFR)
    READ(5,3) (WANG(I),I=1,NBTA)
    READ(5,3) (FN(I),I=1,NFN)
    READ(5,3) (SD(I),I=1,NSD)
    READ(5,3) (RBMST(I),I=1,NSTR)
    READ(5,3) HTDUM
    UMIN=OMEN(1)
    NBTAT=NBTA
    NBTAS=0
    WANG(NBTAT+1)=777.
    NBTAQ=0
    DO 17 I=1,NBTA
    IF(WANG(I).LT.90.) NBTAQ=NBTAQ+1
17  CONTINUE
    NFRS=NFR
    DO 18 I=1,NFR
18  UMENS(I)=OMEN(I)
    JC=1
    IF(NBTAQ.NE.0) JC=2
    JB=1
    DO 19 I=1,NFN
19  FNS(I)=FN(I)
    NFNS=NFN
    KASE(1)=0
    NPAG=NPAG+1
    WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
    WRITE(6,9)
    WRITE(6,51) (TITLE(I),I=1,8)
    WRITE(6,52) MONU,JA
    WRITE(6,53) SCALE,GRAV
    WRITE(6,52) NFR,NBTA,NFN,NSD,NSTR,NOS,NLOOP,IG,LP,IND
    WRITE(6,53) (OMEN(I),I=1,NFR)
    WRITE(6,53) (WANG(I),I=1,NBTA)

```

```

WRITE(6,53) (FN(I),I=1,NFN)
WRITE(6,53) (SD(I),I=1,NSD)
WRITE(6,53) (RBMST(I),I=1,NSTR)
WRITE(6,53) HTDUM
IF (SCALE.LE.0.) SCALE=1.
IF (GRAV.LE.0.) GRAV=32.174
IF (NSD.GE.1) GO TO 79
NSD=1
SD(1)=0.
79 IF (JC.NE.2) GO TO 43
IF (JA.NE.2) GO TO 43
IF (NFN.GE.1) GO TO 144
JB=1
FN(1)=0.0
GO TO 43
144 CONTINUE
C
C FOLLOWING OR QUARTERING SEA CASE
C
C READ IN BOUNDS FOR RWS AND DELTA RWS
C (RWS IS REAL WAVE LENGTH / LENGTH OF SHIP)
C
C STORE BOUNDS IN RWS(1,N,1) N=1,NB
C INCREMENTS RWS(2,N,1) N=1,NB-1
C NUMBER OF BOUNDS IN RWS(3,1,1)
C
C BOUNDS MUST BE IN ASCENDING ORDER FROM MINIMUM TO MAXIMUM
C
C READ(5,3) (RWS(1,N,1),N=1,8)
C READ(5,3) (RWS(2,N,1),N=1,8)
C READ(5,3) OMIN,UMAX,DOME
C
C NB=0
C DO 301 I=1,8
C IF (RWS(1,I,1).LE.0.0 ) GO TO 302
C NB=NB+1
301 CONTINUE
302 CONTINUE
RWS(3,1,1)=NB
C
C WRITE(6,3) (RWS(1,N,1),N=1,NB)
C NB=NB-1
C WRITE(6,3) (RWS(2,N,1),N=1,NB)
C WRITE(6,3) OMIN,UMAX,DOME
C
43 READ(5,3) EL,GYR,GYRT,GCB,VCG,GMT,DEPCAT,BRCL
READ(5,3) FAL,FAY,DEPA,CHRDA,SPNA,THKA,CLFA,XZFA
READ(5,3) FBL,FBY,DEPB,CHRDB,SPNB,THKB,CLFB,XZFB
READ(5,7) XZFO,XZVL,XZHB,XZPB,KV,KW
READ(5,4) (ST(I),BEAM(I),DRFT(I),AREA(I),NM(I),MPS(I),I=1,NOS)
WRITE(6,53) EL,GYR,GYRT,GCB,VCG,GMT,DEPCAT,BRCL
WRITE(6,53) FAL,FAY,DEPA,CHRDA,SPNA,THKA,CLFA,XZFA
WRITE(6,53) FBL,FBY,DEPB,CHRDB,SPNB,THKB,CLFB,XZFB
WRITE(6,57) XZFO,XZVL,XZHB,XZPB,KV,KW
WRITE(6,54) (ST(I),BEAM(I),DRFT(I),AREA(I),NM(I),MPS(I),I=1,NOS)

```

```

    RGY=GYR
    MS=0
    DO 30 I=1,NUS
    IF (ST(I).NE.10.) GO TO 30
    MS=I
    GO TO 31
30  CUNTINUE
    MS=0
31  NIX=NM(1)
    DO 10 I=2,NUS
    IF (NIX.GE.NM(I)) GO TO 10
    NIX=NM(I)
10  CUNTINUE
    IN(1)=IABS(NM(1))
    NUX=IN(1)
    DO 20 I=2,NUS
    IN(I)=IABS(NM(I))
    IF (NUX.GE.IN(I)) GO TO 20
    NUX=IN(I)
20  CUNTINUE
    DO 21 I=1,NOS
    BEAM(I)=BEAM(I)*SCALE
21  DRFT(I)=DRFT(I)*SCALE
    IF (NUX.LE.0) GO TO 13
    NPAG=NPAG+1
    WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
    KIM=0
    DO 11 I=1,NOS
    YBG(I)=0.
    IF (IN(I).LE.0) GO TO 11
    LEE=3
    NUT=IN(I)
    IF (NUT.LE.8) GO TO 14
    LEE=5
14  KIM=KIM+LEE
    IF (KIM.LE.50) GO TO 15
    KIM=LEE
    NPAG=NPAG+1
    WRITE(6,5) (PATT(J),J=1,6),(TITLE(J),J=1,8),PATT(7),NPAG
15  WRITE(6,335) ST(I)
    READ(5,40) (X(I,J),J=1,NUT)
    READ(5,40) (Y(I,J),J=1,NUT)
    WRITE(6,40) (X(I,J),J=1,NUT)
    WRITE(6,40) (Y(I,J),J=1,NUT)
    DO 165 J=1,NUT
    X(I,J)=X(I,J)*SCALE
    Y(I,J)=Y(I,J)*SCALE
165  YJK(J)=Y(I,J)
    YLGS=XMAX(NUT,YJK)
    YSML=XMIN(NUT,YJK)
    DRFT(I)=YLGS-YSML
    YBG(I)=YLGS
11  CUNTINUE

```

```

13 IF (SCALE.EQ.1.) GO TO 23
   EL=EL*SCALE
   VCG=VCG*SCALE
   GMT=GMT*SCALE
   DEPCAT=DEPCAT*SCALE
   BRCL=BRCL*SCALE
   DU 22 I=1,NSD
22 SU(I)=SD(I)*SCALE
23 READ(5,2) NOW,NOL,NSP,NST
   IF(NOW.LE.0) GO TO 75
   READ(5,3) (WINK(I),I=1,NOW)
   READ(5,3) (SHLT(I),I=1,NOL)
   READ(5,3) (SPEED(I),I=1,NSP)
   READ(5,3) (STAT(I),I=1,NST)
   WRITE(6,3) (WINK(I),I=1,NOW)
   WRITE(6,3) (SHLT(I),I=1,NOL)
   WRITE(6,3) (SPEED(I),I=1,NSP)
   WRITE(6,3) (STAT(I),I=1,NST)
   NFN=NOL*NSP
   IF(NFN.GT.4 .OR. JB.EQ.3 .OR. JA.NE.1) GO TO 77
   UWAX=OMAX
   WRITE(6,8)
   JJ=0
   FACT=1.688
   IF(GRAV.LT.32.) FACT=.3048*FACT
   DU 150 L=1,NOL
   DU 150 M=1,NSP
   JJ=JJ+1
150 FN(JJ)=FACT*SPEED(M)/SQRT(GRAV*SHLT(L))
   WRITE(6,3) (FN(JJ),JJ=1,NFN)
75 IF (MS.NE.0) GO TO 69
   WRITE(6,6)
   GO TO 78
69 DUM=XMAX(NOS,YBG)
   DU 16 I=1,NUS
   NUT=IN(I)
   IF(NUT.LE.0) GO TO 16
   DU 12 J=1,NUT
12 Y(I,J)=Y(I,J)-DUM
16 CONTINUE
   CALL AETSKC(4LPGM1)
77 IF (LP.LE.0 .AND. IP.LE.0) GO TO 80
   ENDFILE 48
   ENDFILE 48
   REWIND 48
80 IF (IND.EQ.0) GO TO 777
   I=777
   WRITE(22) I,I,I
   ENDFILE 22
   REWIND 22
777 WRITE(6,3000)
   END

```

```
FUNCTION XMIN(N,X)
DIMENSION X(30)
XMIN=X(1)
IF(N.LE.1) GO TO 4
DO 2 K=2,N
IF(XMIN.LT.X(K)) GO TO 2
XMIN=X(K)
2 CONTINUE
4 RETURN
END
```

```
FUNCTION XMAX(N,X)
DIMENSION X(30)
1 XMAX=X(1)
IF(N.LE.1) GO TO 4
DO 2 K=2,N
IF(XMAX-X(K))3,2,2
3 XMAX=X(K)
2 CONTINUE
4 RETURN
END
```

```
FUNCTION SIMPUN(X,Y,N)
DIMENSION X(50), Y(50)
S=0.
NN=N-1
DO 1 J=1,NN
1 S=S+(X(J+1)-X(J))*(Y(J)+Y(J+1))*0.5
SIMPUN=S
RETURN
END
```

OVERLAY(2,0)
PROGRAM PGM1

C

COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVHM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINRET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DOME,OWAX
COMMON/HP10/ XZFU,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLUG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

C

C

C

C

C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

DIMENSION SAS(30),SHB(30),MSB(30),XI(20),YI(20)
DIMENSION FJ(30),VCBS(30)
1 FORMAT(1H0,7X,*LENGTH BETWEEN PERPENDICULARS = *,F10.5,1X,A6)
2 FORMAT(22X,*BEAM AT MIDSHIP = *,F10.5,1X,A6)
3 FORMAT(21X,*DRAFT AT MIDSHIP = *,F10.5,1X,A6)
4 FORMAT(25X,15HDISPLACEMENT = F10.3,10H LONG TONS)
5 FORMAT(1H1,14A6,18X,A6,I4/)
6 FORMAT(20X,20HBLOCK COEFFICIENT = F10.5)
7 FORMAT(6X,*LONGITUDINAL CENTER OF BUOYANCY = *,F10.5,1X,A6,1X,
X *AFT OF F.P.*)
8 FORMAT(6X,34HLONGITUDINAL CENTER OF BUOYANCY = F10.5,9H STATIONS)
9 FORMAT(5X,*LONGITUDINAL CENTER OF FLUTATION = *,F10.5,1X,A6,
X *AFT OF F.P.*)
10 FORMAT(5X,35HLONGITUDINAL CENTER OF FLUTATION = F10.5,9H STATIONS)
11 FORMAT(10X,*VERTICAL CENTER OF BUOYANCY = *,F10.5,1X,A6,
X *FROM THE DESIGNED LOAD WATERLINE*)
11 FORMAT(12X,28HRADIUS OF GYRATION/L.B.P. = F10.5)
12 FORMAT(44H0 STATION BEAM DRAFT AREA COEFFICIENT)
13 FORMAT(4F9.4)

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14 FORMAT(6X,10HSTATION = F9.4,6X,30HAREA COEFFICIENT CHANGED FROM F1
10.4,2X,2HT0,2X,F10.4)
15 FORMAT(1H0)
69 FURMAT(13X,27HGIVEN CENTER OF BUOYANCY = F10.5,9H STATIONS)
90 FURMAT(3F9.4,E15.8)
92 FURMAT(1H0,5X,30HMINIMUM CRITICAL ENC. FREQ. = F8.4,16H DUE TO STA
TION F7.4)
206 FURMAT(1H0,30X,23H***DATA FOR ONE HULL***)
300 FURMAT(27X,13HBEAM/DRAFT = F10.5)
301 FURMAT(26X,14HLENGTH/BEAM = F10.5)
66 FURMAT(1H0,5X,41HTHE HEAVE-HEAVE RESTORING COEFFICIENT IS F10.5/6X
1.41HTHE HEAVE-PITCH RESTORING COEFFICIENT IS F10.5/6X,41HTHE PITCH
2-PITCH RESTORING COEFFICIENT IS F10.5)
193 FURMAT(6X,32HCRITICAL ENC. FREQ. FOR STATION ,F7.4,3H = F8.4)
UNITS=6HFEET
IF (GRAV.LT.32.) UNITS=6HMETERS
FST=EL/20.
DU 16 K=1,NUS
IF (IN(K).GT.0) GO TO 17
SQAR(K)=AREA(K)*BEAM(K)*DRFT(K)
VCBS(K)=0.
GO TO 20
17 NUT=IN(K)
VCBS(K)=0.
VCBA=0.
VCBB=0.
DU 18 J=1,NUT
YI(J)=Y(K,J)
18 XI(J)=X(K,J) + SD(1)
YSML=XMIN(NUT,YI)
DU 190 IJI=1,NUT
NNN=IJI
IF (YSML.EQ.YI(IJI)) GO TO 191
190 CONTINUE
191 IJI=NNN
IF (MONO .GT. 1) GO TO 199
IJ=IJI-1
DU 122 J=1,IJ
122 VCBA=VCBA+ABS((X(K,J)+X(K,J+1))*(Y(K,J)**2-Y(K,J+1)**2))*0.25
SQER=SIMPUN(YI,XI,IJI)
SQER=ABS(SQER)
DU 195 JJJ=IJI,NUT
IF (JJJ.EQ.NUT) GO TO 127
VCBB=VCBB+ABS((X(K,JJJ)+X(K,JJJ+1))*(Y(K,JJJ)**2-Y(K,JJJ+1)**2))*
*0.25
127 CONTINUE
KKK=JJJ-IJI+1
XI(KKK)=XI(JJJ)
195 YI(KKK)=YI(JJJ)
SQER2=SIMPUN(YI,XI,KKK)
IF (MONO-1)56,57,199
56 SQAR(K)=ABS(SQER2)-SQER
VCBS(K)=VCBS(K)+VCBB+VCBA
GO TO 55

```

```

57 SQAR(K)=SQER + SQER2
   IF (X(K,1) .LE. 0. .AND. X(K,NUT) .LE. 0.) GO TO 59
   VCBS(K)=VCBS(K)+VCBB+VCBA
   GU TO 55
59 VCBS(K)=VCBS(K)+VCBA-VCBB
   GU TO 55
199 SQER=SIMPUN(YI,XI,NUT)
   SQAR(K)=2.*ABS(SQER)
   NAT=NUT-1
   DO 125 J=1,NAT
125 VCBS(K) =VCBS(K)+0.25*ABS((X(K,J)+X(K,J+1))*(Y(K,J)**2-Y(K,J+1)**
   12))
   VCBS(K)=2.*VCBS(K)
55 DO 196 J=1,NUT
   YI(J)=Y(K,J)
196 XI(J)=X(K,J)
   BEAM(K)=ABS(XI(NUT)-XI(1))
   IF (MONO.GT.1) BEAM(K) = 2.*BEAM(K)
   IF (BEAM(K).NE.0.0) GO TO 600
   AREA(K)=SQAR(K)/DRFT(K)**2
   X(K,1)=X(K,1)-0.001
   XI(1)=X(K,1)
   GO TO 20
600 AREA(K)=SQAR(K)/(BEAM(K)*DRFT(K))
20 SS(K)=FST*ST(K)
16 SAS(K)=SS(K)*SQAR(K)
   KPK=0
   LSD=0
   IF (NIX.GT.0) GO TO 21
   DO 32 K=1,NUS
   IF (NM(K).GT.0) GO TO 32
   IF ((BEAM(K).LE.0.) .OR. (DRFT(K).LE.0.)) GO TO 32
   AIR=AREA(K)
   RAT=0.5*BEAM(K)/DRFT(K)
   TAR=1.0/RAT
   IF (RAT.LE.1.0) GO TO 33
   BL=0.29456*(2.0-TAR)
   GO TO 34
33 BL=0.29456*(2.0-RAT)
34 UL=0.098125*(RAT+TAR+10.0)
   IF (AREA(K).GT.BL) GO TO 35
   AREA(K)=BL+0.0001
   GO TO 36
35 IF (AREA(K).LT.UL) GO TO 32
   AREA(K)=UL-0.0001
36 IF (KPK.GT.0) GO TO 37
   KPK=KPK+1
   NPAG=NPAG+1
   WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
   WRITE(6,15)
37 WRITE(6,14)ST(K),AIR,AREA(K)
   LSD=LSD+1
   SQAR(K)=AREA(K)*BEAM(K)*DRFT(K)
   SAS(K)=SS(K)*SQAR(K)
32 CONTINUE

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```

21 IF (NUX.LE.0) GO TO 25
   IF (KPK.GT.0) GO TO 93
   NPAG=NPAG+1
   WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
93 WRITE(6,12)
   DU 22 K=1,NOS
   IF (IN(K).LE.0) GO TO 22
   LSD=LSD+1
   IF (AREA(K).LT.1000.0) GO TO 91
   WRITE(6,90)ST(K),BEAM(K),DRFT(K),AREA(K)
   GO TO 22
91 WRITE(6,13)ST(K),BEAM(K),DRFT(K),AREA(K)
22 CONTINUE
   IF (NIX.LE.0) GO TO 25
   UX=100.0
   IF (LSD.LT.23) GO TO 201
   NPAG=NPAG+1
201 WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
   WRITE(6,15)
   DU 23 K=1,NOS
   IF (NM(K).LE.0) GO TO 23
   IF (BEAM(K).NE.0.0) GO TO 601
   FJ(K) = 0.0
   GO TO 602
601 CONTINUE
   A=3.1415927*DRFT(K)/BEAM(K)
   A=A/TANH(A)
   FJ(K)=SQRT(A*EL/DRFT(K))
602 CONTINUE
   IF (FJ(K).GT.UX) GO TO 233
   UX=FJ(K)
   JOHN=K
233 WRITE(6,193)ST(K),FJ(K)
23 CONTINUE
   WRITE(6,92)UX,ST(JOHN)
25 CONTINUE
30 VOL=SIMPUN(SS,SQAR,NOS)
   IF (BEAM(MS).EQ.0.0) GO TO 703
   BLUCK=VOL/(EL*BEAM(MS)*DRFT(MS))
   GO TO 704
703 BLUCK=0.0
704 CONTINUE
   VCB=SIMPUN(SS,VCBS,NOS)/VOL
   ROY=SIMPUN(SS,SAS,NOS)/VOL
   GYR=RGY**2
   CHL=BOY/FST
   IF (GCB.LE.0.0) GO TO 68
   BUY=FST*GCB
68 DU 19 K=1,NOS
   SHB(K)=(SS(K)-BUY)*BEAM(K)
19 HSB(K)=(SS(K)-ROY)*SHR(K)
   AMP1=SIMPUN(SS,BEAM,NOS)/EL**2
   AMP2=SIMPUN(SS,HSB,NOS)/EL**4

```

```

RF33=EL**3*AMP1/VOL
RM55=EL**3*AMP2/VOL - ABS(VCB+VCG)/EL
RP35=SIMPUN(SS,SHB,NOS)/VOL
CFL=BOY*EL*RP35/RF33
FLC=CFL/FST
PST=FST*CBL
FACT=35.89744
IF (GRAV.LT.32.) FACT=.02832*FACT
VOL=VOL/FACT
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,206)
WRITE(6,1) EL,UNITS
WRITE(6,2) BEAM(MS),UNITS
WRITE(6,3) DRFT(MS),UNITS
WRITE(6,4) VOL
VOL=VOL*FACT/EL**3
WRITE(6,6) BLUCK
WRITE(6,7) PST,UNITS
WRITE(6,8) CHL
IF (GCB.LE.0.0) GO TO 67
WRITE(6,69) GCB
PST=FST*GCB
67 WRITE(6,9) CFL,UNITS
WRITE(6,10) FLC
WRITE(6,111) VCR,UNITS
WRITE(6,11) RGY
BUR=BEAM(MS)/DRFT(MS)
WRITE(6,300) BDR
IF (BEAM(MS).EQ.0.0) GO TO 700
ELBR=EL/BEAM(MS)
GO TO 701
700 ELBR=0.0
701 CONTINUE
WRITE(6,301) ELBR
WRITE(6,66) RF33,RP35,RM55
DO 31 K=1,NUS
SS(K)=SS(K)/EL
SQAR(K)=SQAR(K)/EL**2
BEAM(K)=BEAM(K)/EL
DRFT(K)=DRFT(K)/EL
IF (NM(K).LE.0) GO TO 31
NUT=IN(K)
DO 24 J=1,NUT
X(K,J)=X(K,J)/EL
24 Y(K,J)=Y(K,J)/EL
31 CONTINUE
PST=PST/EL
FAL=FAL/EL
FBL=FBL/EL
FAY=FAY/EL
FBY=FBY/EL
CALL NILS(NUS,MS,ST,DS,JFK)
IF (JFK.GT.0) GO TO 76

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```
      ID=-1
      GO TO 77
76  IF (OMIN.LE.0.0.OR.JA.EQ.3) GO TO 77
C
C   TRANSFER TO LOOP TO CALL PGM2 AND PGM3
C
      CALL AETSKC(5LPGM1A)
C
77  CONTINUE
      IF (ID.EQ.2 .OR. ID.EQ.-1) CALL AETSKC(5LMOT35)
      CALL AETSKC(4LPGM4)
      END
```

OVERLAY(3,0)
PROGRAM PGM1B

C
C

COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,UMAX,DUME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCB,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

CUN=1.688
IF(GRAV.LT.32.) CON=.3048*CON
CUN=SQRT(GRAV*EL)/CON
FACT=SQRT(GRAV/EL)
FARD=0.017453293
BSD=BEAM(MS)*EL
DU 205 ISD=1,NSD
HHS=2.0*(SD(ISD))-BSD
IF(BSD.LE.1.E-07) GO TO 88
RATIO=HHS/BSD
GO TO 87
88 RATIO=HHS
87 IF(MONO.GE.1) RATIO=0.
SU(ISD)=SD(ISD)/EL
IF(ISD.GT.1) FAY=FAY+SD(ISD)-SD(ISD-1)
IF(ISD.GT.1) FBY=FBY+SD(ISD)-SD(ISD-1)
CALL AETSKC(5LQPGM2)
IF(ID.GT.1) GO TO 77
CALL AETSKC(6LQPGM2B)

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IF(ID.GT.1) GO TO 77
CALL AETSKC(5LQPGM3)
IF(NOW.GT.0) GO TO 77
5 FORMAT(1H1,14A6,18X,A6,I4/)
172 FORMAT(5X,*RELATIVE AND ABSOLUTE DISPLACEMENT, VELOCITY, AND*,
X * ACCELERATION AT STATION *,F5.1)
173 FORMAT(3X,*SPEED =*,F5.1,* KNOTS*)
175 FORMAT(3X,*ENC PER(SEC)*,6X,*REL DISPL*,6X,*ABS DISPL*,12X,
X *VEL*,8X,*ACCEL/G*,7X,*WAVE L/L*)
177 FORMAT(5X,F10.2,4(7X,F8.3),5X,F10.4)
171 FORMAT(3X,*WAVE HEADING =*,F6.2,* DEGREES*/)
DO 150 KI=1,NSTR
RBMSTK=RBMST(KI)
LINES=3
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,172) RBMSTK
ARM=EL*(PST-.05*RBMSTK)
DO 160 MM=1,NBTA
COSB=COSBET(MM)
DO 160 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 160
LINES=LINES+LMT+4
IF(LINES.LE.60) GO TO 140
LINES=3
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,172) RBMSTK
140 SPID=FN(JJ)*CON
WRITE(6,173) SPID
WRITE(6,171) WANG(MM)
WRITE(6,175)
DO 170 N=1,LMT
WAVEN=FACT*WFR(JJ,N,MM)
WAVEN=COSB*WAVEN*WAVEN/GRAV
HEAVE = REAL(EFH(JJ,N,MM))
DELTA = FARD*AIMAG(EFH(JJ,N,MM))
PITCH = REAL(EMP(JJ,N,MM))*2./EL
EPSIL = FARD*AIMAG(EMP(JJ,N,MM))
ABMA=HEAVE*COS(DELTA)-ARM*PITCH*COS(EPSIL)
ABMB=HEAVE*SIN(DELTA)-ARM*PITCH*SIN(EPSIL)
ABMO=SQRT(ABMA**2 + ABMB**2)
RLMA=ABMA -COS(ARM*WAVEN)
RLMB=ABMB + SIN(ARM*WAVEN)
RLMO=SQRT(RLMA**2 + RLMB**2)
OMEGAE=OMEN(N)*FACT
ENCP=6.2831853/OMEGAE
VEL=OMEGAE*ABMO
ACCEL=OMEGAE*VEL/GRAV
170 WRITE(6,177) ENCP,RLMO,ABMO,VEL,ACCEL,RWS(JJ,N,MM)
160 CONTINUE
150 CONTINUE

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      IJ=1
77  CONTINUE
      IF(IND.LE.0) GO TO 78
      DO 81 JJ=1,NFN
      DO 81 N=1,NFR
      DO 81 MM=1,NBTA
      A1 EMP(JJ,N,MM)=EMK(JJ,N,MM)+II*AIMAG(EMP(JJ,N,MM))
      WRITE(22) NFN,NFR,NBTA
      WRITE(22) (FN(I),I=1,NFN),(OMEN(I),I=1,NFR),(WANG(I),I=1,NBTA)
      WRITE(22) ((WFR(JJ,N,MM),EFH(JJ,N,MM),EMP(JJ,N,MM)),JJ=1,NFN),
      X  N=1,NFR),MM=1,NBTA)
78  IF(JA.EQ.2) CALL AETSKC(5LPGM1A)
      IF(ID.EQ.2 .OR. ID.EQ.-1) CALL AETSKC(5LMOT35)
      IF(LP.EQ.0 .AND. IP.EQ.0 .AND. NOW.EQ.0) CALL AETSKC(5LMOT35)
      IF(LP.EQ.0 .AND. IP.EQ.0) CALL AETSKC(4LPGM5)
205  CONTINUE
      END

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PROGRAM QPGM2

C

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COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBT,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DOME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLUG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

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END OF COMMON DECK
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COMMON/ENDCOM/ENDCOM

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1 FORMAT(6X,*DYNAMIC COEFFICIENTS OF THE EQUATIONS OF MOTION*////
X 6X,*A33 IS SCALED BY M.*//
X 6X,*A35 AND A53 ARE SCALED BY *,4HM*L.//
X 6X,*A55 IS SCALED BY M*,5H*L*L.//
X 6X,*B33 IS SCALED BY M*,1H*,*SQRT(G/L).*//
X 6X,*B35 AND B53 ARE SCALED BY M*,11H*SQRT(G*L).//
X 6X,*B55 IS SCALED BY M*,13H*L*SQRT(G*L).//
X 6X,*M IS THE DISPLACED MASS.*//
X 6X,*G IS THE ACCELERATION DUE TO GRAVITY.*//
X 6X,*L IS THE DISTANCE BETWEEN PERPENDICULARS.*////
X 6X,*FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT*,6H(G*L).//
X 6X,*BETA IS THE WAVE HEADING ANGLE IN DEGREES.*//
X 6X,*BETA = 180. FOR HEAD SEAS.*//
X 6X,*OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY*,
X *SQRT(G/L).*//
X 6X,*THE HULL SEPARATION/BEAM RATIO IS THE DISTANCE*/
X 6X,*BETWEEN THE HULLS DIVIDED BY THE BEAM OF ONE HULL.*)
2 FORMAT(1H0,5X,*BARE HULL POTENTIAL FLOW ADDED MASS AND DAMPING*,
X * COEFFICIENTS*/6X,*FN = *,F5.3/
X 10X,*OMEGA*,7X,*A33*,7X,*A35*,7X,*A53*,7X,*A55*,7X,*B33*,7X,
X *B35*,7X,*B53*,7X,*B55*)

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3 FORMAT(F15.4,6F10.6)
4 FORMAT(1H0,5X,*ADDED MASS COEFFICIENTS AND DAMPING COEFFICIENTS*
X * EXCLUDING CROSS-FLOW DRAG*/6X,*FN = *,F5.3/
X 10X,*OMEGA*,7X,*A33*,7X,*A35*,7X,*A53*,7X,*A55*,7X,*B33*,7X,
X *B35*,7X,*B53*,7X,*B55*)
5 FORMAT(1H1,14A6,18X,A6,I4/)
6 FORMAT(F15.4,8F10.6)
11 FORMAT(1H0,5X,8HSTATION F7.4)
150 FORMAT(1H0,80X,*HULL SEPARATION/BEAM = *,F7.4)
205 FORMAT(1H0,5X,43HPROJECTED AREA OF THE SUBMERGED HULL/L**2 =,E15.6
1/5X,13HMOMENT/L**3 =,E15.6,5X,24HMOMENT OF INERTIA/L**4 =,E15.6)
IF(1.EQ.0) CALL PGM1B
FALP=PST-FAL
FBLP=PST-FBL
QPI = 0.7853982
RVOL = VOL * EL**3
NSU=NOS
I1=(0.0,1.0)
DU 12 MM=1,NBTA
WAND=WANG(MM)*.01745329252
CUSBET(MM)=COS(WAND)
12 SINBET(MM)=SIN(WAND)
CALL QDFCN
DU 25 JJ=1,NFN
LMT=MIL(JJ)
IF(MIL(JJ).LE.0) GO TO 25
DU 20 N=1,LMT
DU 20 MM=1,NBTA
20 RWS(JJ,N,MM)=1./SWR(JJ,N,MM)
25 CONTINUE
DU 40 N=1,NFR
A33(N)=0.0
AHP(N)=0.0
AP(N)=0.0
40 CONTINUE
DU 50 JJ=1,NFN
DU 50 N=1,NFR
DHP(JJ,N) = 0.0
DP(JJ,N)=0.0
B33(JJ,N,1)=0.
DU 50 MM=1,NBTA
EFH(JJ,N,MM)=(0.,0.)
50 EMP(JJ,N,MM)=(0.,0.)
PRUA=0.
PRUM=0.
PRUI=0.
DU 60 K=1,NUS
XIP=PST-SS(K)
XIP2=XIP*XIP
DST=DS(K)
NUT=NM(K)
IF(NUT .EQ. 0) GO TO 60
DU 333 IJK=1,NUT
333 XS(IJK)=X(K,IJK)

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XLG=XMAX(NUT,XS)
XSM=XMIN(NUT,XS)
AVBM(K)=XLG-XSM
BAM=BEAM(K)
DRT=DRFT(K)
AIR=AREA(K)
DA=DST*AVBM(K)
PRUA=PROA+DA
PRUM=PROM-XIP*DA
PROI=PROI+XIP2*DA
NUN=NUT-1
NUE=2*NUN
DU 62 J=1,NUT
XS(J)=X(K,J)+SD(ISD)
62 YS(J)=Y(K,J)
YSML = XMIN(NUT,YS)
DU 65 IJI = 1, NUT
NNN = IJI
IF(YSML.EQ.YS(IJI)) GO TO 66
65 CONTINUE
66 MAXD = NNN
IF(MONO .GT. 1) MAXD=1
DU 63 J=1,NUN
XX(J)=0.5*(XS(J)+XS(J+1))
YY(J)=0.5*(YS(J)+YS(J+1))
XINT=XS(J+1)-XS(J)
YINT=YS(J+1)-YS(J)
DEL(J)=SQRT(XINT**2+YINT**2)
SNE(J)=YINT/DEL(J)
63 CSE(J)=XINT/DEL(J)
CALL FRANK
IF(ID.LT.2) GO TO 60
STATION=20.0*SS(K)
WRITE(6,11)STATION
GO TO 77
60 CONTINUE
WRITE(6,205) PRUA,PROM,PROI
DU 30 N=1,NFR
GXI=OMEN(N)
DEB=GXI*VOL
DEA=GXI*DEB
A33(N)=A33(N)/DEA
AHP(N)=AHP(N)/DEA
AP(N)=AP(N)/DEA
DU 30 JJ=1,NFN
B33(JJ,N,1)=B33(JJ,N,1)/DEB
DHP(JJ,N)=DHP(JJ,N)/DEB
30 DP(JJ,N)=DP(JJ,N)/DEB
DU 31 N=1,NFR
GXI=OMEN(N)
GX2=GXI*GXI
A33N=A33(N)
A35N=AHP(N)
DU 31 JJ=1,NFN

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FNJ=FN(JJ)
R55=FNJ*FNJ/GX2
B33S=B33(JJ,N,1)
SB=FNJ*B33S/GX2
A35(JJ,N)=A35N-SB
A53(JJ,N)=A35N+SB
A55(JJ,N)=AP(N)+R55*A33N
SA=DHP(JJ,N)
SB=FNJ*A33N
B35(JJ,N,1)=SA+SB
B53(JJ,N,1)=SA-SB
B55(JJ,N,1)=DP(JJ,N)+R55*B33S
31 CONTINUE
IF(IG.LT.2) GO TO 34
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
WRITE(6,1)
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
KR=0
DU 33 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 33
NF4=LMT+4
WRITE(6,2) FN(JJ)
WRITE(6,6) (OMEN(N),A33(N),A35(JJ,N),A53(JJ,N),A55(JJ,N),
X B33(JJ,N,1),B35(JJ,N,1),B53(JJ,N,1),B55(JJ,N,1),N=1,LMT)
IF(JJ.EQ.NFN) GO TO 33
KR=KR+NF4
IF(55-KR.GE.NF4) GO TO 33
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
33 CONTINUE
34 CONTINUE
ADAB=AMAB=AIAB=0.
VDAB=VMAB=VIAB=0.
IFIN=0
IF(CLFA.EQ.0. .AND. CLFB.EQ.0.) GO TO 67
IFIN=1
CSA=CHRDA*SPNA
CSB=CHRDB*SPNB
FALP2=FALP*FALP
FBLP2=FBLP*FBLP
ADFA=QPI*CSA*(CHRDA+THKA)/RVOL
ADFB=QPI*CSB*(CHRDB+THKB)/RVOL
AUAB=ADFA+ADFB
AMAB=-FALP*ADFA-FBLP*ADFB
AIAB=FALP2*ADFA+FBLP2*ADFB
67 CUN=.5*EL/RVOL
CUNA=CON*CSA*CLFA

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CUNB=CON*CSB*CLFB
CUNV=.5*XZVL/VOL
DU 70 N=1,NFN
GX2=OMEN(N)
GX2=GX2*GX2
A33(N)=A33(N)+ADAB
DU 70 JJ=1,NFN
FNJ=FN(JJ)
IF (IFIN.EQ.0) GO TO 68
VDPA=CONA*FNJ
VDPB=CONB*FNJ
VDAB=VDPA+VDPB
VMAB=-FALP*VDPA-FBLP*VDPB
VIAB=FALP2*VDPA+FBLP2*VDPB
68 VISF=CONV*FNJ
R35=FNJ/GX2
R55=FNJ*R35
A35(JJ,N)=A35(JJ,N)+AMAB
A53(JJ,N)=A53(JJ,N)+AMAB
A55(JJ,N)=A55(JJ,N)+R55*ADAB+AIAB
SB33=B33(JJ,N,1)+VISF*PROA+VDAB
SA=FNJ*ADAB
SB=VISF*PRUM+VMAB
SB35=B35(JJ,N,1)+SA+SB
SB53=B53(JJ,N,1)-SA+SB
SB55=B55(JJ,N,1)+VISF*PROI+VIAB
DU 70 MM=1,NBTA
B33(JJ,N,MM)=SB33
B35(JJ,N,MM)=SB35
B53(JJ,N,MM)=SB53
70 B55(JJ,N,MM)=SB55
C355=CONV*PROA+CONA+CONB
C555=CONV*PRUM-FALP*CONA-FBLP*CONB
IF (IG.LT.2) GO TO 77
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150)RATIO
KR=0
DU 95 JJ=1,NFN
LMT=MIL(JJ)
NF4=LMT+4
IF (LMT.LE.0) GO TO 95
WRITE(6,4) FN(JJ)
WRITE(6,6) (OMEN(N),A33(N),A35(JJ,N),A53(JJ,N),A55(JJ,N),
X B33(JJ,N,1),B35(JJ,N,1),B53(JJ,N,1),B55(JJ,N,1),N=1,LMT)
IF (JJ.EQ.NFN) GO TO 95
KR=KR+NF4
IF ((55-KR).GE.NF4) GO TO 95
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150)RATIO
95 CONTINUE
77 CONTINUE
CALL AERTRNK
END

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PROGRAM QPGM2B

C

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COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBT,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BKCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),JP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

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C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

C

COMMON/ENDCOM/ENDCOM

C

COMPLEX EGH,ENP
COMMON/PR23/ EGH(4,30,3),ENP(4,30,3)

C

COMPLEX AVC,CA,CB,CCON,CEX,CEXAL,CEXBL,CPART,CPARTA,CPARTB,CPET,
X CZIH,CZIP,EXMN,EXPL,F3V,F5V,IKC,IKS,IKSS,IVISF,WEXMN,WEXPL
COMPLEX SEFH(4,30,3),SEMP(4,30,3)

C

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DIMENSION DTMA(30),EPK(4,30,3)
2 FORMAT(1H0,5X,*DAMPING COEFFICIENTS INCLUDING CROSS-FLOW DRAG*/
X 6X,*FN = *,F5.3//13X,*BETA = *,F6.1/
X 6X,*OMEGA*,7X,*B33*,7X,*B35*,7X,*B53*,7X,*B55*)
3 FORMAT(1H0,5X,*DAMPING COEFFICIENTS INCLUDING CROSS-FLOW DRAG*/
X 6X,*FN = *,F5.3//13X,*BETA = *,F6.1,27X,*BETA = *,F6.1/
X 6X,*OMEGA*,2(7X,*B33*,7X,*B35*,7X,*B53*,7X,*B55*))
4 FORMAT(1H0,5X,*DAMPING COEFFICIENTS INCLUDING CROSS-FLOW DRAG*/
X 6X,*FN = *,F5.3//13X,*BETA = *,F6.1,2(27X,*BETA = *,F6.1)/
X 6X,*OMEGA*,3(7X,*B33*,7X,*B35*,7X,*B53*,7X,*B55*))
5 FORMAT(1H1,14A6,18X,A6,I4/)
6 FORMAT(1H0,5X,*EXCITING FORCE, MOMENT AND PHASES*////
X 6X,*THE FORCE AMPLITUDE IS SCALED BY THE HEAVE RESTORING FORCE*/
X 6X,*C33 = RHO*,5H*G*A*,*(WATERPLANE AREA).*/

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X 6X,*THE MOMENT AMPLITUDE IS SCALED BY THE PITCH RESTORING *,
X *MOMENT*/6X,*C55 = RHO*,5H*G*A*,*(MOMENT OF INERTIA OF*,
X * WATERPLANE)/L.*//
X 6X,1H*,*MOMENT DENOTES THE MOMENT AMPLITUDE SCALED BY L*,1H*,
X *(WAVE NUMBER)*,1H*,*C55.*//
X 6X,*G IS THE ACCELERATION DUE TO GRAVITY.*//
X 6X,*A IS THE WAVE AMPLITUDE.*//
X 6X,*L IS THE DISTANCE BETWEEN PERPENDICULARS.*//
X 6X,*RHO IS THE WATER DENSITY.*//)
7 FORMAT(6X,*FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT*,
X 6H(G*L).)//
X 6X,*BETA IS THE WAVE HEADING ANGLE IN DEGREES.*//
X 6X,*BETA = 180. FOR HEAD SEAS.*//
X 6X,*OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY*,
X * SQRT(G/L).*//
X 6X,*THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE*,
X * WAVE AT THE CG. *//
X 6X,*L/LAM IS L/(WAVE LENGTH).*//
X 6X,*FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO *,
X *THREE*/6X,*REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED *,
X *CWR1 AND CWR2.*)
8 FORMAT(1H0,5X,*EXCITING FORCE, MUMENT AND PHASES*/
X 6X,*FN = *,F5.3/6X,*BETA = *,F6.1/
X 6X,*REGION *,11,*CWR1 = *,F9.4,* CWR2 = *,F9.4//
X 6X,*OMEGA*,5X,*L/LAM*,5X,*FORCE*,5X,*PHASE*,4X,*MOMENT*,5X,
X *PHASE*,3X,7H*MOMENT,5X,*LAM/L*)
9 FORMAT(1H0,5X,*EXCITING FORCE, MUMENT AND PHASES*/
X 6X,*FN = *,F5.3/6X,*BETA = *,F6.1//
X 6X,*OMEGA*,5X,*L/LAM*,5X,*FORCE*,5X,*PHASE*,4X,*MOMENT*,5X,
X *PHASE*,3X,7H*MOMENT,5X,*LAM/L*)
10 FORMAT(F11.4,F10.4,F10.5,F10.3,F10.5,F10.3,F10.5,F10.4)
12 FORMAT(1X,F10.4,4F10.6)
13 FORMAT(1X,F10.4,8F10.6)
14 FORMAT(1X,F10.4,12F10.6)
150 FORMAT(1H0,80X,*HULL SEPARATION/BEAM = *,F7.4)
202 FORMAT(6X,*FN = *,F5.3/6X,*BETA = *,F6.1/10X,*OMEGA*,5X,*HEAVE*,
X 5X,*PHASE*,5X,*PITCH*,5X,*PHASE*,5X,*LAM/L*)
203 FORMAT((5X,F10.3,2(F10.5,F10.3),F10.4))
204 FORMAT(6X,*EQUATIONS OF MOTION SOLVED USING DAMPING*,
X * COEFFICIENTS EXCLUDING CROSS-FLOW DRAG.*)
205 FORMAT(6X,*EQUATIONS OF MOTION SOLVED USING EXCITING FORCE*,
X * INCLUDING FIN AND BODY LIFT CONTRIBUTIONS.*)
206 FORMAT(6X,*EQUATIONS OF MOTION SOLVED WITH VISCOUS*,
X * CROSS-FLOW DAMPING EFFECTS.*)
500 FORMAT(5X,*MOTION AMP FAILED TO CONVERGE FOR BETA =*,F8.2,
X *FN =*,F8.4,* LAST 2 VALUES =*,E12.5,* AND*,E12.5,
X *CALCULATION CONTINUES.*)
501 FORMAT(5X,*ITERATION NOT USED. MAX AMP =*,E12.5)
502 FORMAT(1X,I2)
IF(1.EQ.0) CALL PGM1B
SUI=SD(ISD)
DVOL=1./VOL
IF(IG.NE.3) GO TO 29
CALL SOLVE(2,DVOL,DVOL,1,NFN,1,NBTA,1,NFR)

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KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
WRITE(6,204)
DU 28 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 28
LMP=LMT+5
DU 27 MM=1,NBTA
IF(55-KR.GE.LMP) GO TO 26
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
WRITE(6,204)
26 WRITE(6,202) FN(JJ),WANG(MM)
WRITE(6,203) (OMEN(N),EGH(JJ,N,MM),ENP(JJ,N,MM),RWS(JJ,N,MM),
X N=1,LMT)
KR=KR+LMP
27 CONTINUE
28 CONTINUE
29 CONTINUE
ELEL=EL*EL
EL3=ELEL*EL
RVOL=EL3*VOL
DEPAL=DEPA/EL
DEPBL=DEPB/EL
DEPCAL=DEPCAT/EL
FALP=PST-FAL
FBLP=PST-FBL
FALP2=FALP*FALP
FBLP2=FBLP*FBLP
CSCA=.5*CHRDA*SPNA*CLFA
CSCB=.5*CHRDB*SPNB*CLFB
IF(CLFA.LE.0. .AND. CLFB.LE.0. .AND. XZVL.EQ.0.) GO TO 399
DU 80 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 80
FNJ=FN(JJ)
IVISF=.5*II*FNJ*XZVL
FNJ=FNJ/ELEL
DU 81 MM=1,NBTA
CUSB=COSBET(MM)
SINB=SINBET(MM)
SSINB=SUI*SINB
DU 81 N=1,LMT
CAY=WN(JJ,N,MM)
F3V=(0.,0.)
F5V=(0.,0.)
IKC=II*CAY*CUSB
END=EXP(-CAY*DEPCAL)
DU 75 K=1,NUS
XIP=PST-SS(K)

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IF (DEPCAT.E(4.0.) EKD=EXP(-CAY*AREA(K)*DRFT(K))
CPET=EKD*AVBM(K)*CEXP(IKC*XIP)*DS(K)
F3V=F3V-CPET
75 F5V=F5V+XIP*CPET
CCON=IVISF*WFR(JJ,N,MM)*COS(CAY*SSINB)
CAYB=CAY*SINB
FEXF=FNJ*WFR(JJ,N,MM)
CA=-II*FEXF*CSCA*EXP(-CAY*DEPAL)*COS(CAYB*FAY)*CEXP(IKC*FALP)
CB=-II*FEXF*CSCB*EXP(-CAY*DEPBL)*COS(CAYB*FBY)*CEXP(IKC*FBLP)
EFH(JJ,N,MM)=EFH(JJ,N,MM)+CA+CB+CCON*F3V
81 EMP(JJ,N,MM)=EMP(JJ,N,MM)-FALP*CA-FBLP*CB+CCON*F5V
80 CONTINUE
IF(IG.NE.3) GO TO 39
CALL SOLVE(2,DVOL,DVOL,1,NFN,1,NBTA,1,NFR)
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
WRITE(6,205)
DU 38 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 38
LMP=LMT+5
DU 37 MM=1,NBTA
IF(55-KR.GE.LMP) GO TO 31
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
WRITE(6,205)
31 WRITE(6,202) FN(JJ),WANG(MM)
WRITE(6,203) (OMEN(N),EGH(JJ,N,MM),ENP(JJ,N,MM),RWS(JJ,N,MM),
X N=1,LMT)
KR=KR+LMP
37 CONTINUE
38 CONTINUE
39 CONTINUE
399 IF(XZVL+XZFU+XZFA+XZFB.GT.0.) GO TO 34
DU 36 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 36
DU 35 N=1,LMT
DU 35 MM=1,NBTA
EFH(JJ,N,MM)=EFH(JJ,N,MM)/AMP1
35 EMP(JJ,N,MM)=EMP(JJ,N,MM)/AMP2
36 CONTINUE
GO TO 76
34 CUN=(-CSCA*FALP-CSCB*FBLP)*EL/RVUL
DU 51 JJ=1,NFN
DU 51 N=1,NFR
EPK(JJ,N,1)=B33(JJ,N,1)
EPK(JJ,N,2)=B35(JJ,N,1)
EPK(JJ,N,3)=B53(JJ,N,1)
51 DP(JJ,N)=B55(JJ,N,1)

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DU 714 JJ=1,NFN
LMT=MIL(JJ)
IF (LMT.LE.0) GO TO 714
DU 713 MM=1,NBTA
ILOOP=-1
DU 53 N=1,LMT
SEFH(JJ,N,MM)=EFH(JJ,N,MM)/AMP1
53 SEMP(JJ,N,MM)=EMP(JJ,N,MM)/AMP2
555 ILOOP=ILOOP+1
IF (ILOOP.LE.0) GO TO 52
DU 56 N=1,LMT
EFH(JJ,N,MM)=EFH(JJ,N,MM)*AMP1
56 EMP(JJ,N,MM)=EMP(JJ,N,MM)*AMP2
52 CALL SOLVE(2,DVOL,DVOL,JJ,JJ,MM,MM,1,LMT)
IF (IG.NE.3) GO TO 25
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
WRITE(6,206)
LMP=LMT+4
IF (55-KR.GE.LMP) GO TO 24
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
WRITE(6,206)
24 WRITE(6,202) FN(JJ),WANG(MM)
WRITE(6,203) (OMEN(N),EGH(JJ,N,MM),ENP(JJ,N,MM),
X RWS(JJ,N,MM),N=1,LMT)
KR=KR+LMP
25 IF (NLOOP.LE.1) GO TO 55
DU 54 N=1,LMT
54 DTMA(N)=REAL(EGH(JJ,N,MM))
EGHMX=EGHMX
EGHMX=XMAX(LMT,DTMA)
IF (EGHMX.LT..8) GO TO 556
IF (ILOOP.LE.0) GO TO 55
IF (ABS(EGHMX-EGHMXL)/EGHMXL.LE.1) GO TO 557
55 CSXA=CHRDA*SPNA*XZFA
CSXB=CHRDB*SPNB*XZFB
C .21221=2/(3*PI)
C .005=A/EL=EMPIRICAL FACTOR
C XZFUC=(.005*EL)*.21221*XZF0/EL
XZFUC=.001061*XZF0
VISM=XZFUC/VOL
DU 712 N=1,LMT
GX1=OMEN(N)
VISP=VISM*GX1
EFH(JJ,N,MM)=EFH(JJ,N,MM)/AMP1
EMP(JJ,N,MM)=EMP(JJ,N,MM)/AMP2
ZRH=REAL(EGH(JJ,N,MM))
ZRP=REAL(ENP(JJ,N,MM))
ZIH=AIMAG(EGH(JJ,N,MM))/57.295779
ZIP=AIMAG(ENP(JJ,N,MM))/57.295779

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CZIH=ZRH*CEXP(-II*ZIH)
CZIP=2.*ZRP*CEXP(-II*ZIP)
CAY=WN(JJ,N,MM)
OMEW=WFR(JJ,N,MM)
PROA=0.
PRUM=0.
PROI=0.
F3V=(0.,0.)
F5V=(0.,0.)
WDW=OMEW/GXI
IKS=II*CAY
IKC=IKS*COSBET(MM)
IKS=IKS*SINBET(MM)
IKSS=IKS*SDI
EXPL=CEXP(IKSS)
EXMN=CEXP(-IKSS)
WEXPL=WDW*EXPL
WEXMN=WDW*EXMN
EKD=EXP(-CAY*DEPCAL)
DO 575 K=1,NOS
AVB=AVBM(K)
DST=DS(K)
XIP=PST-SS(K)
IF(DEPCAT.EQ.0.) EKD=EXP(-CAY*AREA(K)*DRFT(K))
CEX=EKD*CEXP(IKC*XIP)
CPART=CZIH-CZIP*XIP
VZEROP=CABS(CPART-WEXPL*CEX)
VZEROM=CABS(CPART-WEXMN*CEX)
AVV=AVB*(VZEROP+VZEROM)*DST
PROA=PROA+AVV
AVV=XIP*AVV
PRUM=PRUM+AVV
PROI=PROI+XIP*AVV
AVC=AVB*CEX*(VZEROP*EXPL+VZEROM*EXMN)*DST
F3V=F3V+AVC
575 F5V=F5V+XIP*AVC
EKDA=EXP(-CAY*DEPAL)
EKDB=EXP(-CAY*DEPBL)
CEXAL=WDW*EKDA*CEXP(IKC*FALP)
CEXBL=WDW*EKDB*CEXP(IKC*FBLP)
CPARTA=CZIH-FALP*CZIP
CPARTB=CZIH-FBLP*CZIP
IKSS=IKS*FAY
PARTA=CABS(CPARTA-CEXAL*CEXP(IKSS))+CABS(CPARTA-CEXAL*CEXP(IKSS))
IKSS=IKS*FBY
PARTB=CABS(CPARTB-CEXBL*CEXP(IKSS))+CABS(CPARTB-CEXBL*CEXP(-IKSS))
CUN=.21221*GX I/RVOL
VUPA=CON*CSXA*PARTA
VUPB=CON*CSXB*PARTB
CUN=.21221*GX I*GX I/EL3
PARTA=CON*CSXA*PARTA
PARTB=CON*CSXB*PARTB
CUN=XZFOC*GX I*OMEW
EFH(JJ,N,MM)=SEFH(JJ,N,MM)+II*(-CON*F3V-PARTA*CEXAL-PARTB*CEXBL)/
X  AMPI

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EMP(JJ,N,MM)=SEMP(JJ,N,MM)+II*(CON*FSV+FALP*PARTA*CEXAL+FBLP*
X PARTB*CEXBL)/AMP2
B33(JJ,N,MM)=EPK(JJ,N,1)+VISP*PROA+VOPA+VDPB
CON=-VISP*PRON-VOPA*FALP-VDPB*FBLP
B35(JJ,N,MM)=EPK(JJ,N,2)+CON
B53(JJ,N,MM)=EPK(JJ,N,3)+CON
712 B55(JJ,N,MM)=DP(JJ,N)+VISP*PROI+FALP2*VOPA+FBLP2*VDPB
IF(NLOOP.LE.1) GO TO 713
IF(ILOOP.LE.NLOOP) GO TO 555
WRITE(6,500) WANG(MM),FN(JJ),EGHMXL,EGHMX
GO TO 558
556 WRITE(6,501) EGHMX
557 DO 715 N=1,LMT
EFH(JJ,N,MM)=EFH(JJ,N,MM)/AMP1
715 EMP(JJ,N,MM)=EMP(JJ,N,MM)/AMP2
558 WRITE(6,502) ILOOP
713 CONTINUE
714 CONTINUE
76 IF(IG.LE.0) GO TO 77
DO 85 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 85
DO 84 MM=1,NBTA
DO 84 N=1,LMT
ZRH=CABS(EFH(JJ,N,MM))
ZRP=CABS(EMP(JJ,N,MM))
IF(ZRH.LE.0.) GO TO 87
ZIH=-57.295779*ATAN2(AIMAG(EFH(JJ,N,MM)),REAL(EFH(JJ,N,MM)))
IF(ZIH.GT.90.) ZIH=ZIH-360.
EGH(JJ,N,MM)=CMPLX(ZRH,ZIH)
GO TO 88
87 EGH(JJ,N,MM)=(0.,0.)
88 IF(ZRP.LE.0.) GO TO 90
ZIP=-57.295779*ATAN2(AIMAG(EMP(JJ,N,MM)),REAL(EMP(JJ,N,MM)))
IF(ZIP.LT.-270.) ZIP=ZIP+360.
ENP(JJ,N,MM)=CMPLX(ZRP,ZIP)
EPK(JJ,N,MM)=ZRP/WN(JJ,N,MM)
GO TO 84
90 ENP(JJ,N,MM)=(0.,0.)
EPK(JJ,N,MM)=0.
84 CONTINUE
85 CONTINUE
IF(IG.LT.2) GO TO 111
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150) RATIO
KR=0
NFP=NFR+5
DO 40 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 40
GO TO(41,42,43),NBTA
41 WRITE(6,2) FN(JJ),WANG(1)
WRITE(6,12) (OMEN(N),B33(JJ,N,1),B35(JJ,N,1),B53(JJ,N,1),
X B55(JJ,N,1),N=1,LMT)

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      GO TO 45
42  WRITE(6,3) FN(JJ),WANG(1),WANG(2)
      WRITE(6,13) (OMEN(N),(B33(JJ,N,MM),B35(JJ,N,MM),B53(JJ,N,MM),
      X  B55(JJ,N,MM),MM=1,2),N=1,LMT)
      GO TO 45
43  WRITE(6,4) FN(JJ),(WANG(I),I=1,3)
      WRITE(6,14) (OMEN(N),(B33(JJ,N,MM),B35(JJ,N,MM),B53(JJ,N,MM),
      X  B55(JJ,N,MM),MM=1,3),N=1,LMT)
45  IF(JJ.EQ.NFN) GO TO 40
      KR=KR+NFP
      IF(55-KR.GE.NFP) GO TO 40
      KR=0
      NPAG=NPAG+1
      WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
      WRITE(6,150) RATIO
40  CONTINUE
111 NPAG=NPAG+1
      WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
      WRITE(6,150) RATIO
      WRITE(6,6)
      WRITE(6,7)
      NPAG=NPAG+1
      WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
      WRITE(6,150) RATIO
      KR=0
      DO 100 JJ=1,NFN
      LMT=MIL(JJ)
      IF(LMT.LE.0) GO TO 100
      LMP=LMT+5
      IF(KASE(JJ).NE.0) LMP=LMP+1
      DO 110 MM=1,NBTA
      IF(55-KR.GE.LMP) GO TO 103
      KR=0
      NPAG=NPAG+1
      WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
      WRITE(6,150) RATIO
103 IF(KASE(JJ).EQ.0) GO TO 101
      WRITE(6,8) FN(JJ),WANG(MM),KASE(JJ),CWR1(JJ),CWR2(JJ)
      GO TO 102
101 WRITE(6,9) FN(JJ),WANG(MM)
102 WRITE(6,10) (OMEN(N),SWR(JJ,N,MM),EGH(JJ,N,MM),ENP(JJ,N,MM),
      X  EPK(JJ,N,MM),RWS(JJ,N,MM),N=1,LMT)
      KR=KR+LMP
110 CONTINUE
100 CONTINUE
77  CONTINUE
      CALL AERTRNK
      END

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SUBROUTINE SOLVE (IOPT, CONEFH, CONEMP, IFNF, IFNL, IBTAF, IBTAL,
X              IFRF, IFRL)
C
COMMON/HP1/ NPAG, TITLE (8), PATT (7), RATIO
COMMON/HP2/ ID, IG, IP, IND, ISD, ISART, JA, JB, JC, K, LP, MAXD, MONO, MS,
X          NIX, NLOOP, NSD, NSO, NSTR, NUX
COMMON/HP3/ NOS, NM (30), BEAM (30), DRFT (30), AREA (30), MPS (30),
X          AVBM (30), ST (30), IN (30), SQAR (30), X (30, 20), Y (30, 20)
COMMON/HP4/ NUT, NON, NOE, XS (20), YS (20), XX (19), YY (19), DEL (19),
X          SNE (19), CSE (19)
COMMON/HP5/ VOL, XIP, DST, PST, BAM, DRT, AIR, AMP1, AMP2, DS (30), SS (30)
COMMON/HP6/ NOW, NOL, NSP, NST, WINK (5), SHLT (6), SPEED (6), STAT (20)
COMMON/HP7/ NFN, NFNS, FN (6), FNS (6)
COMMON/HP8/ NBTA, NBTAS, NBTAT, NBTAG, WANG (8), COSBET (3), SINBET (3)
COMMON/HP9/ NFR, NFRS, OMEN (30), OMENS (30), OMIN, OMAX, DUME, UWAX
COMMON/HP10/ XZFU, XZVL, XZHB, XZPH, KV, KW
COMMON/HP11/ CHRDA, THKA, SPNA, FAL, XZFA, CLFA, DEPA, FAY
COMMON/HP12/ CHRDB, THKB, SPNB, FBL, XZFB, CLFB, DEPB, FBY
COMMON/HP13/ GRAV, DEPCAT, SD (6), RBMST (10)
COMMON/HP14/ EL, GCB, GYR, RGY, VCG, BRCL, RF33, RP35, RM55
COMMON/HP15/ A33 (30), A35 (4, 30), A53 (4, 30), A55 (4, 30), C35S, C55S,
X          B33 (4, 30, 3), B35 (4, 30, 3), B53 (4, 30, 3), B55 (4, 30, 3)
COMMON/HP16/ AHP (30), DHP (4, 30), AP (30), DP (4, 30)
COMMON/HP17/ OMEGA, UN, PAH (19), PVH (19)
COMMON/HP18/ BLOG (19, 19), YLOG (19, 19)
COMMON/HP19/ KASE (4), MIL (4), CWR1 (4), CWR2 (4), WFR (4, 30, 3),
X          WN (4, 30, 3), SWR (4, 30, 3), RWS (4, 30, 3)
COMMON/HP20/ II, EFH (4, 30, 3), EMP (4, 30, 3), EMK (4, 30, 3)
COMPLEX II, EFH, EMP

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C
C END OF COMMON DECK
C (MAKE ALL CHANGES ABOVE THESE CARDS)
C

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COMMON/ENDCOM/ENDCOM

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C
COMPLEX EGH, ENP
COMMON/PR23/ EGH (4, 30, 3), ENP (4, 30, 3)
DIMENSION TUD (4, 4), BOD (4, 1), INDEX (4, 3)

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C
DO 10 JJ=IFNF, IFNL
LMT=MIL (JJ)
IF (LMT.LT. IFRF) GO TO 10
IFRLL=IFRL
IF (LMT.LT. IFRL) IFRLL=LMT
FNJ2=FN (JJ) **2
C35=RP35+FNJ2*C35S
C55=RM55+FNJ2*C55S
DO 20 N=IFRF, IFRLL
DO 30 MM=IBTAF, IBTAL
GXI=OMEN (N)
GX2=GXI*GXI
TUD (1, 1)=-GX2*(A33 (N)+1.0)+RF33
TUD (1, 2)=-GX2*A35 (JJ, N)+C35
TUD (1, 3)=GXI*B33 (JJ, N, MM)

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TUD(1,4)=GXI*B35(JJ,N,MM)
TUD(2,1)=-GX2*A53(JJ,N)+RP35
TUD(2,2)=-GX2*(A55(JJ,N)+GYR)+C55
TUD(2,3)=GXI*B53(JJ,N,MM)
TUD(2,4)=GXI*B55(JJ,N,MM)
TUD(3,1)=-TUD(1,3)
TUD(3,2)=-TUD(1,4)
TUD(3,3)=TUD(1,1)
TUD(3,4)=TUD(1,2)
TUD(4,1)=-TUD(2,3)
TUD(4,2)=-TUD(2,4)
TUD(4,3)=TUD(2,1)
TUD(4,4)=TUD(2,2)
BOD(1,1)=CONEFH*REAL(EFH(JJ,N,MM))
BOD(2,1)=CONEMP*REAL(EMP(JJ,N,MM))
BOD(3,1)=CONEFH*AIMAG(EFH(JJ,N,MM))
BOD(4,1)=CONEMP*AIMAG(EMP(JJ,N,MM))
CALL MATINS(TUD,4,4,BOD,1,1,DTRM,ID,INDEX)
GO TO(32,33),ID
33 EFH(JJ,N,MM)=(0.,0.)
    EMP(JJ,N,MM)=(0.,0.)
    IF(IOPT.EQ.3) EMK(JJ,N,MM)=0.
    GO TO 30
32 ZRH=SQRT(BOD(1,1)**2+BOD(3,1)**2)
    ZIH=-57.295779*ATAN3(BOD(3,1),BOD(1,1))
    ZRP=0.5*SQRT(BOD(2,1)**2+BOD(4,1)**2)
    ZIP=-57.295779*ATAN3(BOD(4,1),BOD(2,1))
    IF(ZIH.GT.90.) ZIH=ZIH-360.
    IF(ZIP.LT.-270.) ZIP=ZIP+360.
    EGH(JJ,N,MM)=CMPLX(ZRH,ZIH)
    ENP(JJ,N,MM)=CMPLX(ZRP,ZIP)
    IF(IOPT.EQ.3) EMK(JJ,N,MM)=2.*ZRP/WN(JJ,N,MM)
30 CONTINUE
20 CONTINUE
10 CONTINUE
    RETURN
    END

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PROGRAM QPGM3

C

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COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NUN,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),UP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLUG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

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C

END OF COMMON DECK

C

(MAKE ALL CHANGES ABOVE THESE CARDS)

C

COMMON/ENDCOM/ENDCOM

C

COMPLEX EGH,ENP

C

COMMON/PR23/ EGH(4,30,3),ENP(4,30,3)

C

I FORMAT(1H0,5X,*MOTION AMPLITUDES AND PHASES*////

```

X 6X,*THE HEAVE AMPLITUDE IS SCALED BY A.*//
X 6X,*THE PITCH AMPLITUDE IS SCALED BY 2*,1H*,*A/L.*//
X 6X,1H*,*PITCH DENOTES PITCH AMPLITUDE SCALED BY A*,1H*,
X *(WAVE NUMBER).*//
X 6X,*A IS THE WAVE AMPLITUDE.*////
X 6X,*FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT*,6H(G*L).//
X 6X,*BETA IS THE WAVE HEADING ANGLE IN DEGREES.*//
X 6X,*BETA = 180. FOR HEAD SEAS.*//
X 6X,*OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY*,
X * SQRT(G/L).*//
X 6X,*THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE *
X *WAVE AT THE CG.*//
X 6X,*L/LAM IS L/(WAVE LENGTH).*//
X 6X,*FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO *,
X *THREE*/6X,*REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED *,
X *CWR1 AND CWR2.*)

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5 FORMAT(1H1,I4A6,18X,A6,I4/)
8 FORMAT(1H0,5X,*MOTION AMPLITUDES AND PHASES*/6X,*FN = *,F5.3/
X 6X,*BETA = *,F6.1/ 6X,*REGION*,I1,* CWR1 = *,F9.4,* CWR2 = *,
X F9.4//6X,*OMEGA*,5X,*L/LAM*,5X,*HEAVE*,5X,*PHASE*,5X,*PITCH*,
X 5X,*PHASE*,4X,1H*,*PITCH*,5X,*LAM/L*)
9 FORMAT(1H0,5X,*MOTION AMPLITUDES AND PHASES*/6X,*FN = *,F5.3/
X 6X,*BETA = *,F6.1//6X,*OMEGA*,5X,*L/LAM*,5X,*HEAVE*,5X,*PHASE*,
X 5X,*PITCH*,5X,*PHASE*,4X,1H*,*PITCH*,5X,*LAM/L*)
10 FORMAT(F11.4,F10.4,F10.5,F10.3,F10.5,F10.3,F10.5,F10.4)
150 FORMAT(1H0,80X,23HHULL SEPARATION/BEAM = F7.4)
IF(1.EQ.0) CALL PGM1B
CUN=AMP2/VOL
CALL SOLVE(3,RF33,CON,1,NFN,1,NBTA,1,NFR)
DU 20 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 20
DU 30 N=1,LMT
DU 30 MM=1,NBTA
EFH(JJ,N,MM)=EGH(JJ,N,MM)
30 EMP(JJ,N,MM)=ENP(JJ,N,MM)
20 CONTINUE
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150)RATIO
WRITE(6,1)
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150)RATIO
DU 44 MM=1,NBTA
DU 40 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 40
LMP=LMT+4
IF(KASE(JJ).NE.0) LMP=LMP+1
IF(55-KR.GE.LMP) GO TO 43
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,150)RATIO
43 IF(KASE(JJ).EQ.0) GO TO 41
WRITE(6,8) FN(JJ),WANG(MM),KASE(JJ),CWR1(JJ),CWR2(JJ)
GO TO 42
41 WRITE(6,9) FN(JJ),WANG(MM)
42 WRITE(6,10) (OMEN(N),SWR(JJ,N,MM),EFH(JJ,N,MM),EMP(JJ,N,MM),
X EMK(JJ,N,MM),RWS(JJ,N,MM),N=1,LMT)
KR=KR+LMP
40 CONTINUE
44 CONTINUE
CALL AERTRN
END

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SUBROUTINE NILS(NOS,MS,ST,DS,JFK)
DIMENSION ST(30),DS(30)
81 FORMAT(1H0,5X,33HINCORRECT STATION SPACINGS - STOP)
1 DO 5 K=1,NOS
5 DS(K)=0.0
NSM=NOS-2
NSX=2*(NOS/2)
IF(NSX.EQ.NOS) GO TO 11
DO 10 K=1,NSM,2
D1=ST(K+1)-ST(K)
D2=ST(K+2)-ST(K+1)
IF(ABS(D1-D2).GT.0.001) GO TO 777
D=0.1*D2*0.16666667
DS(K)=DS(K)+D
DS(K+1)=DS(K+1)+4.0*D
DS(K+2)=DS(K+2)+D
10 CONTINUE
GO TO 78
11 IF((2*(MS/2)).EQ.MS) GO TO 12
MS1=MS-2
GO TO 13
12 MS1=MS-1
13 MS2=MS1+1
MS3=MS2+1
MS4=MS3+1
IF((MS1.LT.3).OR.(MS4.GT.NSM)) GO TO 777
MS0=MS1-2
DO 20 K=1,MS0,2
D1=ST(K+1)-ST(K)
D2=ST(K+2)-ST(K+1)
IF(ABS(D1-D2).GT.0.001) GO TO 777
D=0.1*D2*0.16666667
DS(K)=DS(K)+D
DS(K+1)=DS(K+1)+4.0*D
DS(K+2)=DS(K+2)+D
20 CONTINUE
D1=ST(MS2)-ST(MS1)
D2=ST(MS3)-ST(MS2)
D3=ST(MS4)-ST(MS3)
IF((ABS(D1-D2).GT.0.001).OR.(ABS(D2-D3).GT.0.001)) GO TO 777
D=0.15*D2*0.125
DS(MS1)=DS(MS1)+D
DS(MS2)=DS(MS2)+3.0*D
DS(MS3)=DS(MS3)+3.0*D
DS(MS4)=DS(MS4)+D
DO 30 K=MS4,NSM,2
D1=ST(K+1)-ST(K)
D2=ST(K+2)-ST(K+1)
IF(ABS(D1-D2).GT.0.001) GO TO 777
D=0.1*D2*0.16666667
DS(K)=DS(K)+D
DS(K+1)=DS(K+1)+4.0*D
DS(K+2)=DS(K+2)+D
30 CONTINUE
78 JFK=1
GO TO 77
777 JFK=0
WRITE(6,81)
77 RETURN
END

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C

SUBROUTINE QDFCN

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COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),URFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,UMAX,DUME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BKCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

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DO 10 JJ=1,NFN
KASE(JJ)=KASE(1)
MIL(JJ)=0
CWR1(JJ)=0.0
CWR2(JJ)=0.0
DO 10 MM=1,NBTA
DO 10 N=1,NFR
WFR(JJ,N,MM)=0.
WN(JJ,N,MM)=0.
10 SWR(JJ,N,MM)=0.
IF(JC.EQ.2) GO TO 2
DO 20 JJ=1,NFN
MIL(JJ)=NFR
DO 20 MM=1,NBTA
FNC=FN(JJ)*COSBET(MM)
IF(ABS(FNC).LE.1.E-06) GO TO 31
DO 30 N=1,NFR
TAU=OMEN(N)*FNC
WFR(JJ,N,MM)=.5*(1.-SQRT(1.-4.*TAU))/FNC
WN(JJ,N,MM)=WFR(JJ,N,MM)*WFR(JJ,N,MM)
30 SWR(JJ,N,MM)=WN(JJ,N,MM)/6.2831853

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31   GU TO 20
    DU 35 N=1,NFR
      WFR(JJ,N,MM)=OMEN(N)
      WN(JJ,N,MM)=OMEN(N)*OMEN(N)
35   SWR(JJ,N,MM)=WN(JJ,N,MM)/6.2831853
20   CONTINUE
    GU TO 7

C
C   FOLLOWING SEA CALCULATIONS
C
2   CONTINUE
    DU 40 MM=1,NBTA
      CUSB=COSBET(MM)
    DU 40 JJ=1,NFN
      FNC=FN(JJ)*CUSB
      CRT=.25/FNC
      CWRI(JJ)=2.0*CRT**2/3.1415927
      CWR2(JJ)=4.0*CWRI(JJ)
    DU 60 N=1,NFR
      IF (KASE(1).NE.3 .AND. OMEN(N).GT.CRT) GO TO 40
      MIL(JJ)=MIL(JJ)+1
      TAU=FNC*OMEN(N)
      IF (KASE(1).EQ.1) WFR(JJ,N,MM)=.5*(1.+SQRT(1.-4.*TAU))/FNC
      IF (KASE(1).EQ.2) WFR(JJ,N,MM)=.5*(1.-SQRT(1.-4.*TAU))/FNC
      IF (KASE(1).EQ.3) WFR(JJ,N,MM)=.5*(1.+SQRT(1.+4.*TAU))/FNC
      WN(JJ,N,MM)=WFR(JJ,N,MM)*WFR(JJ,N,MM)
      SWR(JJ,N,MM)=WN(JJ,N,MM)/6.2831853

60   CONTINUE
40   CONTINUE
7    RETURN
    END

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SUBROUTINE FRANK

C

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COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DOME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C355,C555,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

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C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

C

COMMON/ENDCOM/ENDCOM

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COMPLEX CEXH(4,30,3),CEXM(4,30,3),EKXCD,EKZDY,F35,G35,IDW,P3,XU
9 FORMAT(1H0,5X,31HMATRIX IS SINGULAR FOR OMEGA = F7.4)
XIP2=XIP*XIP
CMONO=1.
IF(MONO.EQ.2) CMONO=2.
SAREA=AREA(K)*BEAM(K)*DRFT(K)
IF(BEAM(K).LE.1.E-08) SAREA=AREA(K)*DRFT(K)**2
IF(MPS(K).NE.1) CALL FINIT
DO 10 N=1,NFR
OMEGA=OMEN(N)
UN=OMEGA*OMEGA
IDW=II/OMEGA
IF(MPS(K).NE.1) GO TO 12
DHHA=EMK(1,N,1)
DHHB=EMK(2,N,1)
GO TO 17
12 CALL PRESS
IF(ID.EQ.i) GO TO 11
WRITE(6,9) OMEGA
GO TO 77

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11 DHHA=0.0
   DHHB=0.0
   DU 20 I=1,NON
   CUN=CMONO*DEL(I)*CSE(I)
   DHHA=DHHA+CUN*PAH(I)
20 DHHB=DHHB+CUN*PVH(I)
   IF(MPS(K).NE.2) GO TO 17
   EMK(1,N,1)=DHHA
   EMK(2,N,1)=DHHB
17 DHPA=-XIP*DHHA
   DHPB=-XIP*DHHB
   DPPA=XIP2*DHHA
   DPPB=XIP2*DHHB
   A33(N)=A33(N)+DST*DHHA
   AHP(N)=AHP(N)+DST*DHPA
   AP(N)=AP(N)+DST*DPPA
   DU 30 JJ=1,NFN
   XU=-XIP-IDW*FN(JJ)
   CUNST=0.
   CONSA=0.
   IF(K.GE.KV.AND.K.LE.KW) GO TO 90
   CUNST=UN*SAREA*XZHB*FN(JJ)*CMONO
   CONSA = XZPB * CONST
90 B33(JJ,N,1)=B33(JJ,N,1)+DST*(DHHB+CONST)
   DP(JJ,N)=DP(JJ,N)+DST*(DPPB+CONSA*XIP2)
   DHP(JJ,N)=DHP(JJ,N)+DST*(DHPB-XIP*CONST)
89 IF(MIL(JJ).LT.N) GO TO 30
   DU 33 MM=1,NBTA
   COSB=COSBET(MM)
   SINB=SINBET(MM)
   WNT=WFR(JJ,N,MM)
   WNO=WN(JJ,N,MM)
   EKXCD=CEXP(II*WNO*XIP*COSB)*DST*CMONO
   IF(MPS(K).NE.1) GO TO 42
   F35=CEXH(JJ,N,MM)
   G35=CEXM(JJ,N,MM)
   GO TO 160
42 F35=(0.,0.)
   G35=(0.,0.)
   IF(MONO.NE.1) GO TO 32
   DU 41 I=1,NON
   EKZDY=CEXP(WNO*(YY(I)-II*XX(I)*SINB))*DEL(I)
   ETA2S=-SNE(I)*SINB
   P3=CMPLX(PAH(I),PVH(I))
   CSEI=CSE(I)
   F35=F35+CSEI*EKZDY
   G35=G35+P3*(ETA2S+II*CSEI)*EKZDY
41 CONTINUE
   G35=II*WNT/OMEGA*G35
   GO TO 18
32 DU 31 I=1,NON
   EKZD=EXP(WNO*YY(I))*DEL(I)
   CAYYS=WNO*XX(I)*SINB
   CCUSK=CSE(I)*COS(CAYYS)

```

```

SINKYS=SIN(CAYYS)
C NOTE-- ETA2=-SNE(I),   ETA3=CSE(I)
ETA2S=-SNE(I)*SINB
P3=CMPLX(PAH(I),PVH(I))
F35=F35+CCOSK*EKZD
G35=G35+(-CCOSK+ETA2S*SINKYS)*EKZD*P3
31 CONTINUE
G35=WNT/OMEGA*G35
18 IF (MPS(K).NE.2) GO TO 160
CEXH(JJ,N,MM)=F35
CEXM(JJ,N,MM)=G35
160 EFH(JJ,N,MM)=EFH(JJ,N,MM)+EKXCD*(F35+G35)
EMP(JJ,N,MM)=EMP(JJ,N,MM)+EKXCD*(-XIP*F35+XU*G35)
33 CONTINUE
30 CONTINUE
10 CONTINUE
77 RETURN
END

```

```

SUBROUTINE FINIT
COMMON/HP2/  ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X           NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP4/  NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X           SNE(19),CSE(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
DIMENSION X(20),Y(20)
EQUIVALENCE (XS,X),(YS,Y)
PI=3.1415927
DPNL=0.
DCNL=0.
PPL=0.
PCL=0.
DO 10 I=1,NON
XM1=XX(I)-X(1)
YM1=YY(I)-Y(1)
YP1=YY(I)+Y(1)
FPR1=.5*ALOG(XM1**2+YM1**2)
FCR1=.5*ALOG(XM1**2+YP1**2)
APR1=ATAN2(YM1,XM1)
ACR1=ATAN2(YP1,XM1)
IF(I .GE. MAXD) GO TO 30
IF(YM1 .LT. 0.) APR1=APR1+2.*PI
IF(YP1.GE. 0.) ACR1=-PI
30 CONTINUE
IF(MONO .EQ. 1) GO TO 35
XP1=XX(I)+X(1)
FPL1=.5*ALOG(XP1**2+YM1**2)
FCL1=.5*ALOG(XP1**2+YP1**2)
APL1=ATAN2(YM1,XP1)
ACL1=ATAN2(YP1,XP1)
35 CONTINUE
DO 10 J=1,NON
XM2=XX(I)-X(J+1)
YM2=YY(I)-Y(J+1)
YP2=YY(I)+Y(J+1)
FPR2=.5*ALOG(XM2**2+YM2**2)
FCR2=.5*ALOG(XM2**2+YP2**2)
APR2=ATAN2(YM2,XM2)
IF(I .GE. MAXD) GO TO 20
J11=J+1
IF(I .GE. J11 .AND. APR2 .LE. 0.) APR2=APR2+2.*PI
IF(J11 .GT. MAXD .AND. APR2 .LT. 0.) APR2=APR2+2.*PI
IZIP=(APR1-APR2)*10000.0
ZIP=IZIP
ZIP=ZIP/10000.0
IF(ZIP .GT. PI) APR1=APR1-2.*PI
IF(XM2 .GT. 0.) GO TO 4
GO TO 5
20 J1=J+1
IF(XM2 .GT. 0.) GO TO 4
IF(J1 .GT. I) GO TO 6
C   *** CARDS BELOW ARE FOR CONVEX OR CONCAVE TOP DECK ***
IF(YM2 .LT. 0.) APR2=APR2+2.*PI

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```

GO TO 5
C **** CARDS BELOW ARE FOR CONVEX, FLAT OR CONCAVE BOTTOM ***
6 IF (YM2 .GE. 0.) APR2=APR2-2.*PI
5 IF (YP2 .LT. 0.) GO TO 4
  ACR2=-PI
  GO TO 3
4 ACR2=ATAN2(YP2, XM2)
3 SIMJ=SNE(I)*CSE(J)-SNE(J)*CSE(I)
  CIMJ=CSE(I)*CSE(J)+SNE(I)*SNE(J)
  SIPJ=SNE(I)*CSE(J)+SNE(J)*CSE(I)
  CIPJ=CSE(I)*CSE(J)-SNE(I)*SNE(J)
  DPNR=SIMJ*(FPR1-FPR2)+CIMJ*(APR1-APR2)
  PPR=CSE(J)*(XM1*FPR1-YM1*APR1-XM1-XM2*FPR2+YM2*APR2+XM2)+SNE(J)*(Y
1M1*FPR1+XM1*APR1-YM1-YM2*FPR2-XM2*APR2+YM2)
  DCNR=SIPJ*(FCR1-FCR2)+CIPJ*(ACR1-ACR2)
  PCR=CSE(J)*(XM1*FCR1-YP1*ACR1-XM1-XM2*FCR2+YP2*ACR2+XM2)+SNE(J)*(Y
1P2*FCR2+XM2*ACR2+YP1-YP1*FCR1-XM1*ACR1-YP2)
  IF (MONO .EQ. 1) GO TO 37
  XP2=XX(I)+X(J+1)
  FPL2=.5*ALOG(XP2**2+YM2**2)
  FCL2=.5*ALOG(XP2**2+YP2**2)
  APL2=ATAN2(YM2, XP2)
  ACL2=ATAN2(YP2, XP2)
  DPNL=SIPJ*(FPL2-FPL1)+CIPJ*(APL2-APL1)
  PPL=CSE(J)*(XP2*FPL2-YM2*APL2-XP2-XP1*FPL1+YM1*APL1+XP1)+SNE(J)*(Y
1M1*FPL1+XP1*APL1+YM2-YM2*FPL2-XP2*APL2-YM1)
  DCNL=SIMJ*(FCL2-FCL1)+CIMJ*(ACL2-ACL1)
  PCL=CSE(J)*(XP2*FCL2-YP2*ACL2-XP2-XP1*FCL1+YP1*ACL1+XP1)+SNE(J)*(Y
1P2*FCL2+XP2*ACL2-YP2-YP1*FCL1-XP1*ACL1+YP1)
37 CONTINUE
  BLUG(I, J)=DPNR+DPNL-DCNR-DCNL
  YLUG(I, J)=PPR+PPL-PCR-PCL
  IF (J.EQ.NON) GO TO 10
  XM1=XM2
  YM1=YM2
  FPR1=FPR2
  FCR1=FCR2
C **** NEXT CARD HANDLES ANGLE DIFFERENCE ACROSS MAXD POINT ****
  IF (I .LT. MAXD .AND. (J+1).EQ. MAXD .AND. APR2 .LT. 0.) APR2=APR2
  1+ 2.*PI
  APR1=APR2
  ACR1=ACR2
  YP1=YP2
  IF (MONO .EQ. 1) GO TO 10
  XP1=XP2
  FPL1=FPL2
  FCL1=FCL2
  APL1=APL2
  ACL1=ACL2
10 CONTINUE
  RETURN
  END

```

```

SUBROUTINE PRESS
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
DIMENSION CUN(38,1),CT(38,38),SOUR(19,19),WAVE(19,19)
DIMENSION INDEX(38,3)
DIMENSION X(20),Y(20)
EQUIVALENCE (XS,X),(YS,Y)
DPL=0.
PPL=0.
DWL=0.
PWL=0.
DO 10 I=1,NON
NI=NON+I
CUN(I,1)=0.0
CUN(NI,1)=OMEGA*CSE(I)
22 XR1=UN*(XX(I)-X(1))
YR1=-UN*(YY(I)+Y(1))
CALL DAVID(XR1,YR1,EJ1,CXR1,SXR1,RAR1,RBR1,CR1,SR1)
IF(MONO.EQ.1) GO TO 37
XL1=UN*(XX(I)+X(1))
YL1=YR1
CALL DAVID(XL1,YL1,EJ1,CXL1,SXL1,RAL1,RBL1,CL1,SL1)
37 CONTINUE
DO 10 J=1,NON
NJ=NON+J
SIPJ=SNE(I)*CSE(J)+SNE(J)*CSE(I)
CIPJ=CSE(I)*CSE(J)-SNE(I)*SNE(J)
XR2=UN*(XX(I)-X(J+1))
YR2=-UN*(YY(I)+Y(J+1))
CALL DAVID(XR2,YR2,EJ2,CXR2,SXR2,RAR2,RBR2,CR2,SR2)
DPR=2.*(SIPJ*(CR1-CR2)-CIPJ*(SR1-SR2))
PPR=2./UN*(SNE(J)*(RAR1-RAR2)+CSE(J)*(RBR1-RBR2))
DWR=6.2831853*(EJ2*(SXR2*CIPJ-CXR2*SIPJ)-EJ1*(SXR1*CIPJ-CXR1*SIPJ)
1)
PWR=6.2831853/UN*(EJ1*(SXR1*CSE(J)-CXR1*SNE(J))-EJ2*(SXR2*CSE(J)-
1CXR2*SNE(J)))
IF(MONO.EQ.1) GO TO 38
SIMJ=SNE(I)*CSE(J)-SNE(J)*CSE(I)
CIMJ=CSE(I)*CSE(J)+SNE(I)*SNE(J)
XL2=UN*(XX(I)+X(J+1))
YL2=YR2
CALL DAVID(XL2,YL2,EJ2,CXL2,SXL2,RAL2,RBL2,CL2,SL2)
DPL=2.*(CIMJ*(SL1-SL2)-SIMJ*(CL1-CL2))
PPL=2./UN*(SNE(J)*(RAL1-RAL2)+CSE(J)*(RBL2-RBL1))
DWL=6.2831853*(EJ1*(SXL1*CIMJ-CXL1*SIMJ)-EJ2*(SXL2*CIMJ-CXL2*SIMJ)
1)
PWL=6.2831853/UN*(EJ2*(SXL2*CSE(J)+CXL2*SNE(J))-EJ1*(SXL1*CSE(J)+
1CXL1*SNE(J)))
38 CONTINUE

```

```

CT(I,J)=BLOG(I,J)+DPR+DPL
CT(NI,NJ)=CT(I,J)
CT(I,NJ)=DWR+DWL
CT(NI,J)=-CT(I,NJ)
SUUR(I,J)=YLOG(I,J)+PPR+PPL
WAVE(I,J)=PWR+PWL
IF(J.EQ.NON) GO TO 10
XR1=XR2
YR1=YR2
EJ1=EJ2
CK1=CR2
SR1=SR2
RAR1=RAR2
RBR1=RBR2
CXRI=CXR2
SXR1=SXR2
IF(MONO .EQ. 1) GO TO 10
XL1=XL2
YL1=YL2
CL1=CL2
SL1=SL2
RAL1=RAL2
RBL1=RBL2
CXL1=CXL2
SXL1=SXL2
10 CONTINUE
CALL MATINS(CT,38,NOE,CON,1,1,DTRM,IO,INDEX)
GOTO(11,77),IO
11 DO 20 I=1,NON
PAH(I)=0.0
PVH(I)=0.0
DO 30 J=1,NON
NJ=NON+J
PAH(I)=PAH(I)+CON(J,1)*WAVE(I,J)-CON(NJ,1)*SOUR(I,J)
30 PVH(I)=PVH(I)+CON(J,1)*SOUR(I,J)+CON(NJ,1)*WAVE(I,J)
PAH(I)=OMEGA*PAH(I)
20 PVH(I)=OMEGA*PVH(I)
77 RETURN
END

```

```

SUBROUTINE DAVID(X,Y,E,C,S,RA,RB,CIN,SUN)
C  DAVID - COMPUTATION OF FREQUENCY DEPENDENT PARTS OF
C  2-D POTENTIALS AND KERNELS
DIMENSION F(5),D(5)
DATA (F(I),I=1,5)/0.52175561,0.39866681,0.07594245,
1 0.003611758,0.000023369972/
DATA (D(I),I=1,5)/0.26356032,1.4134031,3.5964258,
1 7.08581,12.640801/
Q=3.1415927
AT=ATAN2(X,Y)
ARG=AT-0.5*Q
E=EXP(-Y)
C=COS(X)
S=SIN(X)
R=X**2+Y**2
AL=0.5*ALOG(R)
A=-Y
B=-X
IF(A.GE.0.0) GO TO 78
IF(B.EQ.0.0) GO TO 79
78 IF(R.GE.100.) GO TO 10
79 TEST=0.00001
IF(R.LT.1.0) GO TO 5
TEST=0.1*TEST
IF(R.LT.2.0) GO TO 5
TEST=0.1*TEST
IF(R.LT.4.0) GO TO 5
TEST=0.1*TEST
5 CONTINUE
SUMC=0.57721566+AL+Y
SUMS=AT+X
TC=Y
TS=X
DO 1 K=1,500
TU=TC
CUX=K
CAY=K+1
FACT=CUX/CAY**2
TC=FACT*(Y*TC-X*TS)
TS=FACT*(Y*TS+X*TU)
SUMC=SUMC+TC
SUMS=SUMS+TS
IF(K.GE.500) GO TO 3
IF((ABS(TC)+ABS(TS)).GT.TEST) GO TO 1
3 CIN=E*(C*SUMC+S*SUMS)
SUN=E*(S*SUMC-C*SUMS)
GO TO 4
1 CONTINUE
10 G1=0.
G2=0.
DO 20 I=1,5
DEN=(-Y+D(I))**2+X**2
GA=F(I)*(-Y+D(I))/DEN
GB=F(I)*(-X)/DEN

```

```
    G1=G1+GA
20  G2=G2+GB
    CIN=E*Q*S-G1
    SON=-(E*Q*S+G2)
    4  RA=AL-CIN
    RB=ARG+SON
    RETURN
    END
```

```
    FUNCTION ATAN3(Y,X)
C    AIN3 - MODIFICATION OF ATAN2, SETS ATAN2(0.,0.)=0.
    IF(Y)1,2,1
    2 IF(X)1,3,1
    3 ATAN3=0,0
    GO TO 4
    1 ATAN3=ATAN2(Y,X)
    4 RETURN
    END
```

```

SUBROUTINE MATINS(A,NR,N1,B,NC,M1,DETERM,ID,INDEX)
C   MATRIX INVERSION WITH ACCOMPANYING SOLUTION OF LINEAR EQUATIONS
C   PIVOT METHOD
C   FORTRAN IV SINGLE PRECISION WITH ADJUSTABLE DIMENSION
C   FEBRUARY 1966  S GOOD DAVID TAYLOR MODEL BASIN  AM MAT4
C   WHERE CALLING PROGRAM MUST INCLUDE
C     DIMENSION A(NR,NR), B(NR,NC), INDEX(NR,3)
C     N     IS THE ORDER OF A
C     M     IS THE NUMBER OF COLUMN VECTORS IN B(MAY BE 0)
C     DETERM WILL CONTAIN DETERMINANT ON EXIT
C     ID    WILL BE SET BY ROUTINE TO 2 IF MATRIX A IS SINGULAR
C           1 IF INVERSION WAS SUCCESSFUL
C     A     THE INPUT MATRIX WILL BE REPLACED BY A INVERSE
C     B     THE COLUMN VECTORS WILL BE REPLACED BY CORRESPONDING
C           SOLUTION VECTORS
C     INDEX WORKING STORAGE ARRAY
C     IF IT IS DESIRED TO SCALE THE DETERMINANT CARD      MAY BE
C     DELETED AND DETERM PRESET BEFORE ENTERING THE ROUTINE
C
EQUIVALENCE (IROW,JROW), (ICOLUM,JCOLUM), (AMAX, T, SWAP)
C           DIMENSION A(NR,NR), B(NR,NC), INDEX(NR,3)
C
C   INITIALIZATION
C
C     N=N1
C     M=M1
C     DETERM=1.
C     DO 20 J=1,N
20  INDEX(J,3) = 0
C     DO 550 I=1,N
C
C   SEARCH FOR PIVOT ELEMENT
C
C     AMAX = 0.0
C     DO 105 J=1,N
C     IF (INDEX(J,3)-1) 60, 105, 60
60  DO 100 K=1,N
C     IF (INDEX(K,3)-1) 80, 100, 715
80  IF (      AMAX -ABS (A(J,K))) 85, 100, 100
85  IROW=J
C     ICOLUM =K
C     AMAX = ABS (A(J,K))
100 CONTINUE
105 CONTINUE
C     INDEX(ICOLUM,3) = INDEX(ICOLUM,3) +1
C     INDEX(I,1)=IROW
C     INDEX(I,2)=ICOLUM
C
C   INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL
C
C     IF (IROW-ICOLUM) 140, 310, 140
140 DETERM=-DETERM
C     DO 200 L=1,N
C     SWAP=A(IROW,L)

```

```

    A(IROW,L)=A(ICOLUM,L)
200 A(ICOLUM,L)=SWAP
    IF(M) 310, 310, 210
210 DO 250 L=1, M
    SWAP=B(IROW,L)
    B(IROW,L)=B(ICOLUM,L)
250 B(ICOLUM,L)=SWAP
C
C    DIVIDE PIVOT ROW BY PIVOT ELEMENT
C
310 PIVOT  =A(ICOLUM,ICOLUM)
    DETERM=DETERM*PIVOT
330 A(ICOLUM,ICOLUM)=1.0
    DO 350 L=1,N
350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT
    IF(M) 380, 380, 360
360 DO 370 L=1,M
370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT
C
C    REDUCE NON-PIVOT ROWS
C
380 DO 550 L1=1,N
    IF(L1-ICOLUM) 400, 550, 400
400 T=A(L1,ICOLUM)
    A(L1,ICOLUM)=0.0
    DO 450 L=1,N
450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T
    IF(M) 550, 550, 460
460 DO 500 L=1,M
500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T
550 CONTINUE
C
C    INTERCHANGE COLUMNS
C
    DO 710 I=1,N
    L=N+1-I
    IF (INDEX(L,1)-INDEX(L,2)) 630, 710, 630
630 JROW=INDEX(L,1)
    JCOLUM=INDEX(L,2)
    DO 705 K=1,N
    SWAP=A(K,JROW)
    A(K,JROW)=A(K,JCOLUM)
    A(K,JCOLUM)=SWAP
705 CONTINUE
710 CONTINUE
    DO 730 K = 1,N
    IF (INDEX(K,3) -1) 715,720,715
720 CONTINUE
730 CONTINUE
    ID = 1
810 RETURN
715 IU = 2
    GO TO 810
    END

```

OVERLAY(4,0)
PROGRAM PGM4

C

COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MOND,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,OWAX
COMMON/HP10/ XZFO,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLUG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFP(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

C

C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

C

C

COMMON/ENDCOM/ENDCOM

C

DIMENSION LLT(2),LUT(2),XL(50),YL(50),TITL(8)
DIMENSION BX(30)
1 FORMAT(I9,F9.4)
IF(LP.LE.0 .AND. IP.LE.0) GO TO 77
IF(ISTART.GT.0) GO TO 9
ISTART=1
OMAX=OWAX
READ(5,1004) NAME1,NAME2,NAME3
1004 FORMAT(3A10)
CALL CAMRAV(35)
CALL IDFRMV(NAME1,NAME2,NAME3)
9 ENCODE(48,8,TITL) TITLE
8 FORMAT(8A6)
CALL FRAMEV(3)
MRK1=63
MRK2=38
IF(LP.LE.0) GO TO 77
DO 100 JIC=1,NOS
NUT=NM(JIC)

```

      BX(JIC) = 0.
      IF (NUT .LE. 0) GO TO 100
      DO 101 KIC=1,NUT
101  XL(KIC)=X(JIC,KIC)
      XSM=XMIN(NUT,XL)
      XLG=XMAX(NUT,XL)
      BX(JIC)=XLG-XSM
      BX(JIC)=ABS(BX(JIC))
100  CONTINUE
      HAM=XMAX(NOS,BX)
      DIM=XMAX(NOS,DRFT)
      RG=1.2*AMAX1(HAM,DTM)
      LLT(1)=1
      LLT(2)=MS
      LUT(1)=MS
      LUT(2)=NOS
      XB=0.
      XT=RG
      DO 5 LL=1,2
      LTL=LLT(LL)
      LTU=LUT(LL)
4  CALL GRIDIV(3,XB,XT,-RG,0.,RG,RG,-0,-0,0,0,1,1)
      CALL PRINTV(48,TITL,320,1014)
      IF(LL.GT.1) GO TO 6
      CALL PRINTV(-16,16HFORWARD STATIONS,445,9)
      GO TO 7
6  CALL PRINTV(-12,12HAFT STATIONS,465,9)
7  DO 10 K=LTL,LTU
      IF(BEAM(K).LT.0.) GO TO 10
      IF(NM(K).GE.0) GO TO 11
      HBM=0.5*BEAM(K)
      SUR=AREA(K)
      TAR=DRFT(K)/HBM
      B=3.*(1.+TAR)
      C=1.+TAR*(10.-10.185916*SUR+TAR)
      AFLA=0.5*(B-SQRT(C))
      AX=2.*(AFLA-TAR)-1.
      BZ=2.*(1.+TAR-AFLA)
      AY=2.*(AFLA-TAR)-2.
      BY=BZ
      ARG=0.
      XL(1)=0.
      YL(1)=-DRFT(K)
      DO 12 J=2,20
      ARG=ARG+0.078539817
      SE1=SIN(ARG)
      CE1=-COS(ARG)
      SE2=SE1*SE1
      CE2=CE1*CE1
      XL(J)=SE1*(AX+BZ*SE2)*HBM
      YL(J)=CE1*(AY+BY*CE2)*HBM
      IF(YL(J).LT.0.0) GO TO 12
      YL(J)=0.0
12  CONTINUE

```

```

XL(21)=HBM
YL(21)=0.
IF(LL.EQ.1) GO TO 3
DU 2 J=1,21
2 XL(J)=-XL(J)
3 DU 13 J=1,20
13 CALL DOTLNV(NXV(XL(J)),NYV(YL(J)),NXV(XL(J+1)),NYV(YL(J+1)))
CALL APLUTV(21,XL,YL,1,1,1,MRK2,IERR)
GO TO 10
11 NUT=NM(K)
IF (NUT .EQ. 0) GO TO 10
NON=NUT-1
SIGN=1.
IF(LL.EQ.2) SIGN=-1.
HRG=.5*RG
DU 14 J=1,NUT
XL(J)=SIGN*X(K,J)+HRG
14 YL(J)=Y(K,J)
DU 15 J=1,NON
15 CALL LINEV(NXV(XL(J)),NYV(YL(J)),NXV(XL(J+1)),NYV(YL(J+1)))
CALL APLUTV(NUT,XL,YL,1,1,1,MRK1,IERR)
10 CONTINUE
5 CONTINUE
777 CALL FRAMEV(3)
CALL PLTND (0)
77 CONTINUE
CALL AETSKC(5LMOT35)
END

```

OVERLAY(5,0)
PROGRAM PGMS

C

COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NUN,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PST,BAM,URT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SMLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NHTA,NHTAS,NBTAT,NHTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/HP9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,UWAX
COMMON/HP10/ XZFO,XZVL,XZHR,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDB,THKB,SPNB,FBL,XZFB,CLFR,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),DP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

C

C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

C

C

COMMON/ENDCOM/ENDCOM

C

DIMENSION SWH(5)
EQUIVALENCE (SWH,WINK)
DIMENSION WURT(2),STA(23),OMENC(51),UWAVE(51),WAVEN(51),ELOLA(51),
10UMEN2(51),HEAVE(51),PITCH(51),SSPEC(51),DELTA(51),EPSIL(51),HEAV2(
251),PITC2(51),ABMO(51),HSPEC(51),PSPEC(51),ADSP(51),AVSP(51),ACSP(
351),RDSP(51),RVSP(51),RASP(51),UWAK(5),UMAK(5),URES(5),URESV(5),
40RESA(5),FITCH(51)
DIMENSION SPROB(23),SNUM(23),RVELS(23),RMOTS(23)
DIMENSION ABMOL(51,20),RDSPL(51,20)
DATA WORT /6H ABS. /6H REL. /
1 FORMAT(6X,25HOUTPUT FOR IRREGULAR SEAS)
2 FORMAT(1H0,5X,20HWAVE HEIGHTS IN FEET/6X,14HSIGNIFICANT = F6.2,5X,
11H AVERAGE = F6.2,5X,25H1/10TH HIGHEST AVERAGE = F6.2//6X,12HSEA S
2TATE = I1//6X,23HWAVE PERIODS IN SECONDS/6X,23HSIGNIFICANT RANGE F
3RUM F6.2,4H TO F6.2,5X,22HPER. OF MAX. ENERGY = F6.2,5X,10H AVERAGE
4 = F6.2//6X,22H AVERAGE WAVE LENGTH = F7.2,5H FEET//6X,99H THE WAVE
5HEIGHTS, AVERAGE WAVE LENGTH AND PERIODS ARE COMPUTED FROM THE PIE
6RSON-MOSKOWITZ SPECTRUM.)
3 FORMAT(6X,26HSIGNIFICANT WAVE HEIGHT = F6.2,4H FT.,5X,14HSHIP LENG
1TH = F7.2,4H FT.,5X,13HSHIP SPEED = F5.2,6H KNOTS,5X,13HFROUDE NO.

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2 = F5.3)
4 FORMAT(1H0,8X,10HENC. FREQ.,8X,10HWAVE FREQ.,10X,8HL/LAMBDA,6X,12H
1SEA SPECTRUM,4X,14HHEAVE SPECTRUM,4X,14HPITCH SPECTRUM/11X,8HPER S
2EC.,10X,8HPER SEC.,22X,14HIN SEC.*FT.**2,4X,14HIN SEC.*FT.**2,4X,1
34HIN SEC.*FT.**2)
5 FORMAT(1H1,14A6,18X,A6,I4/)
6 FORMAT(1X,6F18.6)
7   FORMAT(1H0,5X,15HPITCH RESPONSES)
8   FORMAT(16X,32HDISPLACEMENT IN FEET AND DEGREES,2X,34HVELOCITY IN F
IT. AND DEGS. PER SEC.,3X,33HACC. IN FT. AND DEGS. PER SEC.**2)
9   FORMAT(18X,30H AVERAGE SIGNIF. 1/10TH H.A.,6X,30H AVERAGE SIGN
1IF. 1/10TH H.A.,6X,30H AVERAGE SIGNIF. 1/10TH H.A.)
10  FORMAT(3X,13HAS BOW MOTION,2X,3(3F10.3,6X))
11  FORMAT(1H0,5X,48HABSOLUTE AND RELATIVE VERTICAL MOTION ALONG SHIP)
12  FORMAT(20X,29HVERTICAL DISPLACEMENT IN FEET,14X,22HVERT. VEL. IN F
IT./SEC.,9X,27HVERT. ACC. IN FT./SEC./SEC.)
13  FORMAT(6X,6H STAT.,6X,30H AVERAGE SIGNIF. 1/10TH H.A.,6X,30H AVE
IRAGE SIGNIF. 1/10TH H.A.,6X,30H AVERAGE SIGNIF. 1/10TH H.A.)
14  FORMAT(6X,F6.2,A6,3(3F10.3,6X))
16  FORMAT(3X,13HANGULAR PITCH,2X,3(3F10.3,6X))
17  FORMAT(1H0,5X,47HSTATISTICAL DESCRIPTION OF FULLY DEVELOPED SEAS)
18  FORMAT(18X,28HINSUFFICIENT FREQUENCY RANGE)
19  FORMAT(6X,F6.2,A6,6X,28HINSUFFICIENT FREQUENCY RANGE)
567 FORMAT(6X,*WAVE HEADING ANGLE = *,F7.2,* DEG. *)
NFP=NFR+1
IF (GRAV.GT.32.) GO TO 21
WRITE(6,20)
20  FORMAT(10X,*PGM5 REQUIRES THAT FEET BE USED FOR LENGTH UNITS.*)
CALL AETSKC(5LMUT35)
21  CUNST=.0081*GRAV*GRAV
FRAD=57.295779
FARD=0.017453293
IF (NST.GT.0) GO TO 51
NST=0
51  NTS=NST+3
STA(1)=20.0*PST
STA(2)=0.0
IF (NST.EQ.0) GO TO 52
DO 50 K=1,NST
50  STA(K+2)=STAT(K)
52  STA(NTS)=20.0
OMENC(1)=0.0
OWAVE(1)=0.0
WAVEN(1)=0.0
ELOLA(1)=0.0
UMEN2(1)=0.0
HEAVE(1)=1.0
PITCH(1)=0.0
SSPEC(1)=0.0
DELTA(1)=0.0
EPSIL(1)=-1.5707963
HEAV2(1)=1.0
PITC2(1)=0.0
ABMO(1)=0.0

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HSPEC(1)=0.0
PSPEC(1)=0.0
AUSP(1)=0.0
AVSP(1)=0.0
ACSP(1)=0.0
FITCH(1)=0.0
RUSP(1)=0.0
RVSP(1)=0.0
RASP(1)=0.0
DU 250 MM=1,NBTA
CUSB=COSBET(MM)
IF (COSB.GT.0.) GO TO 250
DU 100 J=1,NOW
CALL SEAST(SWH(J),AWH,HWH,ISEA,PL,PU,PME,AVP,AWL)
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,1)
WRITE(6,17)
WRITE(6,2)SWH(J),AWH,HWH,ISEA,PL,PU,PME,AVP,AWL
DU 200 L=1,NOL
FACT=SQRT(GRAV/SHLT(L))
DU 110 N=2,NFP
OMENC(N)=OMENC(N-1)*FACT
110 OMEN2(N)=OMENC(N)*OMENC(N)
JJ=0
DU 300 M=1,NSP
JJ=JJ+1
SUG=1.689*SPEED(M)/GRAV
DU 120 N=2,NFP
OWAVE(N)=FACT*WFR(JJ,N-1,MM)
WAVEN(N) = OWAVE(N)**2/GRAV
ELOLA(N)=SWR(JJ,N-1,MM)
HEAVE(N)=REAL(EFH(JJ,N-1,MM))
PITCH(N)=REAL(EMP(JJ,N-1,MM))*2./SHLT(L)
HEAV2(N)=HEAVE(N)*HEAVE(N)
PITC2(N)=PITCH(N)*PITCH(N)
DELTA(N)=FARD*AIMAG(EFH(JJ,N-1,MM))
EPSIL(N)=FARD*AIMAG(EMP(JJ,N-1,MM))
SSPEC(N)=CONST/OWAVE(N)**5*EXP(-33.56/(SWH(J)**2*OWAVE(N)**4))
HSPEC(N)=SSPEC(N)*HEAV2(N)
PSPEC(N)=SSPEC(N)*PITC2(N)
120 FITCH(N)=0.25*SHLT(L)**2*PSPEC(N)
DEN=OWAVE(NFP)-OWAVE(NFR)
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,1)
WRITE(6,567) WANG(MM)
WRITE(6,3)SWH(J),SHLT(L),SPEED(M),FN(JJ)
WRITE(6,4)
WRITE(6,6) (OMENC(N),OWAVE(N),ELOLA(N),SSPEC(N),HSPEC(N),FITCH(N),N
I=1,NFP)
NPAG=NPAG+1
WRITE(6,1)
WRITE(6,3)SWH(J),SHLT(L),SPEED(M),FN(JJ)

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```

WRITE(6,7)
WRITE(6,8)
WRITE(6,9)
DU 130 N=2,NFP
AVSP(N)=OMEN2(N)*FITCH(N)
130 ACSP(N)=OMEN2(N)*AVSP(N)
SLOPE=(FITCH(NFP)-FITCH(NFR))/DEN
IF(FITCH(NFP).LT.XMAX(NFP,FITCH))GOTO133
134 WRITE(6,18)
GU TO 131
133 IF(SLOPE.LT.0.0)GOTO132
SLOPE=AMINI(-SLOPE,-1.0)
132 AMOT1=SIMPUN(OWAVE,FITCH,NFP)
AMOT2=-0.5*FITCH(NFP)*FITCH(NFP)/SLOPE
IF(AMOT2.GT.0.2*AMOT1)GOTO134
AMOT=AMOT1+AMOT2
AMOT=SQRT(AMOT)
AMTA=1.2533*AMOT
AMTS=2.0025*AMOT
AMTO=2.5456*AMOT
OWAK(1)=OWAVE(NFP)
OMAK(1)=OMEN2(NFP)
ORES(1)=FITCH(NFP)
ORESV(1)=AVSP(NFP)
ORESA(1)=ACSP(NFP)
OWD=-0.25*ORES(1)/SLOPE
DU 400 JI=2,5
OWAK(JI)=OWAK(JI-1)+OWD
OMAK(JI)=OMAK(JI)*(1.0+SOG*OWAK(JI))
OMAK(JI)=OMAK(JI)*OMAK(JI)
ORES(JI)=ORES(JI-1)+SLOPE*OWD
ORESV(JI)=OMAK(JI)*ORES(JI)
400 ORESA(JI)=OMAK(JI)*ORESV(JI)
ORESV(5)=0.0
ORESA(5)=0.0
AVEL=SIMPUN(OWAVE,AVSP,NFP)+SIMPUN(OWAK,ORESV,5)
AVEL=SQRT(AVEL)
AVLA =1.2533*AVEL
AVLS=2.0025*AVEL
AVLO=2.5456*AVEL
AACC=SIMPUN(OWAVE,ACSP,NFP)+SIMPUN(OWAK,ORESA,5)
AACC=SQRT(AACC)
AACA=1.2533*AACC
AACS=2.0025*AACC
AACO=2.5456*AACC
WRITE(6,10)AMTA,AMTS,AMTO,AVLA,AVLS,AVLO,AACA,AACS,AACO
AMOT=2.0*FRAD/SHLT(L)*AMOT
AVEL=2.0*FRAD/SHLT(L)*AVEL
AACC=2.0*FRAD/SHLT(L)*AACC
AMTA=1.2533*AMOT
AMTS=2.0025*AMOT
AMTO=2.5456*AMOT
AVLA =1.2533*AVEL
AVLS=2.0025*AVEL

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AVLO=2.5456*AVEL
AACAA=1.2533*AACC
AACS=2.0025*AACC
AACO=2.5456*AACC
131 WRITE(6,16)AMTA,AMTS,AMTO,AVLA,AVLS,AVLO,AACA,AACS,AACO
WRITE(6,11)
WRITE(6,12)
WRITE(6,13)
DU 150 K=1,NTS
ARM=SHLT(L)*(PST-0.05*STA(K))
CENT = SHLT(L)*(0.5 - 0.05*STA(K))
DU 160 N=2,NFP
ABMO(N)=HEAV2(N)+ARM**2*PITC2(N)-2.0*ARM*PITCH(N)*HEAVE(N)*CUS(DEL
ITA(N)-EPSIL(N))
ABMOL(N,K) = SQRT(ABMO(N))
ADSP(N)=SSPEC(N)*ABMO(N)
AVSP(N)=UMEN2(N)*ADSP(N)
ACSP(N)=UMEN2(N)*AVSP(N)
TIER=WAVEN(N)*CENT*COSH
RDSP(N)=SSPEC(N)*(ABMO(N)+1.-2.*HEAVE(N)*CUS(TIER-DELTA(N))
X +2.*ARM*PITCH(N)*COS(TIER-EPSIL(N)))
RUSPL(N,K) = SQRT(RDSP(N)/SSPEC(N))
RVSP(N)=UMEN2(N)*RDSP(N)
160 RASP(N)=UMEN2(N)*RVSP(N)
SLOPE=(ADSP(NFP)-ADSP(NFR))/DEN
IF(ADSP(NFP).LT.XMAX(NFP,ADSP))GOTO163
164 WRITE(6,19)STA(K),WORT(1)
GU TO 161
163 IF(SLOPE.LT.0.0)GOTO162
SLOPE=AMINI(-SLOPE,-1.0)
162 AMOT1=SIMPUN(OWAVE,ADSP,NFP)
AMOT2=-0.5*ADSP(NFP)*ADSP(NFP)/SLOPE
IF(AMOT2.GT.0.2*AMOT1)GOTO164
AMOT=AMOT1+AMOT2
AMOT=SQRT(AMOT)
AMTA=1.2533*AMOT
AMTS=2.0025*AMOT
AMTO=2.5456*AMOT
OWAK(1)=OWAVE(NFP)
UMAK(1)=UMEN2(NFP)
ORES(1)=ADSP(NFP)
ORES(1)=AVSP(NFP)
URES(1)=ACSP(NFP)
OWD=-0.25*ORES(1)/SLOPE
DU 500 JI=2,5
OWAK(JI)=OWAK(JI-1)+OWD
UMAK(JI)=OWAK(JI)*(1.0+SOG*OWAK(JI))
UMAK(JI)=UMAK(JI)*UMAK(JI)
URES(JI)=URES(JI-1)+SLOPE*OWD
URES(JI)=UMAK(JI)*URES(JI)
500 URESA(JI)=UMAK(JI)*URES(JI)
URES(5)=0.0
URES(5)=0.0
AVEL=SIMPUN(OWAVE,AVSP,NFP)+SIMPUN(OWAK,URES,5)

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```

AVEL=SQRT(AVEL)
AVLA=1.2533*AVEL
AVLS=2.0025*AVEL
AVLO=2.5456*AVEL
AACC=SIMPUN(OWAVE,ACSP,NFP)+SIMPUN(OWAK,URES,5)
AACC=SQRT(AACC)
AACA=1.2533*AACC
AACS=2.0025*AACC
AAO=2.5456*AACC
WRITE(6,14)STA(K),WORT(1),AMTA,AMTS,AMTO,AVLA,AVLS,AVLO,AACA,AACS,
1AAO
161 SLOPE=(RDSP(NFP)-RDSP(NFR))/DEN
IF(RDSP(NFP).LT.XMAX(NFP,RDSP))GOTO173
174 WRITE(6,19)STA(K),WORT(2)
GO TO 150
173 IF(SLOPE.LT.0.0)GOTO172
SLOPE=AMIN1(-SLOPE,-1.0)
172 RMOT1=SIMPUN(OWAVE,RDSP,NFP)
RMOT2=-0.5*RDSP(NFP)*RDSP(NFP)/SLOPE
IF(RMOT2.GT.0.3*RMOT1)GOTO174
RMOT=RMOT1+RMOT2
RMOT=SQRT(RMOT)
RMTA=1.2533*RMOT
RMTS=2.0025*RMOT
RMT0=2.5456*RMOT
OWAK(1)=OWAVE(NFP)
OMAK(1)=OMEN2(NFP)
ORES(1)=RDSP(NFP)
ORESV(1)=RVSP(NFP)
URES(1)=RASP(NFP)
OWD=-0.25*ORES(1)/SLOPE
DO 600 JI=2,5
OWAK(JI)=OWAK(JI-1)+OWD
OMAK(JI)=OMAK(JI)*(1.0+SOG*OWAK(JI))
OMAK(JI)=OMAK(JI)*OMAK(JI)
ORES(JI)=ORES(JI-1)+SLOPE*OWD
ORESV(JI)=OMAK(JI)*ORES(JI)
600 URESA(JI)=OMAK(JI)*ORESV(JI)
ORESV(5)=0.0
URES(5)=0.0
RVEL=SIMPUN(OWAVE,RVSP,NFP)+SIMPUN(OWAK,URES,5)
RVEL=SQRT(RVEL)
RVLA=1.2533*RVEL
RVLS=2.0025*RVEL
RVLO=2.5456*RVEL
RACC=SIMPUN(OWAVE,RASP,NFP)+SIMPUN(OWAK,URES,5)
RACC=SQRT(RACC)
RACA=1.2533*RACC
RACS=2.0025*RACC
RAO=2.5456*RACC
WRITE(6,14)STA(K),WORT(2),RMTA,RMTS,RMT0,RVLA,RVLS,RVLO,RACA,RACS
1,RAO
C CALCULATION OF SLAM IMPACT FREQUENCY
140 WEN = 3600. / 6.2831853 * RVEL / RMOT

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        SPROB(K) = EXP(-BRCL**2 / (2.*RMOT**2) )
        SNUM(K) = WEN * SPROB(K)
        RVELS(K) = 2. * RVEL**2
        RMOTS(K) = 2. * RMOT**2
150    CONTINUE
        WRITE(6,388)
        DO 350 K=1,NTS
350    WRITE(6,389) STA(K),BRCL, SPROB(K), SNUM(K), RVELS(K),RMOTS(K)
388    FORMAT (1H0 // 15X, 51HCROSS DECK STR. PROBABILITY OF      EXP.NO.
10F SLAMS, 9X, 8HRELATIVE, 12X, 8HRELATIVE / 6X, 58HSTATION  CLE
2ARANCE      SLAM OCCURRENCE      IN ONE HOUR, 11X, 8HVELOCITY, 10X
3.12HDISPLACEMENT/75X,8HVARIANCE,10X,8HVARIANCE//)
389    FORMAT (F12.2, F13.3, 4E20.7)
390    FORMAT(1H1,20X,2HWE,6X,7HABS MOT,3X,7HREL MOT)
391    FORMAT(8H STATION,F7.2,/(14X,3F10.2))
        IF (J.GT.1) GO TO 300
        DO 395 K=1,NTS
        WRITE(6,390)
        WRITE(6,391) STA(K), (OMENC(LM), ABMOL(LM,K), RDSPL(LM,K), LM=2, NFP)
395    CONTINUE
300    CONTINUE
200    CONTINUE
100    CONTINUE
250    CONTINUE
        CALL AETSKC(5LMOT35)
        END

```

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SUBROUTINE SEAST(SWH,AWH,HWH,IS,TL,TU,TA,WA)
IF(SWH.GT.0.15) GO TO 1
IS=0
GO TO 10
1 IF(SWH.GT.1.2) GO TO 2
IS=1
GO TO 10
2 IF(SWH.GT.3.0) GO TO 3
IS=2
GO TO 10
3 IF(SWH.GT.5.0) GO TO 4
IS=3
GO TO 10
4 IF(SWH.GT.7.5) GO TO 5
IS=4
GO TO 10
5 IF(SWH.GT.12.0) GO TO 6
IS=5
GO TO 10
6 IF(SWH.GT.20.0) GO TO 7
IS=6
GO TO 10
7 IF(SWH.GT.40.0) GO TO 8
IS=7
GO TO 10
8 IF(SWH.GT.60.0) GO TO 9
IS=8
GO TO 10
9 IS=9
10 QWH=SQRT(SWH)
AWH=0.62585*SWH
HWH=1.27119*SWH
TL=1.0905712*QWH
TU=3.4343965*QWH
TA=1.9608164*QWH
TM=2.7602723*QWH
WA=13.135862*SWH
RETURN
END

```

OVERLAY(6,0)
PROGRAM PGMIA

C
C
C
C
C
C
C
C

FOLLOWING SEA DISPATCH TASK
REENTERED FOR EACH OF 3 CASES (KASE=1,2,3)
THIS TASK SAVES ALL THE DATA ACCUMULATED SO FAR,
AND REINITIALIZES BEFORE EACH CASE (DATA IS SAVED ON TAPE48)

COMMON/HP1/ NPAG,TITLE(8),PATT(7),RATIO
COMMON/HP2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,L,P,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/HP3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X AVBM(30),ST(30),IN(30),SQAR(30),X(30,20),Y(30,20)
COMMON/HP4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/HP5/ VOL,XIP,DST,PSI,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/HP6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/HP7/ NFN,NFNS,FN(6),FNS(6)
COMMON/HP8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSRET(3),SINRET(3)
COMMON/HP9/ NFR,NFRS,UMEN(30),UMENS(30),UMIN,UMAX,DUME,OW,X
COMMON/HP10/ XZFU,XZVL,XZHB,XZPB,KV,KW
COMMON/HP11/ CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/HP12/ CHRDR,THKB,SPNR,FBL,XZFB,CLFB,DEPB,FBY
COMMON/HP13/ GRAV,DEPCAT,SD(6),RBMST(10)
COMMON/HP14/ EL,GCB,GYR,RGY,VCG,BRCL,RF33,RP35,RM55
COMMON/HP15/ A33(30),A35(4,30),A53(4,30),A55(4,30),C35S,C55S,
X B33(4,30,3),B35(4,30,3),B53(4,30,3),B55(4,30,3)
COMMON/HP16/ AHP(30),DHP(4,30),AP(30),OP(4,30)
COMMON/HP17/ OMEGA,UN,PAH(19),PVH(19)
COMMON/HP18/ BLOG(19,19),YLOG(19,19)
COMMON/HP19/ KASE(4),MIL(4),CWR1(4),CWR2(4),WFP(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/HP20/ II,EFH(4,30,3),EMP(4,30,3),EMK(4,30,3)
COMPLEX II,EFH,EMP

C
C
C
C
C
C
C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

BYPASS IF HEAD SEA

IF (JA.NE.2) CALL AETSKC(5LPGMIR)
IF (KASE(1).GT.0) GO TO 21
NBTAS=NBTAS+1
IF (WANG(NBTAS).LT.90.) GO TO 20
JA=1
JB=1
JC=1
NBTA=NBTAT-NBTAQ
DU 22 MM=1,NBTA
22 WANG(MM)=WANG(MM+NBTAQ)

```

DO 18 I=1,NFRS
18 OMEN(I)=OMENS(I)
NFR=NFRS
DO 19 I=1,NFNS
19 FN(I)=FNS(I)
NFN=NFNS
CALL AETSKC(5LPGM18)
20 JA=2
JB=3
NBTA=1
DO 17 I=1,NFNS
17 FN(I)=FNS(I)
NFN=NFNS
WANG(1)=WANG(NBTAS)
21 MM=1
COSB=COS(WANG(MM)*.01745326252)
C
C COMPUTE DATA LENGTH AND CONSTANTS
C
N=LOGF(ENDCOM)-LOGF(TITLE(1))
TWOPI=6.28318531
MPAG=NPAG
C
C DISPATCH BY ENTERING KASE
C
GO TO (100,200,300,77), KASE(1)+1
C
C CASE 1
C
100 CONTINUE
IF(OMIN.LE.0. .OR. CMAX.LE.0.) GO TO 77
KASE(1)=1
C
NPAG=NPAG+1
5 FORMAT(1H1,14A6,18X,A6,I4/)
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,6) WANG(MM)
6 FORMAT(1H0,10X,*BETA = *,F10.1//11X,*QUARTERING SEA KASE=1 ,*,
X *HIGH FREQUENCY WAVES FASTER THAN SHIP*)
C
C
C WRITE OUT INITIALIZATION OF DATA
C
REWIND 48
WRITE(48) (TITLE(I),I=1,N)
C
C CALCULATE MINIMUM FN AT INTERCEPT OF
C MINIMUM RWS+DELTA LINE AND CRITICAL CURVE
C
RWS BOUNDS ARE IN RWS(1,N,1) N=1,NB
DELTAS ARE IN RWS(2,N,1)
C
NB=RWS(3,1,1)
C

```

```

      A=(RWS(1,1,1)+RWS(2,1,1))/TWOPI
      FNMIN=SQRT(A)/(2.*COSB)
C
C   CALCULATE MAXIMUM FN AT INTERCEPT OF
C   MAXIMUM RWS-DELTA LINE AND OMIN LINE
C
      A=(RWS(1,NB,1)-RWS(2,NB-1,1))/TWOPI
      SA=SQRT(A)
      FNMAX=SA*(1.-OMIN*SA)/COSB
C
      WRITE (6,7) FNMIN,FNMAX
7   FORMAT(1H0,20X,*SPEED RANGE OF INTEREST FROM FROUDE NUMBER *,
1     F7.4,* TO *,F7.4//)
C
C   REDEFINE SPEED ARRAY TO INCLUDE JUST ABOVE RANGE
C
      IJ=0
      DO 111 JJ=1,NFN
      IF(FN(JJ).LT.FNMIN .OR. FN(JJ).GT.FNMAX) GO TO 111
      IJ=IJ+1
      FN(IJ)=FN(JJ)
111  CONTINUE
C
C   IF NO DESIRED SPEEDS ARE IN RANGE, GO TO NEXT CASE
C
      IF(IJ.EQ.0) GO TO 200
      NFN=IJ
C
C   LOOP THRU FN VALUES TO FIND APPLICABLE OMEGA RANGES
C
      DO 121 JJ=1,NFN
C
C   FIND MINIMUM OMEGA AT INTERCEPT OF MINIMUM RWS
C
      USE WN(JJ,1,1) FOR MINIMUM OMEGA FOR FN(JJ)
      WN(JJ,2,1) FOR MAXIMUM OMEGA
      WFR(JJ,1,1) FOR MINIMUM RWS
      WFR(JJ,2,1) FOR MAXIMUM RWS
C
      FNB=FN(JJ)*COSB
      A=RWS(1,1,1)/TWOPI
      SA=1.0/SQRT(A)
      WN(JJ,1,1)=SA*(1.-FNB*SA)
      IF(WN(JJ,1,1).LT.OMIN) WN(JJ,1,1)=OMIN
      OMEG=(1.+SQRT(1.-4.*FNB*WN(JJ,1,1)))/FNB*.5
      WFR(JJ,1,1)=TWOPI/(OMEG*OMEG)
C
C   FIND MAXIMUM OMEGA AT INTERCEPT OF
C   MAXIMUM RWS OR AT CRITICAL CURVE
C
      A=RWS(1,NB,1)/TWOPI
      SA=1.0/SQRT(A)
      CRITFN=.5/(SA*COSB)

```

```

IF(FN(JJ).LT.CRITFN) WN(JJ,2,1)=.25/FNB
IF(FN(JJ).GE.CRITFN) WN(JJ,2,1)=SA*(1.-FNB*SA)
IF(WN(JJ,2,1).GT.OMAX) WN(JJ,2,1)=OMAX
OMEG=(1.+SQRT(1.-4.*FNB*WN(JJ,2,1)))/FNB*.5
WFR(JJ,2,1)=TWOPI/(OMEG*OMEG)
C
121 CONTINUE
GO TO 500
C
C CASE 2
C
200 CONTINUE
C
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
WRITE(6,8) WANG(MM)
8 FORMAT(1H0,10X,*BETA = *,F10.1//11X,*QUARTERING SEA KASE=2.*,
1 * LOW FREQUENCY WAVES FASTER THAN SHIP*)
C
C READ BACK INITIAL DATA
C
REWIND 48
READ(48) (TITLE(I),I=1,N)
NPAG=MPAG+1
C
NB=RWS(3,1,1)
C
KASE(1)=2
C
C CALCULATE MINIMUM FN AS FIRST NON-ZERO FN
C
FNMIN=0.0000001
C
C CALCULATE MAXIMUM FN AS INTERCEPT OF
C MAXIMUM RWS-DELTA LINE AND CRITICAL CURVE
C
A=(RWS(1,NB,1)-RWS(2,NB-1,1))/TWOPI
FNMAX=SQRT(A)/(2.*COSB)
C
WRITE (6,7) FNMIN,FNMAX
C
C REDEFINE SPEEDS ARRAY
C
IJ=0
DO 211 JJ=1,NFN
IF(FN(JJ).LT.FNMIN .OR. FN(JJ).GT.FNMAX) GO TO 211
IJ=IJ+1
FN(IJ)=FN(JJ)
211 CONTINUE
IF(IJ.EQ.0) GO TO 300
NFN=IJ
C
C FIND APPLICABLE OMEGA RANGES
C

```

```

      DO 221 JJ=1,NFN
C
C   FIND MINIMUM OMEGA (MAXIMUM RWS) AT INTERCEPT OF
C   MAXIMUM RWS LINE AND FN
C
      FNB=FN(JJ)*COSB
      A=RWS(1,NB,1)/TWOPI
      SA=1.0/SQRT(A)
      WN(JJ,1,1)=SA*(1.-FNB*SA)
      WFR(JJ,2,1)=RWS(1,NB,1)
C
C   FIND MAXIMUM OMEGA AS INTERCEPT OF MINIMUM RWS
C   OR CRITICAL OMEGA
C
      A=RWS(1,1,1)/TWOPI
      SA=1.0/SQRT(A)
      CRITFN=.5/(SA*COSB)
C
      IF (FN(JJ).GT.CRITFN) WN(JJ,2,1)=.25/FNB
      IF (FN(JJ).LE.CRITFN) WN(JJ,2,1)=SA*(1.-FNB*SA)
      IF (WN(JJ,2,1).GT.OMAX) WN(JJ,2,1)=OMAX
C
      OMEG=(1.-SQRT(1.-4.*FNB*WN(JJ,2,1)))/FNB*.5
      WFR(JJ,1,1)=TWOPI/(CMEG*OMEG)
C
221  CONTINUE
      GO TO 500
C
C
C   KASE=3
C
300  CONTINUE
C
      NPAG=NPAG+1
      WRITE(6,5) (PATT(I),I=1,6),(TITLE(I),I=1,8),PATT(7),NPAG
      WRITE(6,9) WANG(MM)
      9  FORMAT(1H0,10X,*BETA = *,F10.1//11X,*QUARTERING SEA  KASE=3 ,*,
      1      * SHIP FASTER THAN WAVES*)
C
C   READ BACK INITIAL DATA
C
      REWIND 48
      READ(48) (TITLE(I),I=1,N)
      NPAG=MPAG+1
C
      NB=RWS(3,1,1)
C
      KASE(1)=3
C
C
C   CALCULATE MINIMUM FN AS INTERCEPT OF
C   MINIMUM RWS+DELTARWS AND MINIMUM OMEGA
C
      A=(RWS(1,1,1)+RWS(2,1,1))/TWOPI

```

```

      SA=SQRT(A)
      FNMIN=SA*(1.+OMIN*SA)/COSB
C
C   CALCULATE MAXIMUM FN AS INTERCEPT OF
C   MAXIMUM RWS-DELTARWS AND MAXIMUM OMEGA
C
      A=(RWS(1,NB,1)-RWS(2,NB-1,1))/TWOPI
      SA=SQRT(A)
      FNMAX=SA*(1.+OMAX*SA)/COSB
C
      WRITE (6,7) FNMIN,FNMAX
C
C   REDEFINE SPEEDS ARRAY
C
      IJ=0
      DO 311 JJ=1,NFN
      IF (FN(JJ).LT.FNMIN .OR. FN(JJ).GT.FNMAX) GO TO 311
      IJ=IJ+1
      FN(IJ)=FN(JJ)
311  CONTINUE
C
C   IF NO DESIRED SPEEDS, GO TO NEXT CASE
C
      IF (IJ.EQ.0) GO TO 77
      NFN=IJ
C
C   FIND APPLICABLE OMEGA RANGES FOR EACH FN
      DO 321 JJ=1,NFN
C
C   CALCULATE MINIMUM OMEGA AS INTERCEPT
C   OF MAXIMUM RWS
C
      FNB=FN(JJ)*COSB
      A=RWS(1,NB,1)/TWOPI
      SA=-1.0/SQRT(A)
      WN(JJ,1,1)=SA*(1.+FNB*SA)
      IF (WN(JJ,1,1).LT.OMIN) WN(JJ,1,1)=OMIN
      OMEG=(1.+SQRT(1.+4.*FNB*WN(JJ,1,1)))/FNB*.5
      WFR(JJ,2,1) =TWOPI/(OMEG*OMEG)
C
C   CALCULATE MAXIMUM OMEGA AS INTERCEPT
C   OF MINIMUM RWS
C
      A=RWS(1,1,1)/TWOPI
      SA=-1.0/SQRT(A)
      WN(JJ,2,1)=SA*(1.+FNB*SA)
      IF (WN(JJ,2,1).GT.OMAX) WN(JJ,2,1)=OMAX
      OMEG=(1.+SQRT(1.+4.*FNB*WN(JJ,2,1)))/FNB*.5
      WFR(JJ,1,1)=TWOPI/(OMEG*OMEG)
C
C
321  CONTINUE
C
C   END OF FOLLOWING SEA RUN

```

```

C   CHOOSE DELTA OMEGA AND LOAD OMEGA ARRAY
C
C   500 CONTINUE
C
C   FOR EACH FN   FN(JJ)   JJ=1,NFN
C
C       WN(JJ,1,1)   CONTAINS MINIMUM OMEGA
C       WN(JJ,2,1)   CONTAINS MAXIMUM OMEGA
C       WFR(JJ,1,1)  CONTAINS MINIMUM RWS
C       WFR(JJ,2,1)  CONTAINS MAXIMUM RWS
C
C   FOR EACH BOUNDARY   RWS(1,N,1)   N=1,NB   NB=RWS(3,1,1)
C
C       RWS(2,I,1)   CONTAINS DELTA RWS FOR RANGE
C                   RWS(1,I,MM) TO RWS(1,I+1,MM)
C
C   RWS IS REAL WAVE LENGTH DIVIDED BY LENGTH OF SHIP
C
C   WRITE(6,10) (FN(I),WN(I,1,1),WN(I,2,1),WFR(I,1,1),WFR(I,2,1),
C   X   I=1,NFN)
10  FORMAT(10X,*AT FROUDE NUMBER=*,F7.4,* FREQUENCY RANGE IS *,
C   1   F7.4,* TO *,F7.4,* AND WAVE LENGTH RANGE IS *,
C   2   F7.4,* TO *,F7.4)
C
C   RWS(1,NB,1)=RWS(1,NB,1)+1.0
C   NB=NB-1
C   OMIN=100.0
C   OMAX=0.0
C   DUME=100.0
C
C   FIND MINIMUM OMEGA MINIMUM
C   MAXIMUM OMEGA MAXIMUM
C
C   DO 511 JJ=1,NFN
C   IF (WN(JJ,1,1).LT.OMIN) OMIN=WN(JJ,1,1)
C   IF (WN(JJ,2,1).GT.OMAX) OMAX=WN(JJ,2,1)
511 CONTINUE
C
C   LOAD OMEGA ARRAY FROM LOWEST FREQUENCY
C   CLIP HIGHER FREQUENCIES IF BEYOND BOUNDS (50 FREQUENCIES)
C
C   DUMEMIN=OMIN/EL
C   NFR=1
C   OMEN(1)=OMIN
C   DO 531 N=2,30
C
C   FIND MINIMUM DELTA OMEGA AT OMEGA AND ALL SPEEDS
C
C   DUME=100.0
C   DO 525 JJ=1,NFN
C
C   FNB=FN(JJ)*COSB
C   IF (OMEN(N-1).GE.WN(JJ,2,1)) GO TO 525
C   IF (OMEN(N-1).GE.WN(JJ,1,1)) GO TO 520
C   DELTA=WN(JJ,1,1)-OMEN(N-1)

```

```

IF (DELTA.LT.DOME) DOME=DELTA+0.00001
GO TO 525
C
520 CONTINUE
C
FNB2=2.*FNB
DELTA=WN(JJ,2,1)-OMEN(N-1)
IF (DELTA.LT.DOME) DOME=DELTA
C
IF (KASE(1).EQ.1) OMEG=(1.+SQRT(1.-4.*FNB*OMEN(N-1)))/FNB2
IF (KASE(1).EQ.2) OMEG=(1.-SQRT(1.-4.*FNB*OMEN(N-1)))/FNB2
IF (KASE(1).EQ.3) OMEG=(1.+SQRT(1.+4.*FNB*OMEN(N-1)))/FNB2
RWSS=TWOPI/(OMEG*OMEG)
C
DO 521 I=1,NB
IF (RWSS.GT.RWS(1,I+1,1)) GO TO 521
C
A=RWSS/TWOPI
SA=SQRT(A)
DA=RWS(2,I,1)/TWOPI
DELTA=ABS((FNB/(A*A)-.5/(SA*SA*SA))*DA)
IF ((OMEN(N-1)+1.5*DELTA).GT.WN(JJ,2,1))
1 DELTA=WN(JJ,2,1)-OMEN(N-1)
GO TO 522
C
521 CONTINUE
C
522 CONTINUE
IF (DELTA.LT.DOME) DOME=DELTA
C
525 CONTINUE
IF (DOME.LT.DOMEMIN) DOME=DOMEMIN
OMEN(N)=OMEN(N-1)+DOME
NFR=NFR+1
C
IF (OMEN(N).LT.(OMAX-0.00001)) GO TO 531
OMEN(N)=OMAX
GO TO 532
C
531 CONTINUE
532 CONTINUE
C
WRITE (6,11) NFR,OMEN(1),OMEN(NFR)
11 FORMAT(1H0,6X,*ANALYSIS WILL BE BASED ON *,I2,
1 * FREQUENCIES FROM *,F7.4,* TO *,F7.4)
C
C
C GO EXECUTE ANALYSIS
C
CALL AETSKC(5LPGM1B)
77 CONTINUE
KASE(1)=0.
IF (WANG(NBTAS+1).EQ.777.) JC=3
IF (ID.EQ.2 .OR. ID.EQ.-1) CALL AETSKC(5LMOT35)
IF (LP.EQ.0 .AND. IP.EQ.0 .AND. NOW.EQ.0) CALL AETSKC(5LMOT35)
IF (LP.LE.0 .AND. IP.LE.0) CALL AETSKC(4LPGM5)
END

```

APPENDIX B

PROGRAM LISTING OF MOT246

```
OVERLAY(OVFILE,0,0)
PROGRAM MAIN(INPUT=512,OUTPUT=512,TAPE23=512,TAPE48=512,
X TAPES=INPUT,TAPE6=OUTPUT)
```

C
C

```
COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,URT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINRET(3)
COMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,OWAX
COMMON/SRY10/XZHB,XZPB,XZFO,XZVL,KV,KW
COMMON/SRY11/CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCB,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),ORY(30)
COMMON/SRY18/B22(4,30),B26(4,30),B62(4,30),B46(4,30),B64(4,30),
X B66(4,30),B24(4,30),B44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/BLOG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)
```

C
C
C
C

```
END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)
```

```
COMMON/ENDCOM/ENDCOM
```

C

```
DATA PATT/6H MOT24,6H6 SW,6HAY, RO,6HLL AND,6H YAW M,6HOTIUNS,
X 6H OF ,6H PAGE/
NBTAS=0
GO TO 1001
CALL FLAGSV
CALL PLOTDD
1001 CONTINUE
JC=0
CALL AETSKC(6LMOT246)
END
```

```
C ****NOTE**THE FUNCTIONS XMIN, XMAX, SIMPUN, AND ATAN3 AND THE
C ****SUBROUTINES NILS, DAVID, MATINS, AND SEAST ARE THE SAME FOR BOTH
C ****MOT35 AND MOT246. THE SUBROUTINE QDFCN AND THE PROGRAMS PGM4 AND
C ****PGM1A ARE THE SAME FOR MOT35 AND MOT246 EXCEPT FOR THE COMMON
C ****BLOCKS AND THE REFERENCES TO MOT35.
C ****SUBSTITUTE THE COMMON BLOCKS SRY1-SRY22 FOR HP1-HP20.
C ****CHANGE STATEMENTS AT THE END OF PGM4 AND PGM1A FROM
C ****CALL AETSKC(5LMOT35) TO CALL AETSKC(6LMOT246).
C ****THE ABOVE ROUTINES WILL NOT BE REPEATED IN THE MOT246 LISTING.
```

OVERLAY(1,0)
PROGRAM MOT246

C
C
C
C
C
C
C
C
C
C
C
C
C
C
C

OFFSETS MUST BE READ IN. THE X AXIS IS THE TRANVERSE BASE LINE OF STATION 10. THE Y AXIS IS THE VERTICAL CENTER LINE OF STATION 10. Y IS POSITIVE UP AND X IS POSITIVE TO THE RIGHT. LOOKING FORWARD ON THE STARBOARD HULL AND STARTING AT THE BOW THE OFFSETS ARE READ IN COUNTER-CLOCK WISE A STATION AT A TIME. HULL SEPARATION DISTANCE MUST ALSO BE GIVEN. IT IS IDENTIFIED AS SD(NSD) WHERE NSD IS THE NUMBER OF HULL SEPARATIONS TO BE RUN. THE HULL SEPARATION IS THE DISTANCE FROM THE CENTER LINE OF THE CATAMARAN TO THE CENTER LINE OF STATION 10.

COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NBT,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,OWAX
COMMON/SRY10/XZHB,XZPB,XZFO,XZVL,KV,KW
COMMON/SRY11/CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCB,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),DRY(30)
COMMON/SRY18/B22(4,30),B26(4,30),B62(4,30),B46(4,30),B64(4,30),
X B66(4,30),B24(4,30),B44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/BLUG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

C
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C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

C
DIMENSION YJK(20),YBG(30)
1 FORMAT(8A6)
2 FORMAT(12I5)
3 FORMAT(8F10.5)
4 FORMAT(4F9.4,2I9)
5 FORMAT(1H1,15A6,18X,A6,I4/)

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6 FORMAT(1H0,5X,54HSTATION 10.0 NOT GIVEN - READ INPUT DATA FOR NEXT
1 SHIP)
7 FORMAT(4F10.5,2I5)
8   FORMAT(1H0,5X,23HCOMPUTED FROUDE NUMBERS)
9   FORMAT(/* DATA INPUT CARDS*/ 10X,*1*,9X,*2*,9X,*3*,9X,*4*,9X,
X   *5*,9X,*6*,9X,*7*,9X,*8*/1X,8(*1234567890*))
40  FURMAT(8F9.4)
51  FURMAT(1X,8A6)
52  FURMAT(1X,12I5)
53  FURMAT(1X,8F10.5)
54  FURMAT(1X,4F9.4,2I9)
57  FURMAT(1X,4F10.5,2I5)
3000 FURMAT(12H1 END OF JOB)
335 FURMAT(30X,9HSTATION ,F9.4)
78  NPAG=0
    IF (JC.EQ.2 .AND. NBTAS.GT.0) CALL AETSKC(5LPGM1A)
    ID = 1
    READ(5,1) (TITLE(I),I=1,8)
    READ(5,2) MUNO,JA
    IF (JA.LE.0) GO TO 77
    READ(5,3) SCALE,GRAV
    READ(5,2) NFR,NBTA,NFN,NSD,NSTR,NOS,NLOOP,IG,LP,IND
    READ(5,3) (OMEN(I),I=1,NFR)
    READ(5,3) (WANG(I),I=1,NBTA)
    READ(5,3) (FN(I),I=1,NFN)
    READ(5,3) (SD(I),I=1,NSD)
    READ(5,3) (RBMST(I),I=1,NSTR)
    READ(5,3) (RBMHT(I),I=1,NSTR)
    OMEN=OMEN(I)
    NBTAT=NBTA
    NBTAS=0
    WANG(NBTAT+1)=777.
    NBTAQ=0
    DO 17 I=1,NBTA
    IF (WANG(I).LT.90.) NBTAQ=NBTAQ+1
17  CONTINUE
    NFRS=NFR
    DO 18 I=1,NFR
18  OMENS(I)=OMEN(I)
    JC=1
    IF (NBTAQ.NE.0) JC=2
    JB=1
    DO 19 I=1,NFN
19  FNS(I)=FN(I)
    NFNS=NFN
    KASE(1)=0
    NPAG=NPAG+1
    WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
    WRITE(6,9)
    WRITE(6,51) (TITLE(I),I=1,8)
    WRITE(6,52) MONO,JA
    WRITE(6,53) SCALE,GRAV
    WRITE(6,52) NFR,NBTA,NFN,NSD,NSTR,NOS,NLOOP,IG,LP,IND
    WRITE(6,53) (OMEN(I),I=1,NFR)

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WRITE(6,53) (WANG(I),I=1,NBTA)
WRITE(6,53) (FN(I),I=1,NFN)
WRITE(6,53) (SD(I),I=1,NSD)
WRITE(6,53) (RBMST(I),I=1,NSTR)
WRITE(6,53) (RBMHT(I),I=1,NSTR)
IF(SCALE.LE.0.) SCALE=1.
IF(GRAV.LE.0.) GRAV=32.174
IF(NSD.GE.1) GO TO 79
NSD=1
SD(1)=0.
79 IF(JC.NE.2) GO TO 43
IF(JA.NE.2) GO TO 43
IF(NFN.GE.1) GO TO 144
JB=1
FN(1)=0.0
GO TO 43
144 CONTINUE
C
C FOLLOWING OR QUARTERING SEA CASE
C
C READ IN BOUNDS FOR RWS AND DELTA RWS
C (RWS IS REAL WAVE LENGTH / LENGTH OF SHIP)
C
C STURE BOUNDS IN RWS(1,N,1) N=1,NB
C INCREMENTS RWS(2,N,1) N=1,NB-1
C NUMBER OF BOUNDS IN RWS(3,1,1)
C
C BOUNDS MUST BE IN ASCENDING ORDER FROM MINIMUM TO MAXIMUM
C
C READ(5,3) (RWS(1,N,1),N=1,8)
C READ(5,3) (RWS(2,N,1),N=1,8)
C READ(5,3) OMIN,OMAX,DOME
C
C NB=0
C DO 301 I=1,8
C IF(RWS(1,I,1).LE.0.0 ) GO TO 302
C NB=NB+1
301 CONTINUE
302 CONTINUE
RWS(3,1,1)=NB
C
C WRITE(6,3) (RWS(1,N,1),N=1,NB)
C NB=NB-1
C WRITE(6,3) (RWS(2,N,1),N=1,NB)
C WRITE(6,3) OMIN,OMAX,DOME
43 READ(5,3) EL,GYR,GYRT,GCB,VCG,GMT,DEPCAT,BRCL
READ(5,3) FAL,FAY,DEPA,CHRDA,SPNA,THKA,CLFA,XZFA
READ(5,3) FBL,FBY,DEPB,CHRDB,SPNB,THKB,CLFB,XZFB
READ(5,7) XZFO,XZVL,XZHB,XZPB,KV,KW
READ(5,4) (ST(I),BEAM(I),DRFT(I),AREA(I),NM(I),MPS(I),I=1,NOS)
WRITE(6,53) EL,GYR,GYRT,GCB,VCG,GMT,DEPCAT,BRCL
WRITE(6,53) FAL,FAY,DEPA,CHRDA,SPNA,THKA,CLFA,XZFA
WRITE(6,53) FBL,FBY,DEPB,CHRDB,SPNB,THKB,CLFB,XZFB
WRITE(6,57) XZFO,XZVL,XZHB,XZPB,KV,KW
WRITE(6,54) (ST(I),BEAM(I),DRFT(I),AREA(I),NM(I),MPS(I),I=1,NOS)

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```

MS=0
DU 30 I=1,NUS
IF (ST(I).NE.10.) GO TO 30
MS=I
GO TO 31
30 CONTINUE
MS=0
31 NIX=NM(I)
DU 10 I=2,NUS
IF (NIX.GE.NM(I)) GO TO 10
NIX=NM(I)
10 CONTINUE
IN(1)=IABS(NM(1))
NUX=IN(1)
DU 20 I=2,NOS
IN(I)=IABS(NM(I))
IF (NUX.GE.IN(I)) GO TO 20
NUX=IN(I)
20 CONTINUE
DU 21 I=1,NUS
BEAM(I)=BEAM(I)*SCALE
21 DRFT(I)=DRFT(I)*SCALE
IF (NUX.LE.0) GO TO 13
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
KIM=0
DU 11 I=1,NUS
YBG(I)=0.
IF (IN(I).LE.0) GO TO 11
LEE=3
NUT=IN(I)
IF (NUT.LE.8) GO TO 14
LEE=5
14 KIM=KIM+LEE
IF (KIM.LE.50) GO TO 15
KIM=LEE
NPAG=NPAG+1
WRITE(6,5) (PATT(J),J=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
15 WRITE(6,335) ST(I)
READ(5,40) (X(I,J),J=1,NUT)
READ(5,40) (Y(I,J),J=1,NUT)
WRITE(6,40) (X(I,J),J=1,NUT)
WRITE(6,40) (Y(I,J),J=1,NUT)
DU 165 J=1,NUT
X(I,J)=X(I,J)*SCALE
Y(I,J)=Y(I,J)*SCALE
165 YJK(J)=Y(I,J)
YLGS=XMAX(NUT,YJK)
YSML=XMIN(NUT,YJK)
DRFT(I)=YLGS-YSML
YBG(I)=YLGS
11 CONTINUE
13 IF (SCALE.EQ.1.) GO TO 23
EL=EL*SCALE
VCG=VCG*SCALE

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GMT=GMT*SCALE
DEPCAT=DEPCAT*SCALE
HRCL=HRCL*SCALE
DO 22 I=1,NSD
22 SU(I)=SD(I)*SCALE
DO 24 I=1,NSTR
24 RHMHT(I)=RHMHT(I)*SCALE
23 READ(5,2) NOW,NOL,NSP,NST
IF (NOW.LE.0) GO TO 75
READ(5,3) (WINK(I),I=1,NOW)
READ(5,3) (SHLT(I),I=1,NOL)
READ(5,3) (SPEED(I),I=1,NSP)
READ(5,3) (STAT(I),I=1,NST)
WRITE(6,3) (WINK(I),I=1,NOW)
WRITE(6,3) (SHLT(I),I=1,NOL)
WRITE(6,3) (SPEED(I),I=1,NSP)
WRITE(6,3) (STAT(I),I=1,NST)
NFN=NOL*NSP
IF (NFN.GT.4 .OR. JB.EQ.3 .OR. JA.NE.1) GO TO 77
XMAX=XMAX
WRITE(6,8)
JJ=0
FACT=1.688
IF (GRAV.LT.32.) FACT=.3048*FACT
DO 150 L=1,NOL
DO 150 M=1,NSP
JJ=JJ+1
150 FN(JJ)=FACT*SPEED(M)/SQRT(GRAV*SHLT(L))
WRITE(6,3) (FN(JJ),JJ=1,NFN)
75 IF (MS.NE.0) GO TO 69
WRITE(6,6)
GO TO 78
69 DUM=XMAX(NOS,YRG)
DO 16 I=1,NOS
NUT=IN(I)
IF (NUT.LE.0) GO TO 16
DO 12 J=1,NUT
12 Y(I,J)=Y(I,J)-DUM
16 CONTINUE
CALL AETSKC(4LPGM)
77 IF (LP.LE.0 .AND. IP.LE.0) GO TO 80
ENDFILE 48
ENDFILE 48
REWIND 48
80 IF (IND.EQ.0) GO TO 777
I=777
WRITE(23) I,I,I
ENDFILE 23
REWIND 23
777 WRITE(6,3000)
END

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C *****UNCTIONS XMIN, XMAX, AND SIMPUN NOT LISTED--SEE MOT35 LISTING*****

OVERLAY(2,0)
PROGRAM PGM1

C
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COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISU,ISTART,JA,JH,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X UMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NUN,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NHTA,NHTAS,NBTAT,NHTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/SRY9/ NFR,NFRS,UMEN(30),UMENS(30),OMIN,UMAX,DUME,UWAX
COMMON/SRY10/XZHH,XZPR,XZFU,XZVL,KV,KW
COMMON/SRY11/CHROA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHROB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCH,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),URY(30)
COMMON/SRY18/H22(4,30),H26(4,30),H62(4,30),H46(4,30),H64(4,30),
X H66(4,30),H24(4,30),H44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/HLOG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

DIMENSION SAS(30),SHB(30),HSB(30),XI(20),YI(20)
DIMENSION FJ(30),VCBS(30)
1 FORMAT(1H0,7X,*LENGTH BETWEEN PERPENDICULARS = *,F10.5,1X,A6)
2 FORMAT(22X,*BEAM AT MIDSHIP = *,F10.5,1X,A6)
3 FORMAT(21X,*DRAFT AT MIDSHIP = *,F10.5,1X,A6)
4 FORMAT(25X,15HDISPLACEMENT = F10.3,10H LONG TONS)
5 FORMAT(1H1,15A6,18X,A6,I4)
6 FORMAT(20X,20HRLUCK COEFFICIENT = F10.5)
7 FORMAT(6X,*LONGITUDINAL CENTER OF BUOYANCY = *,F10.5,1X,A6,1X,
X *AFT OF F.P.*)
8 FORMAT(6X,34HLONGITUDINAL CENTER OF BUOYANCY = F10.5,9H STATIONS)
9 FORMAT(5X,*LONGITUDINAL CENTER OF FLUTATION = *,F10.5,1X,A6,
X *AFT OF F.P.*)
10 FORMAT(5X,35HLONGITUDINAL CENTER OF FLUTATION = F10.5,9H STATIONS)
11 FORMAT(10X,*VERTICAL CENTER OF BUOYANCY = *,F10.5,1X,A6,
X *FROM THE DESIGNED LOAD WATERLINE*)

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11 FORMAT(12X,28HRADIUS OF GYRATION/L.B.P. = F10.5)
12 FORMAT(44H0 STATION      BEAM      DRAFT AREA COEFFICIENT)
13 FORMAT(4F9.4)
14 FORMAT(6X,10HSTATION = F9.4,6X,30HAREA COEFFICIENT CHANGED FROM F1
10.4,2X,2HT0,2X,F10.4)
15 FORMAT(1H0)
69 FORMAT(13X,27HGIVEN CENTER OF BUOYANCY = F10.5,9H STATIONS)
90 FORMAT(3F9.4,E15.8)
92 FORMAT(1H0,5X,30HMINIMUM CRITICAL ENC. FREQ. = F8.4,16H DUE TO STA
TION F7.4)
206 FORMAT(1H0,30X,23H***DATA FOR ONE HULL***)
300 FORMAT(27X,13HBEAM/DRAFT = F10.5)
301 FORMAT(26X,14HLENGTH/BEAM = F10.5)
66 FORMAT(1H0,5X,41HTHE HEAVE-HEAVE RESTORING COEFFICIENT IS F10.5/6X
1.41HTHE HEAVE-PITCH RESTORING COEFFICIENT IS F10.5/6X,41HTHE PITCH
2-PITCH RESTORING COEFFICIENT IS F10.5)
193  FORMAT(6X,32HCRITICAL ENC. FREQ. FOR STATION ,F7.4,3H = F8.4)
      UNITS=6HFEET
      IF (GRAV.LT.32.) UNITS=6HMETERS
      FST=EL/20.
      GYR=GYR*GYR
      GYRT=GYRT*GYRT
      VCG=VCG/EL
      GMT=GMT/EL
      DU 16 K=1,NOS
      IF (IN(K).GT.0) GO TO 17
      SQAR(K)=AREA(K)*BEAM(K)*DRFT(K)
      VCBS(K)=0.
      GO TO 20
17  NUT=IN(K)
      VCBS(K)=0.
      VCBA=0.
      VCBB=0.
      DU 18 J=1,NUT
      YI(J)=Y(K,J)
18  XI(J)=X(K,J) + SD(1)
      YSML=XMIN(NUT,YI)
      DU 190 IJI=1,NUT
      NNN=IJI
      IF (YSML.EQ.YI(IJI)) GO TO 191
190  CONTINUE
191  IJI=NNN
      IF (MONO .GT. 1) GO TO 199
      IJ=IJI-1
      DU 122 J=1,IJ
122  VCBA=VCBA+ABS((X(K,J)+X(K,J+1))*(Y(K,J)**2-Y(K,J+1)**2))*0.25
      SQER=SIMPUN(YI,XI,IJI)
      SQER=ABS(SQER)
      DU 195 JJJ=IJI,NUT
      IF (JJJ.EQ.NUT) GO TO 127
      VCBB=VCBB+ABS((X(K,JJJ)+X(K,JJJ+1))*(Y(K,JJJ)**2-Y(K,JJJ+1)**2))*
*0.25
127  CONTINUE
      KKK=JJJ-IJI+1
      XI(KKK)=XI(JJJ)

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195 YI(KKK)=YI(JJJ)
    SQER2=SIMPUN(YI,XI,KKK)
    IF(MONO-1)56,57,199
56 SQAR(K)=ABS(SQER2)-SQER
    VCBS(K)=VCHS(K)+VCBB+VCBA
    GO TO 55
57 SQAR(K)=SQER + SQER2
    IF(X(K,1) .LE. 0. .AND. X(K,NUT) .LE. 0.) GO TO 59
    VCBS(K)=VCBS(K)+VCBB+VCBA
    GO TO 55
59 VCHS(K)=VCBS(K)+VCBA-VCBB
    GO TO 55
199 SQER=SIMPUN(YI,XI,NUT)
    SQAR(K)=2.*ABS(SQER)
    NAT=NUT-1
    DO 125 J=1,NAT
125 VCHS(K) =VCBS(K)+0.25*ABS((X(K,J)+X(K,J+1))*(Y(K,J)**2-Y(K,J+1)**
    12))
    VCHS(K)=2.*VCHS(K)
55 DO 196 J=1,NUT
    YI(J)=Y(K,J)
196 XI(J)=X(K,J)
    BEAM(K)=XI(NUT)-XI(1)
    IF(MONO.GT.1) BEAM(K) = 2.*BEAM(K)
    IF(BEAM(K).NE.0.0) GO TO 600
    AREA(K)=SQAR(K)/DRFT(K)**2
    X(K,1)=X(K,1)-0.001
    XI(1)=X(K,1)
    GO TO 20
600 AREA(K)=SQAR(K)/(BEAM(K)*DRFT(K))
20 SS(K)=FST*ST(K)
16 SAS(K)=SS(K)*SQAR(K)
    KPK=0
    LSD=0
    IF(NIX.GT.0) GO TO 21
    DO 32 K=1,NUS
    IF(NM(K).GT.0) GO TO 32
    IF((BEAM(K).LE.0.) .OR. (DRFT(K).LE.0.)) GO TO 32
    AIR=AREA(K)
    RAT=0.5*BEAM(K)/DRFT(K)
    TAR=1.0/RAT
    IF(RAT.LE.1.0) GO TO 33
    RL=0.29456*(2.0-TAR)
    GO TO 34
33 RL=0.29456*(2.0-RAT)
34 UL=0.098125*(RAT+TAR+10.0)
    IF(AREA(K).GT.RL) GO TO 35
    AREA(K)=RL+0.0001
    GO TO 36
35 IF(AREA(K).LT.UL) GO TO 32
    AREA(K)=UL-0.0001
36 IF(KPK.GT.0) GO TO 37
    KPK=KPK+1
    NPAG=NPAG+1
    WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG

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WRITE(6,15)
37 WRITE(6,14)ST(K),AIR,AREA(K)
   LSD=LSD+1
   SQAR(K)=AREA(K)*BEAM(K)*DRFT(K)
   SAS(K)=SS(K)*SQAR(K)
32 CONTINUE
21 IF(NUX.LE.0) GO TO 25
   IF(KPK.GT.0) GO TO 93
   NPAG=NPAG+1
   WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
93 WRITE(6,12)
   DU 22 K=1,NOS
   IF(IN(K).LE.0) GO TO 22
   LSD=LSD+1
   IF(AREA(K).LT.1000.0) GO TO 91
   WRITE(6,90)ST(K),BEAM(K),DRFT(K),AREA(K)
   GO TO 22
91 WRITE(6,13)ST(K),BEAM(K),DRFT(K),AREA(K)
22 CONTINUE
   IF(NIX.LE.0) GO TO 25
   OX=100.0
   IF(LSD.LT.23) GO TO 201
   NPAG=NPAG+1
   WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
201 WRITE(6,15)
   DU 23 K=1,NOS
   IF(NM(K).LE.0) GO TO 23
   IF(BEAM(K).NE.0.0) GO TO 601
   FJ(K) = 0.0
   GO TO 602
601 CONTINUE
   A=3.1415927*DRFT(K)/BEAM(K)
   A=A/TANH(A)
   FJ(K)=SQRT(A*EL/DRFT(K))
602 CONTINUE
   IF(FJ(K).GT.OX) GO TO 233
   OX=FJ(K)
   JOHN=K
233 WRITE(6,193)ST(K),FJ(K)
23 CONTINUE
   WRITE(6,92)OX,ST(JOHN)
25 CONTINUE
   VOL=SIMPUN(SS,SQAR,NOS)
   IF(BEAM(MS).EQ.0.0) GO TO 703
   BLOCK=VOL/(EL*BEAM(MS)*DRFT(MS))
   GO TO 704
703 BLOCK=0.0
704 CONTINUE
   VCB=SIMPUN(SS,VCBS,NOS)/VOL
   BUY=SIMPUN(SS,SAS,NOS)/VOL
   CBL=BOY/FST
   IF(GCB.LE.0.0) GO TO 68
   BUY=FST*GCB
68 DU 19 K=1,NOS
   SHB(K)=(SS(K)-BOY)*BEAM(K)

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19 HSB(K)=(SS(K)-BUY)*SHR(K)
   EL2=EL*EL
   AMP1=SIMPUN(SS,BEAM,NOS)/EL2
   AMP2=SIMPUN(SS,HSB,NOS)/(EL2*EL2)
   CUN=EL2*EL/VOL
   RF33=CON*AMP1
   BG=ABS(VCG*EL+VCB)
   RM55=CON*AMP2-BG/EL
   RP35=SIMPUN(SS,SHB,NOS)/VOL
   GMTS=0.
   IF (ABS(GMT).GT.1.E-04) GO TO 403
   DU 402 K=1,NUS
402 SHB(K)=BEAM(K)**3
   GMTS=SIMPUN(SS,SHB,NOS)/(12.*EL*VOL)-BG/EL
403 CFL=BOY+EL*RP35/RF33
   FLC=CFL/FST
   PST=FST*CBL
   FACT=35.89744
   IF (GRAV.LT.32.) FACT=.02832*FACT
   VOL=VOL/FACT
   NPAG=NPAG+1
   WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
   WRITE(6,206)
   WRITE(6,1) EL,UNITS
   WRITE(6,2) BEAM(MS),UNITS
   WRITE(6,3) DRFT(MS),UNITS
   WRITE(6,4) VOL
   VOL=VOL*FACT/EL**3
   WRITE(6,6) HLUCK
   WRITE(6,7) PST,UNITS
   WRITE(6,8) CBL
   IF (GCB.LE.0.0) GO TO 67
   WRITE(6,69) GCB
   PST=FST*GCB
67  WRITE(6,9) CFL,UNITS
   WRITE(6,10) FLC
   WRITE(6,11) VCH,UNITS
   BUR=BEAM(MS)/DRFT(MS)
   WRITE(6,300) BDR
   IF (BEAM(MS).EQ.0.0) GO TO 700
   ELBR=EL/BEAM(MS)
   GO TO 701
700 ELBR=0.0
701 CONTINUE
   WRITE(6,301) ELBR
   WRITE(6,66) RF33,RP35,RM55
   DU 31 K=1,NUS
   SS(K)=SS(K)/EL
   SQAR(K)=SQAR(K)/EL**2
   BEAM(K)=BEAM(K)/EL
   DRFT(K)=DRFT(K)/EL
   IF (NM(K).LE.0) GO TO 31
   NUT=IN(K)
   DU 24 J=1,NUT
   X(K,J)=X(K,J)/EL

```

```
24 Y(K,J)=Y(K,J)/EL
31 CONTINUE
   PST=PST/EL
   CALL NILS(NOS,MS,ST,DS,JFK)
   IF(JFK.GT.0) GO TO 76
   ID=-1
   GO TO 77
76 IF(OMIN.LE.0.0.OR.JA.EQ.3) GO TO 77
C
C  TRANSFER TO LOOP TO CALL PGM2 AND PGM3
C
   CALL AETSKC(5LPGM1A)
C
77  CONTINUE
   IF(ID.EQ.2 .OR. ID.EQ.-1) CALL AETSKC(6LMOT246)
   CALL AETSKC(4LPGM4)
   END
```

OVERLAY(3,0)
PROGRAM PGM1B

C
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C

CUMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
CUMMON/SRY2/ ID,IG,IP,IND,ISU,ISTART,JA,JB,JC,K,LP,MAXD,MONU,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
CUMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
CUMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
CUMMON/SRY5/ VOL,XIP,DST,PST,BAM,URT,AIR,AMP1,AMP2,DS(30),SS(30)
CUMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
CUMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
CUMMON/SRY8/ NRTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
CUMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,UMAX,DUME,OWAX
CUMMON/SRY10/XZHB,XZPB,XZFO,XZVL,KV,KW
CUMMON/SRY11/CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
CUMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
CUMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
CUMMON/SRY14/EL,GCB,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
CUMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
CUMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
CUMMON/SRY17/ASY(30),DSY(4,30),AY(30),UY(4,30),ARY(30),URY(30)
CUMMON/SRY18/B22(4,30),B26(4,30),B62(4,30),B46(4,30),B64(4,30),
X B66(4,30),B24(4,30),B44(4,30,3)
CUMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
CUMMON/SRY20/BLUG(19,19),YLOG(19,19)
CUMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
CUMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

CUMMON/ENDCOM/ENDCOM

COMPLEX TEMP
TWDDL=2./EL
CON=1.688
IF(GRAV.LT.32.) CON=.3048*CON
CON=SQRT(GRAV*EL)/CON
FACT=SQRT(GRAV/EL)
FARD=0.017453293
BSD=BEAM(MS)*EL
DU 205 ISD=1,NSD
HMS=2.0*(SD(ISD))-BSD
IF(BSD.LE.1.E-07) GO TO 88
RATIO=HMS/BSD
GO TO 87
88 RATIO=HMS
87 IF(MONO.GE.1) RATIO=0.

```

SDI=SD(ISO)/EL
SD(ISO)=SDI
IF(ABS(GMTS).GT.1.E-04) GMT=GMTS+SDI*SDI*AMP1/VOL
IF(GMTS.GT.1.E-04) WRITE(6,176) SD(ISO),GMT
IF(ISO.GT.1) FAY=FAY+EL*(SD(ISO)-SD(ISO-1))
IF(ISO.GT.1) FBY=FBY+EL*(SD(ISO)-SD(ISO-1))
CALL AETSKC(5LQPGM2)
IF(ID.GT.1) GO TO 77
CALL AETSKC(6LQPGM2B)
IF(ID.GT.1) GO TO 77
CALL AETSKC(5LQPGM3)
IF(NOW.GT.0) GO TO 78
5 FORMAT(1H1,15A6,10X,A6,I4)
171 FORMAT(3X,*WAVE HEADING =*,F6.1,* DEGREES*/)
172 FORMAT(3X,*ABSOLUTE DISPLACEMENT, VELOCITY, AND *,
X *ACCELERATION AT STATION *,F5.1,* AND HEIGHT *,F5.1)
173 FORMAT(/3X,*SPEED =*,F5.1,* KNOTS*)
174 FORMAT((5X,F10.2,3(7X,F8.3),5X,F10.4))
175 FORMAT(3X,*ENC PER(SEC)*,6X,*ABS DISPL*,12X,*VEL*,8X,
X *ACCEL/G*,7X,*WAVE L/L*)
176 FORMAT(///10X,*CALCULATED GMT = *,E12.5,* FOR SEPARATION *
X *DISTANCE OF *,F7.2)
DO 150 KI=1,NSTR
LINES=2
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
RBMSTK=RBMST(KI)
RBMHTK=RBMHT(KI)
WRITE(6,172) RBMSTK,RBMHTK
ARM=EL*(PST-.05*RBMSTK)
DO 150 MM=1,NBTA
DO 160 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 160
SPID=FN(JJ)*CON
LINES=LINES+LMT+5
IF(LINES.LE.60) GO TO 89
LINES=5
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
WRITE(6,172) RBMSTK,RBMHTK
89 WRITE(6,173) SPID
WRITE(6,171) WANG(MM)
WRITE(6,175)
DO 170 N=1,LMT
TEMP=EFS(JJ,N,MM)
SWAY=REAL(TEMP)
DELTA=FARD*AIMAG(TEMP)
TEMP=EMY(JJ,N,MM)
YAW=TWODL*REAL(TEMP)
EPSIL=FARD*AIMAG(TEMP)
TEMP=EMR(JJ,N,MM)
ROLL=REAL(TEMP)
RPHASE=FARD*AIMAG(TEMP)

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ABMA=SWAY*COS(DELTA)+ARM*YAW*COS(EPSIL)-RBMHTK*ROLL*COS(RPHASE)
ABMB=SWAY*SIN(DELTA)+ARM*YAW*SIN(EPSIL)-RBMHTK*ROLL*SIN(RPHASE)
ABMO=SQRT(ABMA*ABMA+ABMB*ABMB)
OMEGAE=OMEN(N)*FACT
ENCP=6.2831853/OMEGAE
VEL=OMEGAE*ABMO
ACCEL=OMEGAE*VEL/GRAV
170 WRITE(6,174) ENCP,ABMO,VEL,ACCEL,RMS(JJ,N,MM)
160 CONTINUE
150 CONTINUE
    ID=1
77  CONTINUE
    IF(IND.EQ.0) GO TO 78
    DO 81 JJ=1,NFN
    DO 81 N=1,NFR
    DO 81 MM=1,NBTA
    EMR(JJ,N,MM)=EKR(JJ,N,MM)+II*AIMAG(EMR(JJ,N,MM))
81  EMY(JJ,N,MM)=EKY(JJ,N,MM)+II*AIMAG(EMY(JJ,N,MM))
    WRITE(23) NFN,NFR,NBTA
    WRITE(23) (FN(I),I=1,NFN),(OMEN(I),I=1,NFR),(WANG(I),I=1,NBTA)
    WRITE(23) (((WFR(JJ,N,MM),EFS(JJ,N,MM),EMR(JJ,N,MM),EMY(JJ,N,MM)),
X   JJ=1,NFN),N=1,NFR),MM=1,NBTA)
78  CONTINUE
    IF(JA.EQ.2) CALL AETSKC(5LPGM1A)
    IF(ID.EQ.2 .OR. ID.EQ.-1) CALL AETSKC(6LMOT246)
    IF(LP.EQ.0 .AND. IP.EQ.0 .AND. NOW.EQ.0) CALL AETSKC(6LMOT246)
    IF(LP.EQ.0 .AND. IP.EQ.0) CALL AETSKC(4LPGM5)
205 CONTINUE
    END

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PROGRAM QPGM2

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COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X           NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X           DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X           X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NUN,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X           SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINRET(3)
COMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,UMAX,DUME,OWAX
COMMON/SRY10/XZHB,XZPB,XZFO,XZVL,KV,KW
COMMON/SRY11/CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCB,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),DRY(30)
COMMON/SRY18/B22(4,30),B26(4,30),B62(4,30),B46(4,30),B64(4,30),
X           B66(4,30),B24(4,30),B44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/BLUG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X           WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

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1 FORMAT(1H0,5X,*DYNAMIC COEFFICIENTS OF THE EQUATIONS OF MOTION*
X   ///6X,*A22 IS SCALED BY M.*//
X   6X,*A24, A26 AND A62 ARE SCALED BY *,4HM*L.//
X   6X,*A44, A46, A64 AND A66 ARE SCALED BY *,6HM*L*L.//
X   6X,*B22 IS SCALED BY *,12HM*SQRT(G/L).//
X   6X,*B24, B26 AND B62 ARE SCALED BY *,12HM*SQRT(G*L).//
X   6X,*B44, B46, B64, AND B66 ARE SCALED BY *,14HM*L*SQRT(G*L).//
X   6X,4HB44*,* IS B44 EXCLUDING CROSS-FLOW DRAG CONTRIBUTIONS.*//
X   6X,*M IS THE DISPLACED MASS.*//
X   6X,*G IS THE ACCELERATION DUE TO GRAVITY.*//
X   6X,*L IS THE DISTANCE BETWEEN PERPENDICULARS.*////
X   6X,*FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*,4H*L).//
X   6X,*BETA IS THE WAVE HEADING ANGLE IN DEGREES.*//
X   6X,*BETA = 180. FOR HEAD SEAS.*//
X   6X,*OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED*
X   * BY SQRT(G/L).*//
X   6X,*THE HULL SEPARATION/BEAM RATIO IS THE DISTANCE*/
X   6X,*BETWEEN THE HULLS DIVIDED BY THE BEAM OF ONE HULL.*)

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2 FORMAT(1H0,5X,*BARE HULL POTENTIAL FLOW ADDED MASS COEFFICIENTS*/
X 6X,*FN = *,
X F5.3//10X,*OMEGA*,7X,*A22*,3X,*A24=A42*,7X,*A26*,7X,*A62*,7X,
X *A44*,7X,*A46*,7X,*A64*,7X,*A66*)
3 FORMAT(1H0,5X,*BARE HULL POTENTIAL FLOW DAMPING COEFFICIENTS*/
X 6X,*FN = *,F5.3//
X 10X,*OMEGA*,7X,*B22*,3X,*B24=B42*,7X,*B26*,7X,*B62*,7X,*B44*,
X 7X,*B46*,7X,*B64*,7X,*B66*)
4 FORMAT(F15.4,8F10.6)
5 FORMAT (1H1,15A6,18X,A6,I4)
11 FORMAT(1H0,5X,8HSTATION,F7.4)
150 FORMAT(1H0,80X,*HULL SEPARATION/BEAM =*,F7.4)
205 FORMAT(1H0,5X,43HPROJECTED AREA OF THE SUBMERGED HULL/L**2 =,E15.6
1/5X,13HMOMENT/L**3 =,E15.6,5X,24HMOMENT OF INERTIA/L**4 =,E15.6)
DIMENSION XJK(20)
COMPLEX F2D,F4D1,F4D2,F6D,ICUSRK,EKD2X,CEKXC
IF(1.EQ.0) CALL PGM1B
QPI = 0.7853982
EL2=EL*EL
RVOL=VOL*EL*EL2
NSU=NOS
I1=(0.0,1.0)
DU 12 MM=1,NBTA
WAND=WANG(MM)*.01745329252
CUSBET(MM)=COS(WAND)
12 SINBET(MM)=SIN(WAND)
CALL QDFCN
DU 151 JJ=1,NFN
DU 151 N=1,NFR
DU 151 MM=1,NBTA
151 RWS(JJ,N,MM)=1./SWR(JJ,N,MM)
DU 40 N=1,NFR
A22(N)=0.
A24(N)=0.
A44(N)=0.
DSR(N)=0.
DRR(N)=0.
ASY(N)=0.
AY(N)=0.
ARY(N)=0.
DRY(N)=0.
40 CONTINUE
DU 50 JJ=1,NFN
DU 50 N=1,NFR
DSY(JJ,N)=0.
DY(JJ,N)=0.
B22(JJ,N)=0.
DU 50 MM=1,NBTA
EFS(JJ,N,MM)=(0.,0.)
EMR(JJ,N,MM)=(0.,0.)
50 EMY(JJ,N,MM)=(0.,0.)
SIA=SIM=SII=SIR=SIRM=SIRR=0.
PROA=PROM=PROI=0.
DU 60 K=1,NUS
XIP=PST-SS(K)

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XIP2=XIP*XIP
DST=DS(K)
NUT=NM(K)
IF (NUT .EQ. 0) GO TO 60
DU 333 IJK=1,NUT
333 XJK(IJK)=X(K,IJK)
XLG=XMAX(NUT,XJK)
XSM=XMIN(NUT,XJK)
AVBM(K)=XLG-XSM
BAM=BEAM(K)
DRT=DRFT(K)
AIR=AREA(K)
DA=DST*AVBM(K)
PROA=PROA+DA
PRUM=PROM-XIP*DA
PROI=PROI+XIP2*DA
NUN=NUT-1
NUE=2*NUN
DU 62 J=1,NUT
XS(J)=X(K,J)+SD(ISD)
62 YS(J)=Y(K,J)
YSML = XMIN(NUT,YS)
YLG=XMAX(NUT,YS)
DM=YLG-YSML
DMA(K)=DM
AVD=.5*(YLG+YSML)
AVDA(K)=AVD
DAB=DST*DM
SIA=SIA+DAB
SIM=SIM+DAB*XIP
SII=SII+DAB*XIP2
C AVD IS A NEGATIVE NUMBER
DAB=DAB*AVD
SIR=SIR-DAB
SIRM=SIRM-DAB*XIP
SIRR=SIRR+DAB*AVD
DU 65 IJI = 1, NUT
NNN = IJI
IF (YSML.EQ.YS(IJI)) GO TO 66
65 CONTINUE
66 MAXD = NNN
IF (MONO .GT. 1) MAXD=1
DU 63 J=1,NUN
XX(J)=0.5*(XS(J)+XS(J+1))
YY(J)=0.5*(YS(J)+YS(J+1))
XINT=XS(J+1)-XS(J)
YINT=YS(J+1)-YS(J)
DEL(J)=SQRT(XINT**2+YINT**2)
SNE(J)=YINT/DEL(J)
63 CSE(J)=XINT/DEL(J)
CALL FRANK
IF (ID.LT.2) GO TO 60
STATION=20.0*SS(K)
WRITE(6,11)STATION
GO TO 77
60 CONTINUE

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```

WRITE(6,205) PROA,PROM,PROI
DU 70 N=1,NFN
GXI=OMEN(N)
DEB=GXI*VOL
DEA=GXI*DEB
A22(N)=A22(N)/DEA
A44(N)=A44(N)/DEA
A24(N)=A24(N)/DEA
DRR(N)=DRR(N)/DEB
DSR(N)=DSR(N)/DEB
ARY(N)=ARY(N)/DEA
DRY(N)=DRY(N)/DEB
ASY(N)=ASY(N)/DEA
AY(N)=AY(N)/DEA
DU 70 JJ=1,NFN
DSY(JJ,N)=DSY(JJ,N)/DEB
DY(JJ,N)=DY(JJ,N)/DEB
B22(JJ,N)=B22(JJ,N)/DEB
70 CONTINUE
DU 71 N=1,NFN
GXI=OMEN(N)
GX2=GXI*GX1
DU 71 JJ=1,NFN
FNJ=FN(JJ)
R26=FNJ/GX2
R66=FNJ*R26
SA=ASY(N)
SB=R26*B22(JJ,N)
A26(JJ,N)=SA+SB
A62(JJ,N)=SA-SB
SA=DSY(JJ,N)
SB=FNJ*A22(N)
B26(JJ,N)=SA-SB
B62(JJ,N)=SA+SB
SA=R26*DSR(N)
SB=ARY(N)
A46(JJ,N)=SB+SA
A64(JJ,N)=SB-SA
SA=DRY(N)
SB=FNJ*A24(N)
B46(JJ,N)=SA-SB
B64(JJ,N)=SA+SB
A66(JJ,N)=AY(N)+R66*A22(N)
B66(JJ,N)=DY(JJ,N)+R66*B22(JJ,N)
71 CONTINUE
IF(IG.LT.2) GO TO 306
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
WRITE(6,150) RATIO
WRITE(6,1)
DU 73 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 73
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG

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WRITE(6,150)RATIO
WRITE(6,2) FN(JJ)
WRITE(6,4) (UMEN(N),A22(N),A24(N),A26(JJ,N),A62(JJ,N),A44(N),
X A46(JJ,N),A64(JJ,N),A66(JJ,N),N=1,LMT)
WRITE(6,3) FN(JJ)
WRITE(6,4) (UMEN(N),B22(JJ,N),DSR(N),B26(JJ,N),B62(JJ,N),DRR(N),
X B46(JJ,N),B64(JJ,N),B66(JJ,N),N=1,LMT)
73 CONTINUE
306 CONTINUE
CSA=CHRDIA*SPNA
CSB=CHRDB*SPNB
ADFA=QPI*CSA*(CHRDA+THKA)/RVOL
ADFB=QPI*CSB*(CHRDB+THKB)/RVOL
FAYEL2=FAY*FAY/EL2
FBYEL2=FBY*FBY/EL2
VMAB=(CLFA+FAYEL2*CSA+CLFB*FBYEL2*CSB)/(EL2*VOL)
AMAB=FAYEL2*ADFA+FBYEL2*ADFB
SDI=SD(ISD)
B44SI=PROA*SDI*SDI+SIRR
HXZVL=.5*XZVL/VOL
DO 72 N=1,NFN
GX1=UMEN(N)
GX2=GX1*GX1
A44(N)=A44(N)+AMAB
DO 72 JJ=1,NFN
FNJ=FN(JJ)
VISF=HXZVL*FNJ*FNJ/GX2
A26(JJ,N)=A26(JJ,N)+VISF*SIA
A46(JJ,N)=A46(JJ,N)+VISF*SIR
A66(JJ,N)=A66(JJ,N)+VISF*SIM
VISF=HXZVL*FNJ
SA=VISF*SIM
B26(JJ,N)=B26(JJ,N)+SA
B62(JJ,N)=B62(JJ,N)+SA
SA=DRR(N)+FNJ*VMAB+VISF*B44SI
DO 75 MM=1,NHTA
75 B44(JJ,N,MM)=SA
B24(JJ,N)=DSR(N)+VISF*SIR
SA=VISF*SIRM
B46(JJ,N)=B46(JJ,N)+SA
B64(JJ,N)=B64(JJ,N)+SA
B66(JJ,N)=B66(JJ,N)+VISF*SII
72 B22(JJ,N)=B22(JJ,N)+VISF*SIA
DEPCAL=DEPCAT/EL
DO 80 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 80
HXZVL=.5*FN(JJ)*XZVL
DO 81 MM=1,NHTA
CUSH=COSBET(MM)
SSINH=SDI*SINHET(MM)
DO 81 N=1,LMT
CAY=WN(JJ,N,MM)
ICUSHK=II*CAY*CUSH
EKD=EXP(-CAY*DEPCAL)

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F2D=F4D1=F4D2=F6D=(0.,0.)
DO 82 K=1,NOS
XIP=PST-SS(K)
D=DMA(K)
D2=-AVDA(K)
CEKXC=CEXP(ICOSRK*XIP)*DST
EKD2X=EXP(-CAY*D2)*CEKXC
F2D=F2D+D*EKD2X
IF(DEPCAT.LE.0.) EKC=EXP(-CAY*AREA(K)*DPFT(K))
C DEPCAT DEFINED FOR SWATH
C AREA(K)*DPFT(K) GIVES (CROSS SECTIONAL AREA)/DIAM
F4D1=AVBM(K)*EKD*CEKXC
F4D2=F4D2+D*C2*EKD2X
82 F6D=F6D+XIP*D*EKD2X
CON=HXZVL*WFR(JJ,N,MM)
ARG=CAY*SSINB
CONC=CON*COS(ARG)
EFS(JJ,N,MM)=EFS(JJ,N,MM)-CONC*F2D
EMR(JJ,N,MM)=EMR(JJ,N,MM)-CON*SDI*SIN(ARG)*F4D1-CONC*F4D2
EMY(JJ,N,MM)=EMY(JJ,N,MM)-CONC*F6D
81 CONTINUE
80 CONTINUE
77 CONTINUE
CALL AER.TRNK
END

```

PROGRAM QPGM2B

C
C

COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISU,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,URT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NBT,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,OWAX
COMMON/SRY10/XZHB,XZPB,XZFU,XZVL,KV,KW
COMMON/SRY11/CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCB,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),DRY(30)
COMMON/SRY18/B22(4,30),B26(4,30),B62(4,30),B46(4,30),B64(4,30),
X B66(4,30),B24(4,30),B44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/BLOG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

C
C
C
C
C

END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

DIMENSION DTMA(30)
COMPLEX EGS,ENR,ENY,SEMR(4,30,3)
COMMON /PR23B/ EGS(4,30,3),ENR(4,30,3),ENY(4,30,3)
COMPLEX CZIR,COSBK,SINBKS,ERKSP,ERKSM,EX,EXPL,EXMN,CZIRS,CZIRH,
X F4DMP,TA,CZIS,CZIIY,SZIR,IKS,CEXPA,CEXPB,CEXMA,CEXMB,PA,PB,
X EKDA,EKDB
5 FORMAT (1H1,15A6,18X,A6,I4)
7 FORMAT(F15.4,8F10.6)
6 FORMAT(1H0,5X,*EXCITING FORCE, MUMENTS AND PHASES*////
X 6X,*THE SWAY FORCE IS SCALED BY *,6HM*G*A.//
X 6X,*THE ROLL AND YAW MOMENTS ARE SCALED BY *,6HM*G*A.//
X 6X,7H*MOMENT,* DENOTES THE MOMENT SCALED BY *,
X 20HM*G*A*(WAVE NUMBER).//
X 6X,*M IS THE DISPLACED MASS.*//
X 6X,*G IS THE ACCELERATION DUE TO GRAVITY.*//
X 6X,*A IS THE WAVE AMPLITUDE.*//
X 6X,*L IS THE DISTANCE BETWEEN PERPENDICULARS.*////

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X 6X,*FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*,4H*L).//
X 6X,*BETA IS THE WAVE HEADING ANGLE IN DEGREES.*//
X 6X,*BETA = 180. FOR HEAD SEAS.*//
X 6X,*OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED*,
X * BY SQRT(G/L).*//
X 6X,*THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT*/
X 6X,*TO THE WAVE AT THE CG. *//
X 6X,*L/LAM = L/(WAVE LENGTH).*//
X 6X,*FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO*,
X * THREE*/6X,*REGIONS SEPARATED BY TWO CRITICAL SWR, DENOTED *,
X *CWR1 AND CWR2.*
8 FORMAT(1H0,5X,*EXCITING FORCE, MUMENTS AND PHASES*/
X 6X,*FN = *,F5.3/6X,*BETA = *,F6.1//
X * REGION *,I1,* CWR1 = *,F9.4,* CWR2 = *,F9.4/6X,*OMEGA*,5X,
X *L/LAM*,4X,*SFORCE*,5X,*PHASE*,3X,*RMOMENT*,5X,*PHASE*,3X,
X 7H*MOMENT,3X,*YMOMENT*,5X,*PHASE*,3X,7H*MOMENT,5X,*LAM/L*)
9 FORMAT(1H0,5X,*EXCITING FORCE, MUMENTS AND PHASES*/
X 6X,*FN = *,F5.3/6X,*BETA = *,F6.1//
X 6X,*OMEGA*,5X,*L/LAM*,4X,*SFORCE*,5X,*PHASE*,3X,*RMOMENT*,
X 5X,5H*PHASE,3X,7H*MOMENT,3X,7H*YMOMENT,5X,5H*PHASE,3X,7H*MOMENT,
X 5X,5HLAM/L)
10 FORMAT((1X,F10.4,F10.4,F10.5,F10.3,2(F10.5,F10.3,F10.5),F10.4))
13 FORMAT(1H0,5X,*ADDED MASS COEFFICIENTS*/6X,*FN = *,F5.3//
X 10X,*OMEGA*,7X,3HA22,3X,7HA24=A42,7X,3HA26,7X,3HA62,7X,3HA44,
X 4X,3HA46,7X,3HA64,7X,3HA66)
X 3HA66)
150 FORMAT(1H0,80X,23HHULL SEPARATION/BEAM = F7.4)
212 FORMAT(1H0,5X,*FN = *,F5.3/6X,*BETA = *,F6.1/10X,
X *OMEGA*,6X,*SWAY*,5X,*PHASE*,6X,*ROLL*,5X,*PHASE*,7X,*YAW*,5X,
X *PHASE*,5X,*LAM/L*)
213 FORMAT((5X,F10.3,3(F10.5,F10.3),F10.4))
214 FORMAT(/6X,*EQUATIONS OF MOTION SOLVED USING B44 EXCLUDING *,
X *VISCOUS EFFECTS*)
215 FORMAT(/6X,*EQUATIONS OF MOTION SOLVED WITH CROSS-FLOW *
X *VISCOUS DAMPING AND ROLL WAVE EXCITING MOMENT INCLUDED*)
410 FORMAT(1H0,5X,*DAMPING COEFFICIENTS*/6X,*FN = *,F5.3//
X 6X,5H*OMEGA,7X,3HB22,3X,7HB24=B42,7X,3HB44,7X,3HB66,7X,3HB26,
X 7X,3HB62,7X,3HB46,7X,3HB64,6X,4HB44*/35X,6HBETA = /
X 35X,F6.1/)
411 FORMAT(1X,F10.4,9F10.6)
412 FORMAT(1H0,5X,*DAMPING COEFFICIENTS*/6X,*FN = *,F5.3//
X 6X,5H*OMEGA,7X,3HB22,3X,7HB24=B42,2(7X,3HB44),7X,3HB66,7X,3HB26,
X 7X,3HB62,7X,3HB46,7X,3HB64,6X,4HB44*/31X,2(4X,6HBETA =) /
X 31X,2(4X,F6.1))
413 FORMAT(1X,F10.4,10F10.6)
414 FORMAT(1H0,5X,*DAMPING COEFFICIENTS*/6X,*FN = *,F5.3//
X 6X,5H*OMEGA,7X,3HB22,3X,7HB24=B42,3(7X,3HB44),7X,3HB66,7X,3HB26,
X 7X,3HB62,7X,3HB46,7X,6HB64,6X,4HB44*/31X,3(4X,6HBETA =) /
X 31X,3(4X,F6.1))
415 FORMAT(1X,F10.4,11F10.6)
500 FORMAT(///5X,*ROLL AMP FAILED TO CONVERGE FOR BETA = *,F6.1,
X * FN = *,F5.3/6X,*LAST TWO VALUES = *,E12.5,* AND *,E12.5,3H***,
X *CALCULATION CONTINUES*)
501 FORMAT(///5X,*ITERATION NOT USED. MAX AMP = *,E12.5)
502 FORMAT(5X,*NUMBER OF ITERATIONS =*,I2)

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IF (1.EQ.0) CALL PGM18
PI=3.14159
SUI=SD(ISD)
SU2=SDI*SDI
RFACT=SDI
IF (MONO.EQ.2) RFACT=.5*BEAM(MS)
IF (IG.NE.3) GO TO 29
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
WRITE(6,150) RATIO
WRITE(6,214)
CALL SOLVE(2,VOL,1,NFN,1,NBTA,1,NFR,RFACT)
DU 28 JJ=1,NFN
LMT=MIL(JJ)
IF (LMT.LE.0) GO TO 28
DU 27 MM=1,NBTA
LM4=LMT+4
IF (55-KR.GE.LM4) GO TO 26
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
WRITE(6,150) RATIO
WRITE(6,214)
26 WRITE(6,212) FN(JJ),WANG(MM)
WRITE(6,213) (OMEN(N),EGS(JJ,N,MM),ENR(JJ,N,MM),ENY(JJ,N,MM),
X RWS(JJ,N,MM),N=1,LMT)
KR=KR+LM4
27 CONTINUE
28 CONTINUE
29 CONTINUE
DU 83 JJ=1,NFN
DU 83 N=1,NFR
83 DY(JJ,N)=844(JJ,N,1)
ELEL=EL*EL
FAYEL=FAY/EL
FBYEL=FBY/EL
DEPAL=DEPA/EL
DEPBL=DEPB/EL
DEPCAL=DEPCAT/EL
FALP=PST-FAL/EL
FBLP=PST-FBL/EL
IF (CLFA.LE.0. .AND. CLFB.LE.0.) GO TO 399
CUNA=.5*SPNA*CHRDA*CLFA*FAYEL/ELEL
CUNB=.5*SPNB*CHRDB*CLFB*FBYEL/ELEL
DU 80 JJ=1,NFN
LMT=MIL(JJ)
IF (LMT.LE.0) GO TO 80
DU 81 MM=1,NBTA
CUSB=COSBET(MM)
SINB=SINBET(MM)
DU 81 N=1,LMT
CAY=WN(JJ,N,MM)
CAYB=CAY*SINB

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SYA=SIN(CAYB*FAYEL)
SYB=SIN(CAYB*FBYEL)
CAYB=CAY*CUSB
WLA=CAYB*FALP
WLB=CAYB*FBLP
CUN=WFR(JJ,N,MM)*FN(JJ)
FEXA=CON*EXP(-CAY*DEPAL)*CONA*SYA
FEXB=CON*EXP(-CAY*DEPBL)*CONB*SYB
81 EMR(JJ,N,MM)=EMR(JJ,N,MM)-FEXA*CEXP(II*WLA)-FEXB*CEXP(II*WLB)
80 CONTINUE
399 IF (XZFO+XZFA+XZFB.LE.0.) GO TO 73
C .21221=2/(3*PI)
C .005=A/EL=EMPIRICAL FACTOR
C CONT=(.005*EL)*.21221*XZFO/EL
  CUNT=.001061*XZFO
  CUNS=CONT/VOL
  CUN=2./(3.*PI*ELEL*EL)
  CUNEA=CON*XZFA*FAYEL*CHRDA*SPNA
  CUNEB=CON*XZFB*FBYEL*CHRDB*SPNB
  CUNDA=CUNEA*FAYEL/VOL
  CUNDB=CUNEB*FBYEL/VOL
  DU 70 JJ=1,NFN
  LMT=MIL(JJ)
  IF (LMT.LE.0) GO TO 70
  DU 71 MM=1,NBTA
  ILOOP=-1
  IF (IG.NE.3) GO TO 78
  KR=0
  NPAG=NPAG+1
  WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
  WRITE(6,150) RATIO
  WRITE(6,215)
  LM4=LMT+4
78 DU 74 N=1,LMT
74 SEMR(N)=EMR(JJ,N,MM)
555 ILOOP=ILOOP+1
  CALL SOLVE(2,VOL,JJ,JJ,MM,MM,1,LMT,RFACT)
  IF (IG.NE.3) GO TO 82
  IF (55-KR.GE.LM4) GO TO 79
  KR=0
  NPAG=NPAG+1
  WRITE(6,5) (PATT(I),I=1,7),(TITLE(I),I=1,8),PATT(8),NPAG
  WRITE(6,150) RATIO
  WRITE(6,215)
79 WRITE(6,212) FN(JJ),WANG(MM)
  WRITE(6,213) (UMEN(N),EGS(JJ,N,MM),ENR(JJ,N,MM),ENY(JJ,N,MM),
  X RWS(JJ,N,MM),N=1,NFR)
  KR=KR+LM4
82 IF (NLOOP.LE.0) GO TO 21
  DU 54 N=1,LMT
54 DTMA(N)=REAL(ENR(JJ,N,MM))
  ENRMXL=ENRMX
  ENRMX=XMAX(LMT,DTMA)
  IF (ENRMX.GT..01) GO TO 556
  WRITE(6,501) ENRMX

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      ILOOP=NL OOP
      GO TO 21
556 IF (ILOOP.LE.0) GO TO 21
      IF (ABS(1.-ENRMX/ENRML).LE..1) GO TO 71
C   COMPUTE CROSS-FLOW VISCOUS DAMPING AND WAVE-EXCITING MOMENT
C
      21 DO 75 N=1,LMT
          GXI=OMEN(N)
          CAY=WN(JJ,N,MM)
          OMEG=WFR(JJ,N,MM)
          WDW=OMEG/GXI
          WW=OMEG*GXI
          COSB=COSBET(MM)
          SINB=SINBET(MM)
          EKD=EXP(-CAY*DEPCAL)
          EKDW=WDW*EKD
          COSBK=II*CAY*COSB
          SINBKS=II*SDI*CAY*SINB
          EBKSP=CEXP(SINBKS)
          EBKSM=CEXP(-SINBKS)
          TA=EGS(JJ,N,MM)
          ZRS=REAL(TA)
          ZIS=AIMAG(TA)/57.295779
          CZIS=ZRS*CEXP(-II*ZIS)
          TA=ENR(JJ,N,MM)
          ZRR=REAL(TA)
          ZIR=AIMAG(TA)/57.295779
          CZIR=ZRR*CEXP(-II*ZIR)/RFACT
          TA=ENY(JJ,N,MM)
          ZRY=REAL(TA)
          ZIY=AIMAG(TA)/57.295779
          CZIY=ZRY*CEXP(-II*ZIY)
          CZIRS=II*CZIR
          SZIR=SDI*CZIR
          B44DMP=0.
          F4DMP=(0.,0.)
          DO 72 K=1,NOS
              XIP=PST-SS(K)
              D=DMA(K)
              D2=-AVDA(K)
              DD2=D*D2
              AVB=AVBM(K)
              DST=DS(K)
              EX=CEXP(XIP*COSBK)
              EXPL=EX*EBKSP
              EXMN=EX*EBKSM
              IF (DEPCAT.LE.0) EKDW=WDW*EXP(-CAY*AREA(K)*DRFT(K))
              ZRSD=CABS(SZIR+EKDW*EXPL)
              ZRPD=CABS(SZIR-EKDW*EXMN)
              EHX=EXP(-CAY*D2)
              WX=WDW*EHX
              CZIRH=CZIS+XIP*CZIY+D2*CZIR
              Y1SD=CABS(II*CZIRH-WX*EXPL)
              Y1PD=CABS(II*CZIRH-WX*EXMN)
              B44DMP=B44DMP+(SD2*AVB*(ZRSD+ZRPD)+DD2*D2*(Y1SD+Y1PD))*DST
              F4DMP=F4DMP+(II*AVB*SDI*(ZRSD*EXPL-ZRPD*EXMN)-
X   DD2*(Y1SD*EXPL+Y1PD*EXMN))*DST

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72 CONTINUE
EKDA=EXP(-CAY*DEPAL)*CEXP(COSBK*FALP)
EKDB=EXP(-CAY*DEPBL)*CEXP(COSBK*FBLP)
C1=WDW*EKDA
C2=WDW*EKDB
IKS=II*CAY*SINB
PA=IKS*FAYEL
PB=IKS*FBYEL
C1XPA=CEXP(PA)
C1XMA=CEXP(-PA)
C1XPB=CEXP(PB)
C1XMB=CEXP(-PB)
ZSURDA=CABS(FAYEL*CZIR+C1*CEXPA)
ZPURDA=CABS(FAYEL*CZIR-C1*CEXMA)
ZSURDB=CABS(FBYEL*CZIR+C2*CEXPB)
ZPURDB=CABS(FBYEL*CZIR-C2*CEXMB)
B44(JJ,N,MM)=DY(JJ,N)+CONS*GXI*B44DMP+GXI*(CONDA*(ZSURDA+ZPURDA)
X +CONDB*(ZSURDB+ZPURDB))
EMR(JJ,N,MM)=SEMR(N)+WW*CONT*EKD*F4DMP+II*WW*CONEA*EKDA*
X (ZSURDA*CEXPA-ZPURDA*CEXMA)+II*WW*CONEB*EKDB*(ZSURDB*CEXPB-
X ZPURDB*CEXMB)
75 CONTINUE
IF(NLOOP.GT.ILOOP) GO TO 555
WRITE(6,500) WANG(MM),FN(JJ),ENRMLX,ENRMLX
71 CONTINUE
70 CONTINUE
73 DO 85 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 85
DO 84 MM=1,NBTA
DO 84 N=1,LMT
EFS(JJ,N,MM)=EFS(JJ,N,MM)/VOL
EMR(JJ,N,MM)=EMR(JJ,N,MM)/VOL
EMY(JJ,N,MM)=EMY(JJ,N,MM)/VOL
ZRS=CABS(EFS(JJ,N,MM))
ZRR=CABS(EMR(JJ,N,MM))
ZRY=CABS(EMY(JJ,N,MM))
ZIS=0.
IF(ZRS.GT.0.)
X ZIS=-57.295779*ATAN2(AIMAG(EFS(JJ,N,MM)),REAL(EFS(JJ,N,MM)))
IF(ZIS.GT.90.) ZIS=ZIS-360.
ZIR=0.
IF(ZRR.GT.0.)
X ZIR=-57.295779*ATAN2(AIMAG(EMR(JJ,N,MM)),REAL(EMR(JJ,N,MM)))
IF(ZIR.LT.-270.) ZIR=ZIR+360.
ZII=0.
IF(ZRY.GT.0.)
X ZII=-57.295779*ATAN2(AIMAG(EMY(JJ,N,MM)),REAL(EMY(JJ,N,MM)))
IF(ZII.LT.-270.) ZII=ZII+360.
EGS(JJ,N,MM)=CMPLX(ZRS,ZIS)
ENR(JJ,N,MM)=CMPLX(ZRR,ZIR)
ENY(JJ,N,MM)=CMPLX(ZRY,ZII)
CAY=WN(JJ,N,MM)
EKR(JJ,N,MM)=ZRR/CAY
EKY(JJ,N,MM)=ZRY/CAY
84 CONTINUE
85 CONTINUE

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IF (IG.LE.0) GO TO 77
IF (IG.EQ.1) GO TO 111
DU 95 JJ=1,NFN
NPAG=NPAG+1
WRITE (6,5) (PATT(I),I=1,7), (TITLE(I),I=1,8), PATT(8), NPAG
WRITE (6,150) RATIO
WRITE (6,13) FN(JJ)
WRITE (6,7) (OMEN(N), A22(N), A24(N), A26(JJ,N), A62(JJ,N), A44(N),
X A46(JJ,N), A64(JJ,N), A66(JJ,N), N=1, NFR)
GU TO (401,402,403) NBTA
401 WRITE (6,410) FN(JJ), WANG(1)
WRITE (6,411) (OMEN(N), B22(JJ,N), B24(JJ,N), B44(JJ,N,1),
X B66(JJ,N), B26(JJ,N), B62(JJ,N), B46(JJ,N), B64(JJ,N), DY(JJ,N),
X N=1, NFR)
GU TO 404
402 WRITE (6,412) FN(JJ), WANG(1), WANG(2)
WRITE (6,413) (OMEN(N), B22(JJ,N), B24(JJ,N), (B44(JJ,N,I), I=1,2),
X B66(JJ,N), B26(JJ,N), B62(JJ,N), B46(JJ,N), B64(JJ,N), DY(JJ,N),
X N=1, NFR)
GU TO 404
403 WRITE (6,414) FN(JJ), (WANG(I), I=1,3)
WRITE (6,415) (OMEN(N), B22(JJ,N), B24(JJ,N), (B44(JJ,N,I), I=1,3),
X B66(JJ,N), B26(JJ,N), B62(JJ,N), B46(JJ,N), B64(JJ,N), DY(JJ,N),
X N=1, NFR)
404 CONTINUE
95 CONTINUE
111 NPAG=NPAG+1
WRITE (6,5) (PATT(I), I=1,7), (TITLE(J), J=1,8), PATT(8), NPAG
WRITE (6,150) RATIO
WRITE (6,6)
NPAG=NPAG+1
WRITE (6,5) (PATT(I), I=1,7), (TITLE(J), J=1,8), PATT(8), NPAG
WRITE (6,150) RATIO
KR=0
DU 104 MM=1, NBTA
DU 100 JJ=1, NFN
LMT=MIL(JJ)
IF (LMT.LE.0) GO TO 100
LM4=LMT+4
IF (55-KR.GE.LM4) GO TO 103
KR=0
NPAG=NPAG+1
WRITE (6,5) (PATT(I), I=1,7), (TITLE(J), J=1,8), PATT(8), NPAG
WRITE (6,150) RATIO
103 IF (KASE(JJ).EQ.0) GO TO 101
WRITE (6,8) FN(JJ), WANG(MM), KASE(JJ), CWR1(JJ), CWR2(JJ)
GU TO 102
101 WRITE (6,9) FN(JJ), WANG(MM)
102 WRITE (6,10) (OMEN(N), SWR(JJ,N,MM), EGS(JJ,N,MM), ENR(JJ,N,MM),
X EKJ(JJ,N,MM), ENY(JJ,N,MM), EKY(JJ,N,MM), RWS(JJ,N,MM), N=1, LMT)
KR=KR+LM4
100 CONTINUE
104 CONTINUE
77 CONTINUE
CALL AERTRNK
END

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PROGRAM QPGM3

C
C

COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DOME,OWAX
COMMON/SRY10/XZHB,XZPB,XZFO,XZVL,KV,KW
COMMON/SRY11/CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCB,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),DRY(30)
COMMON/SRY18/B22(4,30),B26(4,30),B62(4,30),B46(4,30),B64(4,30),
X B66(4,30),B24(4,30),B44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/BLUG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

COMPLEX EGS,ENR,ENY
COMMON /PR23B/ EGS(4,30,3),ENR(4,30,3),ENY(4,30,3)
1 FORMAT(1H0,5X,*MOTION AMPLITUDES AND PHASES*////
X 6X,*THE SWAY AMPLITUDE IS SCALED BY A.*//
X 6X,*THE ROLL AMPLITUDE IS SCALED BY *,6H2*A/B.//
X 6X,*THE YAW AMPLITUDE IS SCALED BY *,6H2*A/L.//
X 6X,5H*ROLL,* DENOTES ROLL AMPLITUDE SCALED BY *,
X 4H A*,*(WAVE NUMBER).*//
X 6X,4H*YAW,* DENOTES YAW AMPLITUDE SCALED BY *,
X 16HA*(WAVE NUMBER).//
X 6X,*A IS THE WAVE AMPLITUDE.*//
X 6X,*B IS THE TOTAL HULL SEPARATION FOR TWIN-HULL SHIPS.*//
X 6X,*B IS THE BEAM AT MIDSHIP FOR MONO-HULL SHIPS.*//
X 6X,*L IS THE DISTANCE BETWEEN PERPENDICULARS.*////
X 6X,*FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*,4H*L).//
2 FORMAT(6X,*BETA IS THE WAVE HEADING ANGLE IN DEGREES.*//
X 6X,*BETA = 180. FOR HEAD SEAS.*//

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X 6X,*OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED*,
X * BY SQRT(G/L).*//
X 6X,*THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT*
X * TO THE WAVE AT THE CO. *//
X 6X,*L/LAM = L/(WAVE LENGTH).*//
X 6X,*FOR FOLLOWING SEAS THE FREQUENCY IS DIVIDED INTO THREE*/
X 6X,*REGIONS SEPARATED BY TWO CRITICAL SWR, DENOTED CWR1 AND *
X *CWR2.*)
5 FORMAT (1H1,15A6,18X,A6,I4)
8 FORMAT(1H0,5X,28HMOTION AMPLITUDES AND PHASES/6X,
X 5HFN = ,F5.3/6X,7HBETA = ,F6.1// 8
1H REGION 11,8H CWR1 = F8.4,8H CWR2 = F8.4/6X,5HOMEGA,7X,3HSWR,5X,5
XH SWAY,5X,5HPHASE,6X,4HROLL,5X,5HPHASE,4X,5H*ROLL,5X,3HYAW,7X,
X 5HPHASE,5X,4H*YAW,5X,5HLAM/L)
9 FORMAT(1H0,5X,*MOTION AMPLITUDES AND PHASES*/
X 6X,*FN = *,F5.3/6X,*BETA = *,F6.1//6X, 5H
XOMEGA,5X,5HL/LAM,6X,4HSWAY,5X,5HPHASE,6X,4HROLL,5X,5HPHASE,5X,
X 5H*ROLL,7X,3HYAW,5X,5HPHASE,6X,4H*YAW,5X,5HLAM/L)
10 FORMAT((1X,2F10.4,F10.5,F10.3,2(F10.5,F10.3,F10.5),F10.4))
150 FORMAT(1H0,80X,23HHULL SEPARATION/BEAM = F7.4)
IF(1.EQ.0) CALL PGM18
RFACT=SD(ISD)
IF(MONO.EQ.2) RFACT=.5*BEAM(MS)
CALL SOLVE(3,1.,1,NFN,1,NBTA,1,NFR,RFACT)
DU 20 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 20
DU 30 N=1,LMT
DU 30 MM=1,NBTA
EFS(JJ,N,MM)=EGS(JJ,N,MM)
EMR(JJ,N,MM)=ENR(JJ,N,MM)
EMY(JJ,N,MM)=ENY(JJ,N,MM)
30 CONTINUE
20 CONTINUE
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
WRITE(6,150)RATIO
WRITE(6,1)
WRITE(6,2)
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
WRITE(6,150)RATIO
DU 44 MM=1,NBTA
DU 40 JJ=1,NFN
LMT=MIL(JJ)
IF(LMT.LE.0) GO TO 40
LM4=LMT+4
IF((55-KR).GE.LM4) GO TO 43
KR=0
NPAG=NPAG+1
WRITE(6,5) (PATT(I),I=1,7),(TITLE(J),J=1,8),PATT(8),NPAG
WRITE(6,150)RATIO
IF(KASE(JJ).EQ.0) GO TO 41
WRITE(6,8) FN(JJ),WANG(MM),KASE(JJ),CWR1(JJ),CWR2(JJ)
43

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GO TO 42
41 WRITE(6,9) FN(JJ),WANG(MM)
42 WRITE(6,10) (OMEN(N),SWR(JJ,N,MM),EFS(JJ,N,MM),EMR(JJ,N,MM),
X   EKR(JJ,N,MM),EMY(JJ,N,MM),EKY(JJ,N,MM),PWS(JJ,N,MM),N=1,LMT)
KR=KR+LM4
40 CONTINUE
44 CONTINUE
CALL AERTRN
END
```

SUBROUTINE SOLVE(IUPT,CON,IFNF,IFNL,IBTAF,IBTAL,IFRF,IFRL,RFACT)

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COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),BEAM(30),DRFT(30),AREA(30),MPS(30),
X DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NBTA,NBTAS,NBTAT,NBTAQ,WANG(8),COSBET(3),SINBET(3)
COMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,DUME,OWAX
COMMON/SRY10/XZHB,XZPB,XZFO,XZVL,KV,KW
COMMON/SRY11/CHRDA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCB,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),DRY(30)
COMMON/SRY18/B22(4,30),B26(4,30),B62(4,30),B46(4,30),B64(4,30),
X B66(4,30),B24(4,30),B44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/BLOG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

COMPLEX EGS,ENR,ENY,TA
COMMON /PR23B/ EGS(4,30,3),ENR(4,30,3),ENY(4,30,3)
DIMENSION TOD(6,6),ROD(6,6),BOD(6,1),INDEX(6,3)
DU 10 JJ=IFNF,IFNL
LMT=MIL(JJ)
IF(LMT.LT.IFRF) GO TO 10
IFRLL=IFRL
IF(LMT.LT.IFRL) IFRLL=LMT
DU 20 N=IFRF,IFRLL
GXI=OMEN(N)
GX2=GXI*GXI
A24V=A24(N)-VCG
TUD(1,1)=-GX2*(A22(N)+1.)
TUD(1,2)=-GX2*A24V
TUD(1,3)=-GX2*A26(JJ,N)
TUD(1,4)=GXI*B22(JJ,N)
TUD(1,5)=GXI*B24(JJ,N)
TUD(1,6)=GXI*B26(JJ,N)

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TUD(2,1)=-GX2*A24V
TUD(2,2)=-GX2*(A44(N)+GYRT)+GMT
TUD(2,3)=-GX2*A46(JJ,N)
TUD(2,4)=GXI*B24(JJ,N)
C TOD(2,5) DEFINED IN BETA LOOP
TUD(2,5)=0.
TUD(2,6)=GXI*B46(JJ,N)
TUD(3,1)=-GX2*A62(JJ,N)
TUD(3,2)=-GX2*A64(JJ,N)
TUD(3,3)=-GX2*(A66(JJ,N)+GYR)
TUD(3,4)=GXI*B62(JJ,N)
TUD(3,5)=GXI*B64(JJ,N)
TUD(3,6)=GXI*B66(JJ,N)
TUD(4,1)=-TUD(1,4)
TUD(4,2)=-TUD(1,5)
TUD(4,3)=-TUD(1,6)
TUD(4,4)=TUD(1,1)
TUD(4,5)=TUD(1,2)
TUD(4,6)=TUD(1,3)
TUD(5,1)=-TUD(2,4)
TUD(5,2)=-TUD(2,5)
TUD(5,3)=-TUD(2,6)
TUD(5,4)=TUD(2,1)
TUD(5,5)=TUD(2,2)
TUD(5,6)=TUD(2,3)
TUD(6,1)=-TUD(3,4)
TUD(6,2)=-TUD(3,5)
TUD(6,3)=-TUD(3,6)
TUD(6,4)=TUD(3,1)
TUD(6,5)=TUD(3,2)
TUD(6,6)=TUD(3,3)
DU 45 IT=1,6
DU 45 IR=1,6
45 RUD(IT,IR)=TOD(IT,IR)
DU 30 MM=IBTAF,IBTAL
DU 46 IT=1,6
DU 46 IR=1,6
46 TUD(IT,IR)=RUD(IT,IR)
SA=GXI*B44(JJ,N,MM)
TUD(2,5)=SA
TUD(5,2)=-SA
TA=EFS(JJ,N,MM)/CON
RUD(1,1)=REAL(TA)
RUD(4,1)=AIMAG(TA)
TA=EMR(JJ,N,MM)/CON
RUD(2,1)=REAL(TA)
RUD(5,1)=AIMAG(TA)
TA=EMY(JJ,N,MM)/CON
RUD(3,1)=REAL(TA)
RUD(6,1)=AIMAG(TA)
CALL MATINS(TOD,6,6,BOD,1,1,UTRM,ID,INDEX)
IF(ID.EQ.1) GO TO 32
EFS(JJ,N,MM)=(0.,0.)
EMR(JJ,N,MM)=(0.,0.)
EMY(JJ,N,MM)=(0.,0.)

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IF (IOPT.EQ.2) GO TO 32
EKR(JJ,N,MM)=0.
EKY(JJ,N,MM)=0.
GO TO 30
32 SA=BOD(1,1)
SB=BOD(4,1)
ZRS=SQRT(SA*SA+SB*SB)
ZIS=-57.295779*ATAN3(SB,SA)
SA=BOD(2,1)
SB=BOD(5,1)
ZRR=RFACT*SQRT(SA*SA+SB*SB)
ZIR=-57.295779*ATAN3(SB,SA)
SA=BOD(3,1)
SB=BOD(6,1)
ZRY=.5*SQRT(SA*SA+SB*SB)
ZIY=-57.295779*ATAN3(SB,SA)
IF (ZIS.GT.90.) ZIS=ZIS-360.
IF (ZIR.LT.-270.) ZIR=ZIR+360.
IF (ZIY.LT.-270.) ZIY=ZIY+360.
EGS(JJ,N,MM)=CMPLX(ZRS,ZIS)
ENR(JJ,N,MM)=CMPLX(ZRR,ZIR)
ENY(JJ,N,MM)=CMPLX(ZRY,ZIY)
IF (IOPT.EQ.2) GO TO 30
CAY=WN(JJ,N,MM)
EKR(JJ,N,MM)=ZRR/(CAY*RFACT)
EKY(JJ,N,MM)=2.*ZRY/CAY
30 CONTINUE
20 CONTINUE
10 CONTINUE
RETURN
END

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C ****SUBROUTINES NILS AND QDFCN NOT LISTED--SEE MOT35 LISTING****
C ****COMMON BLOCKS IN QDFCN SHOULD BE IDENTICAL TO THOSE IN MAIN.****

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SUBROUTINE FRANK

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COMMON/SRY1/ NPAG,TITLE(8),PATT(8),RATIO
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JH,JC,K,LP,MAXD,MONO,MS,
X NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY3/ NOS,NM(30),HEAM(30),DRFT(30),AREA(30),MPS(30),
X DMA(30),AVDA(30),AVBM(30),ST(30),IN(30),SQAR(30),
X X(30,20),Y(30,20)
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY6/ NOW,NOL,NSP,NST,WINK(5),SHLT(6),SPEED(6),STAT(20)
COMMON/SRY7/ NFN,NFNS,FN(6),FNS(6)
COMMON/SRY8/ NRTA,NRTAS,NRTAT,NRTAQ,WANG(8),COSHET(3),SINRET(3)
COMMON/SRY9/ NFR,NFRS,OMEN(30),OMENS(30),OMIN,OMAX,OME,OWAX
COMMON/SRY10/XZHB,XZPB,XZFO,XZVL,KV,KW
COMMON/SRY11/CHRNA,THKA,SPNA,FAL,XZFA,CLFA,DEPA,FAY
COMMON/SRY12/CHRDB,THKB,SPNB,FBL,XZFB,CLFB,DEPB,FBY
COMMON/SRY13/GRAV,DEPCAT,SD(6),RBMST(10),RBMHT(10)
COMMON/SRY14/EL,GCH,GYR,GYRT,GM,GMT,GMTS,VCG,RF33,RP35,RM55
COMMON/SRY15/A26(4,30),A62(4,30),A46(4,30),A64(4,30),A66(4,30)
COMMON/SRY16/A22(30),A44(30),A24(30),DSR(30),DRR(30)
COMMON/SRY17/ASY(30),DSY(4,30),AY(30),DY(4,30),ARY(30),DRY(30)
COMMON/SRY18/R22(4,30),R26(4,30),R62(4,30),R46(4,30),R64(4,30),
X R66(4,30),R24(4,30),R44(4,30,3)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/RLOG(19,19),YLOG(19,19)
COMMON/SRY21/KASE(4),MIL(4),CWR1(4),CWR2(4),WFR(4,30,3),
X WN(4,30,3),SWR(4,30,3),RWS(4,30,3)
COMMON/SRY22/II,EFS,EMR,EMY,EKR(4,30,3),EKY(4,30,3)
COMPLEX II,EFS(4,30,3),EMR(4,30,3),EMY(4,30,3)

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END OF COMMON DECK
(MAKE ALL CHANGES ABOVE THESE CARDS)

COMMON/ENDCOM/ENDCOM

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COMPLEX XU,EKXCD,EKZDY,IDW,ETA235,F26,F4,G26,G4,
X SF26(4,30,3),SG26(4,30,3),SF4(4,30,3)
9 FORMAT(1H0,5X,31HMATRIX IS SINGULAR FOR OMEGA = F7.4)
CMONO=1.
IF(MONO.EQ.2) CMONO=2.
SAREA=AREA(K)*HEAM(K)*DRFT(K)
IF(BEAM(K).LE.1.E-08) SAREA=AREA(K)*DRFT(K)**2
IF(MPS(K).NE.1) CALL FINIT
DO 10 N=1,NFR
OMEGA=OMEN(N)
UN=OMEGA*OMEGA
IDW=II/OMEGA
IF(MPS(K).NE.1) GO TO 12
DSSA=EKR(1,N,1)
DSSB=EKR(2,N,1)
DSRA=EKR(1,N,2)
DSRB=EKR(2,N,2)

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DKRA=EKR(1,N,3)
DKRB=EKR(2,N,3)
GO TO 17
12 CALL PRESS
IF (ID.EQ.1) GO TO 11
WRITE(6,9) OMEGA
RETURN
11 DSSA=0.
DSSB=0.
DSRA=0.
DSRB=0.
DKRA=0.
DKRB=0.
DO 20 I=1,NON
CUN=-DEL(I)*SNE(I)
IF (MONO.EQ.2) CUN=2.*CON
DSSA=DSSA+CUN*PAS(I)
DSSB=DSSB+CUN*PVS(I)
CUN=DEL(I)*(XX(I)*CSE(I)+YY(I)*SNE(I))
IF (MONO.EQ.2) CUN=2.*CON
DSRA=DSRA+CUN*PAS(I)
DSRB=DSRB+CUN*PVS(I)
DKRA=DKRA+CUN*PAR(I)
20 DKRB=DKRB+CUN*PVR(I)
IF (MPS(K).NE.2) GO TO 17
EKR(1,N,1)=DSSA
EKR(2,N,1)=DSSB
EKR(1,N,2)=DSRA
EKR(2,N,2)=DSRB
EKR(1,N,3)=DKRA
EKR(2,N,3)=DKRB
17 DSTX=DST*XIP
DSTXX=DSTX*XIP
A22(N)=A22(N)+DST*DSSA
A3Y(N)=A3Y(N)+DSTX*DSSA
AY(N)=AY(N)+DSTXX*DSSA
A24(N)=A24(N)+DST*DSRA
DSR(N)=DSR(N)+DST*DSRB
A44(N)=A44(N)+DST*DKRA
DKR(N)=DKR(N)+DST*DKRB
ARY(N)=ARY(N)+DSTX*DSRA
DRY(N)=DRY(N)+DSTX*DSRB
DO 30 JJ=1,NFN
XU=XIP+IDW*FN(JJ)
CONST=0.
CUNSA=0.
IF (K.GE.KV .AND. K.LE.KW) GO TO 90
CONST=UN*SAREA*XZHB*FN(JJ)*CMONO
CUNSA = XZPH * CONST
90 B22(JJ,N)=B22(JJ,N)+DST*(DSSB+CONST)
DSY(JJ,N)=DSY(JJ,N)+DSTX*(DSSR+CUNSA)
DY(JJ,N)=DY(JJ,N)+DSTXX*(DSSB+CUNSA)
IF (MIL(JJ).LT.N) GO TO 30
DO 33 MM=1,NHTA
CUSH=COSBET(MM)

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SINH=SINHET(MM)
WNT=WFR(JJ,N,MM)
CAY=WN(JJ,N,MM)
WDW=WNT/OMEGA
EKXCD=CEXP(II*CAY*XIP*COSB)*DST*CMONO
IF(MPS(K),NE,1) GO TO 150
F26=SF26(JJ,N,MM)
G26=SG26(JJ,N,MM)
F4=SF4(JJ,N,MM)
GO TO 160
150 F26=(0.,0.)
F4=(0.,0.)
G26=(0.,0.)
G4=(0.,0.)
IF(MONO,NE,1) GO TO 32
DO 41 I=1,NUN
XXI=XX(I)
YYI=YY(I)
EKZUY=CEXP(CAY*(YYI-II*XXI*SINH))*DEL(I)
ETA2=-SNE(I)
ETA3=CSE(I)
ETA23S=(-ETA3+II*ETA2*SINH)*EKZUY
F26=F26 + ETA2*EKZUY
G26=G26 + ETA23S*(PAS(I)+II*PVS(I))
F4=F4 + (XXI*ETA3-YYI*ETA2)*EKZUY
G4=G4 + ETA23S*(PAR(I)+II*PVR(I))
41 CONTINUE
G26=WDW*G26
F4=F4+WDW*G4
GO TO 18
32 DO 31 I=1,NUN
YYI=YY(I)
XXI=XX(I)
EKZU=EXP(CAY*YYI)*DEL(I)
ETA2=-SNE(I)
ETA3=CSE(I)
CAYYS=CAY*XXI*SINH
SINKYS=SIN(CAYYS)
ETA23=(ETA2*SINH*COS(CAYYS)+ETA3*SINKYS)*EKZU
F26=F26 + ETA2*SINKYS*EKZU
G26=G26 + ETA23*(PAS(I)+II*PVS(I))
F4=F4 + (XXI*ETA3-YYI*ETA2)*SINKYS*EKZU
G4=G4 + ETA23*(PAR(I)+II*PVR(I))
31 CONTINUE
F26=-II*F26
G26=II*WDW*G26
F4=II*(WDW*G4-F4)
18 IF(MPS(K),NE,2) GO TO 160
SF26(JJ,N,MM)=F26
SG26(JJ,N,MM)=G26
SF4(JJ,N,MM)=F4
160 EFS(JJ,N,MM)=EFS(JJ,N,MM) + (F26+G26)*EKXCD
EMR(JJ,N,MM)=EMR(JJ,N,MM) + F4*EKXCD
EMY(JJ,N,MM)=EMY(JJ,N,MM) + (XIP*F26+XU*G26)*EKXCD
33 CONTINUE
30 CONTINUE
10 CONTINUE
RETURN
END

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SUBROUTINE FINIT
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X          NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X          SNE(19),CSE(19)
COMMON/SRY20/BLOG(19,19),YLOG(19,19)
DIMENSION X(20),Y(20)
EQUIVALENCE (XS,X),(YS,Y)
PI=3.1415927
DPNL=0.
DCNL=0.
PPL=0.
PCL=0.
DO 10 I=1,NON
XM1=XX(I)-X(1)
YM1=YY(I)-Y(1)
YP1=YY(I)+Y(1)
FPR1=.5*ALOG(XM1**2+YM1**2)
FCR1=.5*ALOG(XM1**2+YP1**2)
APR1=ATAN2(YM1,XM1)
ACR1=ATAN2(YP1,XM1)
IF(I .GE. MAXD) GO TO 30
IF(YM1 .LT.0.) APR1=APR1+2.*PI
IF(YP1.GE. 0.) ACR1=-PI
30 CONTINUE
IF(MONO .EQ. 1) GO TO 35
XP1=XX(I)+X(1)
FPL1=.5*ALOG(XP1**2+YM1**2)
FCL1=.5*ALOG(XP1**2+YP1**2)
APL1=ATAN2(YM1,XP1)
ACL1=ATAN2(YP1,XP1)
35 CONTINUE
DO 10 J=1,NON
XM2=XX(I)-X(J+1)
YM2=YY(I)-Y(J+1)
YP2=YY(I)+Y(J+1)
FPR2=.5*ALOG(XM2**2+YM2**2)
FCR2=.5*ALOG(XM2**2+YP2**2)
APR2=ATAN2(YM2,XM2)
IF(I .GE. MAXD) GO TO 20
J11=J+1
IF(I .GE. J11 .AND. APR2 .LE. 0.) APR2=APR2+2.*PI
IF(J11 .GT. MAXD .AND. APR2 .LT. 0.) APR2=APR2+2.*PI
IZIP=(APR1-APR2)*10000.0
ZIP=IZIP
ZIP=ZIP/10000.0
IF(ZIP .GT. PI) APR1=APR1-2.*PI
IF(XM2 .GT. 0.) GO TO 4
GO TO 5
20 J1=J+1
IF(XM2 .GT. 0.) GO TO 4
IF(J1 .GT. 1) GO TO 6
C  *** CARDS BELOW ARE FOR CONVEX OR CONCAVE TOP DECK ***
IF(YM2 .LT. 0.) APR2=APR2+2.*PI
GO TO 5

```

C **** CARDS BELOW ARE FOR CONVEX, FLAT OR CONCAVE BOTTOM ***

6 IF (YM2 .GE. 0.) APR2=APR2-2.*PI

5 IF (YP2 .LT. 0.) GO TO 4

ACR2=-PI

GO TO 3

4 ACR2=ATAN2(YP2, XM2)

3 SIMJ=SNE(I)*CSE(J)-SNE(J)*CSE(I)

CIMJ=CSE(I)*CSE(J)+SNE(I)*SNE(J)

SIPJ=SNE(I)*CSE(J)+SNE(J)*CSE(I)

CIPJ=CSE(I)*CSE(J)-SNE(I)*SNE(J)

DPNR=SIMJ*(FPR1-FPR2)+CIMJ*(APR1-APR2)

PPR=CSE(J)*(XM1*FPR1-YM1*APR1-XM1-XM2*FPR2+YM2*APR2+XM2)+SNE(J)*(Y

IM1*FPR1+XM1*APR1-YM1-YM2*FPR2-XM2*APR2+YM2)

DCNR=SIPJ*(FCR1-FCR2)+CIPJ*(ACR1-ACR2)

PCR=CSE(J)*(XM1*FCR1-YP1*ACR1-XM1-XM2*FCR2+YP2*ACR2+XM2)+SNE(J)*(Y

IP2*FCR2+XM2*ACR2+YP1-YP1*FCR1-XM1*ACR1-YP2)

IF (MONO .EQ. 1) GO TO 37

XP2=XX(I)+X(J+1)

FPL2=.5*ALOG(XP2**2+YM2**2)

FCL2=.5*ALOG(XP2**2+YP2**2)

APL2=ATAN2(YM2, XP2)

ACL2=ATAN2(YP2, XP2)

DPNL=SIPJ*(FPL2-FPL1)+CIPJ*(APL2-APL1)

PPL=CSE(J)*(XP2*FPL2-YM2*APL2-XP2-XP1*FPL1+YM1*APL1+XP1)+SNE(J)*(Y

IM1*FPL1+XP1*APL1+YM2-YM2*FPL2-XP2*APL2-YM1)

DCNL=SIMJ*(FCL2-FCL1)+CIMJ*(ACL2-ACL1)

PCL=CSE(J)*(XP2*FCL2-YP2*ACL2-XP2-XP1*FCL1+YP1*ACL1+XP1)+SNE(J)*(Y

IP2*FCL2+XP2*ACL2-YP2-YP1*FCL1-XP1*ACL1+YP1)

37 CONTINUE

RLOG(I, J)=DPNR-DPNL-DCNR+DCNL

YLOG(I, J)=PPR-PPL-PCR+PCL

IF (J.EQ.NON) GO TO 10

XM1=XM2

YM1=YM2

FPR1=FPR2

FCR1=FCR2

C **** NEXT CARD HANDLES ANGLE DIFFERENCE ACROSS MAXD POINT ****

IF (I .LT. MAXD .AND. (J+1).EQ. MAXD .AND. APR2 .LT. 0.) APR2=APR2

I+ 2.*PI

APR1=APR2

ACR1=ACR2

YP1=YP2

IF (MONO .EQ. 1) GO TO 10

XP1=XP2

FPL1=FPL2

FCL1=FCL2

APL1=APL2

ACL1=ACL2

10 CONTINUE

RETURN

END

```

SUBROUTINE PRESS
COMMON/SRY2/ ID,IG,IP,IND,ISD,ISTART,JA,JB,JC,K,LP,MAXD,MONO,MS,
X          NIX,NLOOP,NSD,NSO,NSTR,NUX
COMMON/SRY4/ NUT,NON,NOE,XS(20),YS(20),XX(19),YY(19),DEL(19),
X          SNE(19),CSE(19)
COMMON/SRY5/ VOL,XIP,DST,PST,BAM,DRT,AIR,AMP1,AMP2,DS(30),SS(30)
COMMON/SRY19/OMEGA,UN,PAS(19),PVS(19),PAR(19),PVR(19)
COMMON/SRY20/BLOG(19,19),YLOG(19,19)
DIMENSION CUN(38,2),CT(38,38),SOUR(19,19),WAVE(19,19)
DIMENSION INDEX(38,3)
DIMENSION X(20),Y(20)
EQUIVALENCE (XS,X),(YS,Y)
DPL=0.
PPL=0.
DWL=0.
PWL=0.
DO 10 I=1,NON
NI=NON+I
CUN(I,1)=0.0
CUN(I,2)=0.0
SN=SNE(I)
CUN(NI,1)=-OMEGA*SN
CUN(NI,2)=OMEGA*(XX(I)*CSE(I)+YY(I)*SN)
22 XR1=UN*(XX(I)-X(1))
YR1=-UN*(YY(I)+Y(1))
CALL DAVID(XR1,YR1,EJ1,CXR1,SXR1,RAR1,RBR1,CR1,SR1)
IF(MONO .EQ. 1) GO TO 37
XL1=UN*(XX(I)+X(1))
YL1=YR1
37 CONTINUE
DO 10 J=1,NON
NJ=NON+J
SIPJ=SNE(I)*CSE(J)+SNE(J)*CSE(I)
CIPJ=CSE(I)*CSE(J)-SNE(I)*SNE(J)
XR2=UN*(XX(I)-X(J+1))
YR2=-UN*(YY(I)+Y(J+1))
CALL DAVID(XR2,YR2,EJ2,CXR2,SXR2,RAR2,RBR2,CR2,SR2)
DPR=2.*(SIPJ*(CR1-CR2)-CIPJ*(SR1-SR2))
PPR=2./UN*(SNE(J)*(RAR1-RAR2)+CSE(J)*(RBR1-RBR2))
DWR=6.2831853*(EJ2*(SXR2*CIPJ-CXR2*SIPJ)-EJ1*(SXR1*CIPJ-CXR1*SIPJ)
1)
PWR=6.2831853/UN*(EJ1*(SXR1*CSE(J)-CXR1*SNE(J))-EJ2*(SXR2*CSE(J)-
1CXR2*SNE(J)))
IF(MONO .EQ. 1) GO TO 38
SIMJ=SNE(I)*CSE(J)-SNE(J)*CSE(I)
CIMJ=CSE(I)*CSE(J)+SNE(I)*SNE(J)
XL2=UN*(XX(I)+X(J+1))
YL2=YR2
CALL DAVID(XL2,YL2,EJ2,CXL2,SXL2,RAL2,RBL2,CL2,SL2)
DPL=2.*(CIMJ*(SL1-SL2)-SIMJ*(CL1-CL2))
PPL=2./UN*(SNE(J)*(RAL1-RAL2)+CSE(J)*(RBL2-RBL1))
DWL=6.2831853*(EJ1*(SXL1*CIMJ-CXL1*SIMJ)-EJ2*(SXL2*CIMJ-CXL2*SIMJ)
1)
PWL=6.2831853/UN*(EJ2*(SXL2*CSE(J)+CXL2*SNE(J))-EJ1*(SXL1*CSE(J)+
1CXL1*SNE(J)))

```

```

38 CONTINUE
CT(I,J)=BLUG(I,J)+DPR-DPL
CT(NI,NJ)=CT(I,J)
CT(I,NJ)=DWR-DWL
CT(NI,J)=-CT(I,NJ)
SUUR(I,J)=YLOG(I,J)+PPR-PPL
WAVE(I,J)=PWR-PWL
IF(J.EQ.NON) GO TO 10
XR1=XR2
YR1=YR2
EJ1=EJ2
CR1=CR2
SR1=SR2
RAR1=RAR2
RHR1=RBR2
CXR1=CXR2
SXR1=SXR2
IF(MONO.EQ.1) GO TO 10
XL1=XL2
YL1=YL2
CL1=CL2
SL1=SL2
RAL1=RAL2
RBL1=RBL2
CXL1=CXL2
SXL1=SXL2
10 CONTINUE
CALL MATINS(CT,38,NOE,CON,2,2,DTRM,10,INDEX)
IF(10.EQ.2) RETURN
DO 20 I=1,NON
PAS(I)=0.
PVS(I)=0.
PAR(I)=0.
PVR(I)=0.
DO 30 J=1,NON
NJ=NON+J
CJ=CON(J,1)
CNJ=CON(NJ,1)
WV=WAVE(I,J)
SR=SOUR(I,J)
PAS(I)=PAS(I)+CJ*WV-CNJ*SR
PVS(I)=PVS(I)+CJ*SR+CNJ*WV
CJ=CON(J,2)
CNJ=CON(NJ,2)
PAR(I)=PAR(I)+CJ*WV-CNJ*SR
30 PVR(I)=PVR(I)+CJ*SR+CNJ*WV
PAS(I)=OMEGA*PAS(I)
PVS(I)=OMEGA*PVS(I)
PAR(I)=OMEGA*PAR(I)
20 PVR(I)=OMEGA*PVR(I)
77 RETURN
END

```

```
C ****SUBROUTINE DAVID, FUNCTION ATAN3, SUBROUTINE MATINS, AND PROGRAM
C ****PGM4 NOT LISTED--SEE MOT35 LISTING****
C ****COMMON BLOCKS IN PGM4 SHOULD BE THE SAME AS THOSE IN MAIN.****
C ****THE LAST 2 LINES IN PGM4 SHOULD BE CHANGED TO THE FOLLOWING****
    CALL AETSKC(6LMOT246)
    END
C ****
```

```
OVERLAY(5,0)
PROGRAM PGM5
```

```
C
C FOR FUTURE CALCULATION OF RESPONSES TO IRREGULAR SEAS
    CALL AETSKC(6LMOT246)
    END
```

```
C ****SUBROUTINE SEAST NOT LISTED--SEE MOT35 LISTING****
```

```
C ****PROGRAM PGM1A NOT LISTED--SEE MOT35 LISTING****
C ****COMMON BLOCKS SHOULD BE THE SAME AS THOSE IN MAIN.****
C ****THE LAST 4 LINES IN PGM1A SHOULD BE CHANGED TO THE FOLLOWING****
    IF (ID.EQ.2 .OR. ID.EQ.-1) CALL AETSKC(6LMOT246)
    IF (LP.EQ.2 .OR. ID.EQ.-1) .AND. NOW.EQ.0) CALL AETSKC(6LMOT246)
    IF (LP.LE.0 .AND. IP.LE.0) CALL AETSKC(4LPGM5)
    END
C****
```

APPENDIX C

Determination of Encounter Frequencies
in Following Waves

For cases where β , the wave heading angle, is at least 90 degrees, motion calculations are made as a function of the encounter frequencies specified by the input variable OMEN(I). These values and the Froude number, F_n , are used to calculate corresponding wave frequencies and wavelengths. However, for β values where $0 < \beta < 90$ the frequencies are calculated using the input variables indicating the desired wave length range and the Froude numbers. The program PGMIA is used to determine the encounter frequency values.

The determination of encountering frequency is divided into three regions:

1. Waves which propagate faster than the ship speed, $V_s \ll V_w$
2. Waves which propagate at about the same speed as the ship speed.

$$V_s < V_w$$

3. Waves which propagate slower than ship speed, $V_s > V_w$
- where V_s is the ship speed and V_w is the wave speed.

The above three regions are considered in sequence. In the input, the RWS(1,I,1) values indicate the desired (wave length)/(ship length) values and the RWS(1,I,2) values indicate steps to be used between successive wave length values. These values and the requested Froude number values are used to determine what combinations of Froude number and encounter frequency fall within each region.

The relationships between the non-dimensional wave frequency, ω_o , and the non-dimensional encounter frequency, $\bar{\omega}$, and Froude number, F_n , for each region are described below.

1. Wave Frequencies in Regions 1 and 2.

For the wave frequency, ω_o , the celerity of the wave, C , in deep water is given by

$$C = \frac{g}{\omega_o}$$

where g is the gravitational acceleration

When the ship velocity U is less than $C \sec \beta$, we find the wave-encountering frequency by

$$\omega = \omega_o \left(1 - \frac{U}{C \sec \beta} \right) = \omega_o \left(1 - \frac{U \omega_o \cos \beta}{g} \right) \quad \text{for } 0 \leq \beta < \frac{\pi}{2} \quad (1)$$

If we let

$$\bar{\omega} = \omega \sqrt{\frac{L}{g}}, \quad \bar{\omega}_0 = \omega_0 \sqrt{\frac{L}{g}}, \quad \bar{\lambda} = \frac{\lambda}{L}, \quad \text{and} \quad F_n = \frac{U}{\sqrt{gL}}$$

where L is the ship length (given by EL in the program) and λ is the wave length, we get

$$\bar{\lambda} = \frac{2\pi}{\bar{\omega}} \quad (1)$$

$$\bar{\omega} = \sqrt{\frac{2\pi}{\bar{\lambda}}} (1 - F_n \sqrt{\frac{2\pi}{\bar{\lambda}}} \cos \beta) \quad \text{for} \quad F_n < \frac{1}{\sqrt{\frac{2\pi}{\bar{\lambda}} \cos \beta}} \quad (2)$$

We can also write $\bar{\omega}_0$ as

$$\bar{\omega}_0 = \frac{1 \pm \sqrt{1 - 4 \bar{\omega} F_n \cos \beta}}{2 F_n \cos \beta} \quad (3)$$

We note that for $\bar{\omega} < \frac{1}{4 F_n \cos \beta}$, we have two different wave frequencies or wave lengths for a given encounter frequency, ship speed and wave heading. That means that there exist two different values of $\bar{\lambda}$, say $\bar{\lambda}_1$ and $\bar{\lambda}_2$, to provide an identical $\bar{\omega}$ by Equation (2) for fixed values of F_n and β .

From Equation (1), we can derive

$$\bar{\omega} \bar{\omega}_0 - F_n \bar{\omega}_0^2 \cos \beta$$

or

$$F_n = \frac{1}{\bar{\omega}_0 \cos \beta} \left(1 - \frac{\bar{\omega}}{\bar{\omega}_0} \right) \quad (4)$$

Case 1 (Region 1):

$$\bar{\omega}_0 = \frac{1 + \sqrt{1 - 4 \bar{\omega} F_n \cos \beta}}{2 F_n \cos \beta} \quad (5)$$

For given arrays of ω_0 (or λ) and β , the minimum Froude number can be obtained by

$$(F_n)_m = \frac{1}{2(\bar{\omega}_0)_m \cos \beta} = \frac{1}{2\sqrt{\frac{2\pi}{\bar{\lambda}_m}} \cos \beta} \quad (6)$$

from Equation (5) where the subscripts m and M respectively mean minimum and maximum values. For given arrays of ω_0 and β and a minimum values of $\bar{\omega}$ (defines as OMIN in the program), the maximum Froude number is obtained by

$$\begin{aligned} (F_n)_M &= \frac{1}{(\bar{\omega}_0)_m \cos \beta} \left(1 - \frac{\bar{\omega}_m}{(\bar{\omega}_0)_m} \right) \\ &= \frac{1}{\sqrt{2\pi/\lambda_M} \cos \beta} \left(1 - \frac{\bar{\omega}_m}{\sqrt{2\pi/\lambda_M} \cos \beta} \right) \end{aligned} \quad (7)$$

from Equation (4)

Case 2 (Region 2):

$$\omega_0 = \frac{1 - \sqrt{1 - 4 \bar{\omega} F_n \cos \beta}}{2 F_n \cos \beta}$$

$$(F_n)_{\rightarrow 0} \quad (8)$$

$$(F_n)_M = \frac{1}{2(\bar{\omega}_0)_m \cos \beta} = \frac{1}{2 \sqrt{\frac{2\pi}{\lambda_m}} \cos \beta} \quad (9)$$

2. Wave frequencies in Region 3

Case 3 (Region 3):

$$\bar{\omega} = \sqrt{\frac{2\pi}{\lambda}} (F_n \sqrt{\frac{2\pi}{\lambda}} \cos \beta - 1) \text{ for } F_n < \frac{1}{\sqrt{\frac{2\pi}{\lambda}} \cos \beta} \quad (10)$$

$$F_n = \frac{1}{\bar{\omega}_0 \cos \beta} \left(\frac{\bar{\omega}}{\bar{\omega}_0} - 1 \right) \quad (11)$$

$$\bar{\omega}_0 = \frac{1 + \sqrt{1 + 4 \bar{\omega} F_n \cos \beta}}{2 F_n \cos \beta} \quad (12)$$

$$(F_n)_m = \frac{1}{2(\bar{\omega}_0)_m \cos \beta} = \frac{1}{2 \sqrt{2\pi/\lambda_m} \cos \beta} \quad (13)$$

$$(F_n)_M = \frac{1}{\sqrt{2\pi/\lambda_M} \cos \beta} \left(\frac{\bar{\omega}_M}{\sqrt{2\pi/\lambda_M}} - 1 \right) \quad (14)$$

For given arrays of $\bar{\omega}$ and β , proper bounds of F_n are found in Cases 1 through 3, and if any of the F_n values given as input data are found within the bounds in each case, the encounter frequencies are calculated by Equation (2) for Cases 1 and 2 and by Equation (10) for Case 3. The foregoing procedure is performed in PGM1A.

APPENDIX D

DATA INPUT DESCRIPTIONS

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DATA SET *	FORMAT	COLUMNS	FORTRAN NAME	DESCRIPTION
1	8A6	1-48	TITLE(I)	Descriptive title to be used at the top of each output page
2A	2I5	5	MONO	Define as: 0 for twin-hull configuration 1 for mono-hull configuration with asymmetric cross sections 2 for mono-hull configuration with symmetric cross sections
		10	JA	Define as: 1 if all wave heading angles β (WANG (I)) are such that $90^\circ \leq \text{WANG}(I) \leq 180^\circ$ 2 if any β is less than 90° 3 if only preliminary geometric computations are desired. <u>Recommended for first run.</u>
2B	2F10.5	1-10	SCALE	Scale factor for all linear input (except the data input for the fins). Default value of 1.
		11-20	GRAV	Default value of 32.174. Use 9.807 if length units are given in meters rather than feet.
3	12I5	4-5	NFR	Number of frequencies (OMEN(I)) to be given. Maximum value of 30
		10	NBTA	Number of heading angles (WANG(I)) to be given. Maximum value of 3.
		15	NFN	Number of Froude numbers (FN(I)) to be given. Maximum value of 4.
		20	NSD	Number of hull separations. (SD(I)) for twin-hull configuration only. Define as 1.
		24-25	NSTR	Number of locations (RBMST(I)) for calculation of absolute motion, velocity and acceleration. Relative motion is also calculated in MOT35. Maximum value of 10.
		29-30	NOS	Number of stations for which offset information is given. Maximum value of 30.
		35	NLOOP	Maximum number of iterations for solution of damping and motion equations in PR2B. Value of 3 should be adequate.

* A unique data identifier indicates that a new card should be used. If an array is being defined, a data set may consist of more than one card of the same format.

DATA SET	FORMAT	COLUMNS	FORTRAN NAME	DESCRIPTION
		40	IG	Control variable which determines the extent of the printed output. Values for motions and phases are always given. Define as: 0 for no additional output 1 for exciting forces and moments 2 for exciting forces and moments and added mass and damping coefficients 3 for exciting forces and moments added mass and damping coefficients, and intermediate values of motions if NLOOP > 0.
		45	LP	Controls charactron plotting Define as: 0 for no plots 1 for plots of offsets (Define JA as 3.)
		50	IND	Define as: 0 for typical computer runs 1 for storing motion data on file. For use with a modified version of SMOTION which provides motion results in irregular seas.
4	8F10.5		OMEN(I)	Non-dimensional encounter frequencies for which calculations are desired. $OMEN(I) = \omega / \sqrt{g/EL}$ where EL is defined in data set 10. This input is used for calculations for all speeds $90^\circ \leq B < 180^\circ$. ($I \leq NFR \leq 30$)
5	4F10.5		WANG(I)	Angle of incidence of wave train relative to the direction of ship, given in degrees. Defined as 180° for head seas, 0° for following seas. Must be given in the order of increasing values between 0 and 180. ($I \leq NBTA \leq 3$)
6	8F10.5		FN(I)	Froude number = (forward velocity)/ $\sqrt{g(EL)}$. ($I \leq NFN \leq 4$)
7	8F10.5		SD(I)	For twin-hull ship define as half the distance between the centerlines of hulls. ($I \leq NSD \leq 6$) For mono-hull use blank card.
8A	8F10.5		RBMST(I)	Desired longitudinal locations at which absolute displacement, velocity, and acceleration as well as relative displacement (MOT35 only) are to be calculated. The values should be given as distances from $ST(I) = 0$. to the point of interest in the same unit as EL times (20./EL) (See Data Set 13) ($I \leq NSTR \leq 10$)

DATA SET	FORMAT	COLUMNS	FORTRAN NAME	DESCRIPTION
8B	8F10.5		RBMT(I)	Desired vertical locations of the hull at the longitudinal locations given by RBMT(I) from the calm waterline at which absolute lateral displacement, velocity and acceleration are to be calculated. This input is needed only for MOT246. Give blank card(s) for MOT35. The values should be given in the same dimensional unit as EL. A positive or negative sign should be assigned depending on whether the point is above or below the calm waterline ($I \leq NSTR \leq 10$).

THE FOLLOWING DATA SET IS TO BE INCLUDED ONLY IF AT LEAST ONE VALUE OF WANG (I) IS LESS THAN 90. (THAT IS, IF JA = 2)

9A	8F10.5		RWS(1,I,1)	Bounds of λ/L (wave length divided by EL) for which calculations are desired. Maximum of 8 values.
9B	7F10.5		RWS(2,I,1)	Increments of λ/L to be used between successive pairs of RWS(1,I,1) to RWS(1, I+1, 1) in increments of RWS(2,I,1), for up to 7 sets.
9C	3F10.5	1-10	OMIN	Minimum value of encounter frequency divided by $\sqrt{g/EL}$ for which calculations are desired.
		11-20	OMAX	Maximum values of non-dimensional encounter frequency.
		21-30	DOME	Increment to be used for non-dimensional encounter frequency.
10	8F10.5	1-10	EL	Distance between Station 0 and Station 20. This value is used for non-dimensionalization in the program and should be used in defining GYR, GYRT, OMEN(I), FN(I), RWS(1,I,1), RWS(2,I,1)
		11-20	GYR	The pitch or yaw radius of gyration divided by EL.
		21-30	GYRT	The roll radius of gyration divided by EL. Needed for MOT246 only.

DATA SET	FORMAT	COLUMNS	FORTRAN NAME	DESCRIPTION
		31-40	GCB	Longitudinal center of buoyancy given in station number, normally between 0. and 20. Does not have to be an integer. Will be calculated in program if defined as 0.
		41-50	VCG	Vertical center of gravity referenced to waterline (Positive if above waterline, negative otherwise).
		51-60	GMT	Transverse metacentric height. Used in MOT246 only. Will be calculated in MOT246 if define as 0.
		61-70	DEPCAT	If MONO = 0 (twin-hull), define as vertical distance (positive number) between waterline and maximum breadth point of hull. Otherwise define as 0.
		71-80	BRCL	Used only in irregular sea calculations (NOW>0) If MONO = 0, define as distance (positive number) between waterline and the bottom of cross deck. Otherwise defined as 0.

DATA FOR FIN A AND FIN B

11A	8F10.5	1-10	FAL	Longitudinal distance between Station 0 to quarter chord of fin
		11-20	FAY	Transverse distance between longitudinal plane of symmetry of two hulls (or one hull for mono-hull) and the centroid of fin
		21-30	DEPA	Vertical distance between waterline and mean depth of fin
		31-40	CHRDA	Chord of fin
		41-50	SPNA	Geometric span of fin. If the fin is full-span (spans the entire distance between hulls), then define as half that distance.
		51-60	THKA	Maximum thickness of fin.
		61-70	CLFA	Lift-curve slope (per radian) for fin.
		71-80	XZFA	Drag coefficient. Approximated by 1.2, the value for a flat plate attached to a wall in a uniform flow normal to the plate.

DATA SET	FORMAT	COLUMN	FORTRAM NAME	DESCRIPTION
	8F10.5		FBL	Data for second fin.
			FBY	
			DEPB	
			CHRDB	
			SPNB	
			THKB	
			CLFB	
			XZFB	
12			XZFO	Body cross-flow drag coefficients denoted as C_D in Reference 1. For SWATH with circular cross sections for main hull, 0.5 has been used.
			XZVL	Body viscous-lift coefficient denoted as a_0 in Reference 1. For SWATH with circular cross sections for main hull, 0.07 has been used.
			XZHB	Heave viscous damping coefficient for effect of bulbous bow shape. Used only in MOT35. Define as zero except for mono-hull or conventional catamaran which has a bulbous bow.
			XZPB	Pitch viscous damping coefficient for effect of bulbous bow shape. Used only in MOT35. Define as zero except for mono-hull or catamaran which has a bulbous bow.
		45	KV	Sequenced integer number (counting from the foremost station as 1) of first station without bulbous shape.
		50	KW	Sequenced integer number (counting from the foremost station as 1) of last station without bulbous shape.

ONE CARD OF THE FOLLOWING FORMAT MUST BE PROVIDED FOR EACH STATION. A TOTAL OF NOS CARDS MUST BE GIVEN. AT PRESENT ONLY ST(I), NM(I) AND MPS(I) NEED BE DEFINED. (THE OTHER VARIABLES ARE USED IN OTHER PROGRAMS FOR MONO-HULL SHIPS FOR THE LEWIS-FORM FIT WHICH IS NOT INCLUDED IN THE PRESENT PROGRAMS)

DATA SET	FORMAT	COLUMNS	FORTRAN NAME	DESCRIPTION
13	4F9.4, 2 9	1-9	ST(I)	Station number of the Ith section given in a scale of 20.0 from the forward reference station designated as Station 0. The value can be negative if the station is ahead of Station 0 or it can be greater than 20, if the station is aft of Station 20. The stations corresponding to ST (1), ST(I) = 0, ST (I) = 10., ST(I) = 20., ST(NOS) should always be given. The stations between the foregoing stations should be chosen such that pairs of even spacing between the stations starting from ST(I) = 0, and ST(I) = 20.0 in either direction can be maintained. (I NOS < 30)
		10-18	Beam (I)	Define as 0.
		19-27	DRFT (I)	Define as 0.
		28-36	AREA (I)	Define as 0.
		44-45	NM (I)	Number of offset points used to describe the Ith station. Maximum of 20. For mono-hull ships, 10 is usually adequate.
		54	MPS (I)	Used to indicate location of parallel middle body Define as: 0 is station is not part of the parallel middle body 1 for first station of parallel middle body 2 for all but the first station which is part of the parallel middle body
DATA SET 14 IS REPEATED NOS TIMES, ONCE FOR EACH STATION				
14	8F9.4		X(I,J)	The value of the x-coordinates of the points on the immersed cross sectional contour given in the same dimensional unit as EL with respect to the coordinate system shown in Figure 2. (I < NOS < 30, J < NM (I) < 20) All values (NM(I) in number) for the Ith station are to be given with 8 per card.

DATA SET	FORMAT	COLUMN	FORTTRAN NAME	DESCRIPTION
	8F9.4		Y(I,J)	The values of the y-coordinate of the point corresponding to X(I,J) as shown in Figure 2. (I<NOS<30), J<NM(I)<20) All values (NM(I) in number) for the Ith station are to be given with 8 per card.
15	4I5	5	NOW	Number of significant wave heights (WINK (I)) to be chosen.
		10	NOL	Number of ship lengths (SHLT(I)) to be chosen
		15	NSP	Number of ship speeds (SPEED(I)) to be chosen
		19-20	NST	Number of stations (STAT(I)) to be chosen

CARD SETS 16A-16D ARE TO BE USED ONLY IF NOW IS GREATER THAN 0. THEN THE FOLLOWING DATA ARE USED TO COMPUTE MOTIONS IN IRREGULAR SEAS USING THE PIERSON-MOSKOWITZ SPECTRUM FORMULA.

16A	8F10.5		WINK(I)	Significant wave heights in feet (I<NOW<5)
16B	8F10.5		SHLT(I)	Ship length (as defined by EL but not necessarily the same value) (I<NOL<6). When this value is other than that given by EL, all the ships dimensions are proportionally scaled.
16C	8F10.5		SPEED(I)	Ship speed in knots. (I<NSP<6)
16D	8F10.5		STAT(I)	Station number given in a scale of 20 similar to ST(I) (See Data Set 13) where significant amplitude of absolute and relative (MOT35 only) displacement, velocity and acceleration are to be calculated (I<NST<20)

USE THE FOLLOWING DATA SET ONLY WHEN PLOTTING OFFSETS (LP=1)

17	3A10		NAME1	User's name.
			NAME2	User's code.
			NAME3	User's telephone extension.

IN ORDER TO MAKE CALCULATIONS FOR ADDITIONAL SHIP CONFIGURATIONS, REPEAT DATA SETS 1-16 FOR EACH CONFIGURATION.

18A				Blank Card.
18B				Blank Card.

APPENDIX E

SAMPLE COMPUTER INPUT AND OUTPUT

MOT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A

DATA INPUT CARDS

1	2	3	4	5	6	7	8
123456789012345678901234567890123456789012345678901234567890							
SWATH 6A							
0	1	2	3	4	5	6	7
0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
16	2	1	1	19	3	2	0
.90000	1.00000	1.20000	1.30000	1.40000	1.50000	1.60000	1.70000
1.80000	1.90000	2.00000	2.20000	2.40000	2.70000	3.00000	3.50000
90.00000	135.00000						
0.00000	.44600						
37.50000							
1.00000							
0.00000							
178.14000	.31500	.22300	0.00000	7.44000	11.06000	19.17000	20.00000
40.44000	25.75000	19.17000	8.50000	10.20000	1.28000	4.38000	1.20000
188.12000	23.55000	19.17000	14.70000	17.60000	2.20000	3.43000	1.20000
.50000	-.07000	0.00000	0.00000	0	19		
-1.6000	0.0000	0.0000	0.0000	9	0		
-.8000	0.0000	0.0000	0.0000	9	0		
0.0000	0.0000	0.0000	0.0000	9	0		
1.0000	0.0000	0.0000	0.0000	9	0		
2.0000	0.0000	0.0000	0.0000	15	0		
3.0000	0.0000	0.0000	0.0000	15	0		
4.0000	0.0000	0.0000	0.0000	15	0		
6.0000	0.0000	0.0000	0.0000	15	0		
8.0000	0.0000	0.0000	0.0000	15	0		
10.0000	0.0000	0.0000	0.0000	15	2		
12.0000	0.0000	0.0000	0.0000	15	1		
14.0000	0.0000	0.0000	0.0000	15	1		
16.0000	0.0000	0.0000	0.0000	15	1		
18.0000	0.0000	0.0000	0.0000	15	0		
20.0000	0.0000	0.0000	0.0000	15	0		
22.0000	0.0000	0.0000	0.0000	9	0		
24.0000	0.0000	0.0000	0.0000	9	0		
24.5000	0.0000	0.0000	0.0000	9	0		
25.0000	0.0000	0.0000	0.0000	9	0		

SAMPLE RUN 1 - MOT246 OUTPUT (IG = 2) FOR COMPUTER
 RUN FOR TWO HEADINGS AND TWO FREQUENCIES

BEST AVAILABLE COPY

MOT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A

0.0000	-2.0200	-2.7900	STATION	-1.6000	0.0000	1.9800	2.8100	2.0000
0.0000			-1.9600	0.0000	1.9800	2.8100	2.0000	
10.3100	9.4500	7.5100	5.5000	4.7100	5.5300	7.5300	9.5000	
10.3100								
0.0000	-3.7420	-5.2920	STATION	-1.0000	0.0000	3.7420	5.2920	3.7420
0.0000			-3.7420	0.0000	3.7420	5.2920	3.7420	
12.7920	11.2420	7.5000	3.7580	2.2000	3.7580	7.5000	11.2420	
12.7920								
0.0000	-4.3800	-6.1100	STATION	0.0000	0.0000	4.3600	6.1400	4.3300
0.0000			-4.3000	0.0000	4.3600	6.1400	4.3300	
13.6300	11.7800	7.5000	3.1500	1.4000	3.1900	7.5500	11.8400	
13.6300								
0.0000	-4.8500	-6.7800	STATION	1.0000	0.0000	4.8200	6.8200	4.8200
0.0000			-4.7500	0.0000	4.8200	6.8200	4.8200	
14.3200	12.2600	7.5300	2.6800	0.7300	2.7100	7.5400	12.3000	
14.3200								
-1.0600	-1.0600	-1.0600	STATION	2.0000	-0.1600	-7.2400	-5.0700	0.0000
5.1100	7.2300	5.1200	-1.0600	1.0600	1.0600	1.0600	1.0600	
26.6800	22.7200	18.7800	14.6800	12.5900	7.5200	2.3900	.3400	
2.4300	7.5600	12.6500	14.6800	18.7800	22.7200	26.6800		
			STATION	3.0000				
-2.1700	-2.1700	-2.1700	-2.1700	-0.3200	-7.4400	-5.2000	0.0000	
5.2400	7.4200	5.2400	2.1700	2.1700	2.1700	2.1700		
26.5600	22.5400	18.6400	14.6200	12.7200	7.5200	2.2500	.1100	
2.2900	7.5600	12.7900	14.6200	18.6400	22.5400	26.5600		
			STATION	4.0000				
-3.0000	-3.0000	-3.0000	-3.0000	-5.3600	-7.5300	-5.2800	0.0000	
5.3100	7.5000	5.3000	3.0000	3.0000	3.0000	3.0000		
26.5600	22.5700	18.4600	14.3700	12.7700	7.5000	2.1800	0.0000	
2.2300	7.5600	12.8400	14.3700	18.4600	22.5700	26.5600		
			STATION	6.0000				
-3.5600	-3.5600	-3.5600	-3.5600	-5.3700	-7.5300	-5.2700	0.0000	
5.3400	7.5600	5.3700	3.5600	3.5600	3.5600	3.5600		
26.6400	22.4800	18.3200	14.1600	12.7400	7.5200	2.1700	0.0000	
2.1800	7.5500	12.8500	14.1600	18.3200	22.4800	26.6400		
			STATION	8.0000				
-3.6200	-3.6200	-3.6200	-3.6200	-5.3700	-7.5300	-5.2700	0.0000	
5.3400	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200		
26.6400	22.4600	18.2800	14.1100	12.7400	7.5200	2.1700	0.0000	
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400		
			STATION	10.0000				
-3.6200	-3.6200	-3.6200	-3.6200	-5.3700	-7.5300	-5.2700	0.0000	
5.3400	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200		
26.6400	22.4600	18.2800	14.1100	12.7400	7.5200	2.1700	0.0000	
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400		

MOT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A

-3.6200	-3.6200	-3.6200	STATION	12.0000	-5.3700	-7.5300	-5.2700	0.0000
5.3400	7.5600	5.3700	-3.6200	-3.6200	3.6200	3.6200	3.6200	0.0000
26.6400	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	2.1700	0.0000
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	26.6400	0.0000
			STATION	14.0000				
-3.6200	-3.6200	-3.6200	-3.6200	-5.3700	-7.5300	-5.2700	-5.2700	0.0000
5.3400	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	3.6200	0.0000
26.6400	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	2.1700	0.0000
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	26.6400	0.0000
			STATION	16.0000				
-3.6100	-3.6100	-3.6100	-3.6100	-5.3700	-7.5300	-5.2700	-5.2700	0.0000
5.3400	7.5600	5.3700	3.6100	3.6100	3.6100	3.6100	3.6100	0.0000
26.7000	22.5200	18.3400	14.1500	12.7900	7.5200	2.1700	2.1700	0.0000
2.1800	7.5500	12.8500	14.1500	18.3400	22.5200	26.7000	26.7000	0.0000
			STATION	18.0000				
-3.1100	-3.1100	-3.1100	-3.1100	-5.3000	-7.4800	-5.2500	-5.2500	0.0000
5.3300	7.4900	5.2700	3.1100	3.1100	3.1100	3.1100	3.1100	0.0000
26.6800	22.5700	18.4500	14.3400	12.8200	7.5400	2.2400	2.2400	0.0000
2.2700	7.5700	12.8200	14.3400	18.4500	22.5700	26.6800	26.6800	0.0000
			STATION	20.0000				
-1.4300	-1.4300	-1.4300	-1.4300	-5.0100	-7.1000	-4.9800	-4.9800	0.0000
5.0600	7.1100	5.0100	1.4300	1.4300	1.4300	1.4300	1.4300	0.4500
26.6900	22.6100	18.5300	14.4600	12.5200	7.5500	2.5000	2.5000	0.4500
2.5500	7.5700	12.5500	14.4600	18.5300	22.6100	26.6900	26.6900	0.4500
			STATION	22.0000				
0.0000	-4.3500	-6.1600	-4.3400	0.0000	4.3900	6.1600	6.1600	4.3600
0.0000	11.8800	7.5400	3.1600	1.3800	3.2100	7.5600	7.5600	11.9000
13.6800								
13.6800								
			STATION	24.0000				
0.0000	-3.2500	-4.5700	-3.2300	0.0000	3.2800	4.6100	4.6100	3.2500
0.0000	10.7800	7.5400	4.2800	2.9400	4.3100	7.5700	7.5700	10.7800
12.1100								
12.1100								
			STATION	24.5000				
0.0000	-2.6500	-3.7800	-2.6500	0.0000	2.7000	3.7800	3.7800	2.6600
0.0000	10.5100	7.5200	4.5200	3.2800	4.5200	7.5200	7.5200	10.5100
11.7400								
11.7400								
			STATION	25.0000				
0.0000	-2.7390	-3.8740	-2.7390	0.0000	2.7390	3.8740	3.8740	2.7390
0.0000	10.2400	7.5000	4.7600	3.6260	4.7600	7.5000	7.5000	10.2400
11.3740								
11.3740								

MOT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A

STATION	BEAM	DRAFT AREA COEFFICIENT
-1.6000	0.0000	5.6000
-1.6000	0.0000	10.5840
0.0000	0.0000	12.2300
1.0000	0.0000	13.5900
2.0000	2.1200	26.3400
3.0000	4.3400	26.5500
4.0000	6.0000	26.6600
6.0000	7.1200	26.6400
8.0000	7.2400	26.6400
10.0000	7.2400	26.6400
12.0000	7.2400	26.6400
14.0000	7.2200	26.7000
16.0000	6.2200	26.6800
20.0000	2.8600	26.2400
22.0000	0.0000	12.3000
24.0000	0.0000	9.1700
24.5000	0.0000	8.4600
25.0000	0.0000	7.7480

CRITICAL ENC. FREQ. FOR STATION	-1.6000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	-0.9000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	0.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	1.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	2.0000	=	16.2475
CRITICAL ENC. FREQ. FOR STATION	3.0000	=	11.3556
CRITICAL ENC. FREQ. FOR STATION	4.0000	=	9.6578
CRITICAL ENC. FREQ. FOR STATION	5.0000	=	8.8658
CRITICAL ENC. FREQ. FOR STATION	6.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	8.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	10.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	12.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	14.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	15.0000	=	8.8041
CRITICAL ENC. FREQ. FOR STATION	16.0000	=	9.4855
CRITICAL ENC. FREQ. FOR STATION	20.0000	=	13.9885
CRITICAL ENC. FREQ. FOR STATION	22.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	24.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	24.5000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	25.0000	=	0.0000

MINIMUM CRITICAL ENC. FREQ. = 0.0000 DUE TO STATION 25.0000

MOT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A

DATA FOR ONE HULL

LENGTH BETWEEN PERPENDICULARS = 178.14000 FEET
 BEAM AT MIDSHIP = 7.24000 FEET
 DRAFT AT MIDSHIP = 26.64000 FEET
 DISPLACEMENT = 1289.648 LONG TONS
 BLOCK COEFFICIENT = 1.34741
 LONGITUDINAL CENTER OF BUOYANCY = 100.37494 FEET AFT OF F.P.
 LONGITUDINAL CENTER OF FLotation = 11.26922 STATIONS
 LONGITUDINAL CENTER OF FLotation = 99.66327 FEET AFT OF F.P.
 LONGITUDINAL CENTER OF FLotation = 11.18932 STATIONS
 VERTICAL CENTER OF BUOYANCY = 15.46576 FEET FROM THE DESIGNED LOAD WATERLINE
 BEAM/DRAFT = .27177
 LENGTH/BEAM = 24.60497

THE HEAVE-HEAVE RESTORING COEFFICIENT IS 4.12036
 THE HEAVE-PITCH RESTORING COEFFICIENT IS -.01646
 THE PITCH-PITCH RESTORING COEFFICIENT IS .12559

PROJECTED AREA OF THE SURMERGED HULL/L**2 = .103721E+00
 MOMENT/L**3 = .101487E-02 MOMENT OF INERTIA/L**4 = .135252E-01

DYNAMIC COEFFICIENTS OF THE EQUATIONS OF MOTION

- A22 IS SCALED BY M.
- A24, A26 AND A62 ARE SCALED BY M*L.
- A44, A46, A64 AND A66 ARE SCALED BY M*L*L.
- R22 IS SCALED BY M*SQRT(G/L).
- R24, B26 AND B62 ARE SCALED BY M*SQRT(G*L).
- B44, B46, B64, AND B66 ARE SCALED BY M*L*SQRT(G*L).
- B444 IS B44 EXCLUDING CROSS-FLOW DRAG CONTRIBUTIONS.
- M IS THE DISPLACED MASS.
- G IS THE ACCELERATION DUE TO GRAVITY.
- L IS THE DISTANCE BETWEEN PERPENDICULARS.

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- FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*L).
- BETA IS THE WAVE HEADING ANGLE IN DEGREES.
- BETA = 180. FOR HEAD SEAS.
- OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY SQRT(G/L).
- THE HULL SEPARATION/BEAM RATIO IS THE DISTANCE BETWEEN THE HULLS DIVIDED BY THE BEAM OF ONE HULL.

HULL SEPARATION/BEAM = 9.3591

RARE HULL POTENTIAL FLOW ADDED MASS COEFFICIENTS

FN = 0.000

OMEGA	A22	A24=A42	A26	A62	A44	A45	A64	A66
.9000	5.258523	.321001	.018301	.018301	.049546	.000970	.000970	.426780
1.0000	5.409902	.329937	.018988	.018988	.050080	.001027	.001027	.438079
1.2000	5.612932	.345314	.019817	.019817	.051197	.001117	.001117	.453663
1.3000	5.611019	.348899	.019699	.019699	.051653	.001128	.001128	.453981
1.4000	5.515288	.347954	.019108	.019108	.051936	.001103	.001103	.447376
1.5000	5.330297	.342041	.018074	.018074	.051990	.001039	.001039	.434059
1.6000	5.082882	.331874	.016735	.016735	.051404	.000938	.000938	.415930
1.7000	4.813582	.319096	.015301	.015301	.051416	.000814	.000814	.396004
1.8000	4.563399	.305696	.013983	.013983	.050895	.000682	.000682	.377429
1.9000	4.364771	.293486	.012950	.012950	.050316	.000554	.000554	.362772
2.0000	4.240032	.283897	.012317	.012317	.049750	.000442	.000442	.353877
2.2000	4.278566	.277176	.012581	.012581	.048925	.000287	.000287	.359200
2.4000	4.885033	.297754	.015752	.015752	.049189	.000254	.000254	.411984
2.7000	9.943598	.527317	.039234	.039234	.059173	.000634	.000634	.889585
3.0000-11.275885		-.526275	-.078144	-.078144	.001274	-.003483	-.003483	-.646136
3.5000	-.843749	-.001904	-.013342	-.013342	.030396	-.000855	-.000855	-.018987

RARE HULL POTENTIAL FLOW DAMPING COEFFICIENTS

FN = 0.000

OMEGA	H22	H24=B42	H26	H62	H44	H45	H64	H66
.9000	.322224	.012289	.001633	.001633	.000428	.000092	.000092	.023481
1.0000	.551575	.021941	.002776	.002776	.000803	.000164	.000164	.040201
1.2000	1.338374	.058024	.006640	.006640	.002353	.000430	.000430	.097802
1.3000	1.899193	.085961	.009351	.009351	.003676	.000635	.000635	.139124
1.4000	2.529807	.119485	.012354	.012354	.005395	.000880	.000880	.185860
1.5000	3.166142	.159922	.015319	.015319	.007441	.001144	.001144	.233287
1.6000	3.737662	.191714	.017878	.017878	.009684	.001399	.001399	.276042
1.7000	4.190445	.223563	.019750	.019750	.011967	.001618	.001618	.309873
1.8000	4.499727	.249297	.020799	.020799	.014158	.001783	.001783	.332680
1.9000	4.667420	.268038	.021025	.021025	.016163	.001886	.001886	.344407
2.0000	4.711025	.279838	.020511	.020511	.017923	.001925	.001925	.346243
2.2000	4.510254	.284522	.017637	.017637	.020330	.001823	.001823	.326325
2.4000	4.008212	.265660	.012456	.012456	.021505	.001486	.001486	.280737
2.7000	2.252460	.156744	.000293	.000293	.016560	-.000036	-.000036	.122322
3.0000	8.845831	.544653	.090178	.090178	.037472	.005984	.005984	.639136
3.5000	4.031265	.269785	.024853	.024853	.018029	.002366	.002366	.328503

HULL SEPARATION/BEAM = 9.3591

RARE HULL POTENTIAL FLOW ADDED MASS COEFFICIENTS

FN = .446

OMEGA	A22	A24=A42	A26	A62	A44	A46	A64	A66
.9000	5.258523	.321001	.195723	-.159121	.049546	.007736	-.005797	.1718143
1.0000	5.409902	.329937	.264991	-.227014	.050080	.010812	-.008759	1.514196
1.2000	5.612932	.345314	.434341	-.394707	.051197	.019088	-.016855	1.229012
1.3000	5.611019	.348899	.520906	-.481508	.051653	.023813	-.021558	1.114408
1.4000	5.515288	.347954	.594769	-.556552	.051936	.028292	-.026086	1.007111
1.5000	5.330297	.342041	.645674	-.609526	.051990	.031945	-.029869	.905296
1.6000	5.082882	.331874	.667906	-.634435	.051804	.034338	-.032463	.810878
1.7000	4.813582	.319096	.661992	-.631391	.051416	.035315	-.033688	.727319
1.8000	4.563399	.305696	.633389	-.605424	.050895	.034999	-.033635	.657593
1.9000	4.364771	.293486	.589589	-.563690	.050316	.033669	-.032561	.603277
2.0000	4.240032	.283897	.537596	-.512962	.049750	.031644	-.030760	.564730
2.2000	4.278566	.277176	.428195	-.403034	.048925	.026505	-.025932	.535042
2.4000	4.845033	.297754	.326110	-.294606	.049189	.020825	-.020316	.580684
2.7000	4.943598	.527317	.177039	-.098571	.059773	.010224	-.008955	1.160907
3.0000	-11.275885	-.526275	.360216	-.516505	.001274	.023507	-.030474	-.895353
3.5000	-.843749	-.001904	.133429	-.160113	.030396	.008968	-.010677	-.032688

RARE HULL POTENTIAL FLOW DAMPING COEFFICIENTS

FN = .446

OMEGA	R22	R24=R42	R26	R62	R44	R46	R64	R66
.9000	.322224	.012289	-2.343659	2.346934	.000428	-.143074	.143259	.102611
1.0000	.551575	.021941	-2.410940	2.415593	.000803	-.146988	.147316	.149918
1.2000	1.338374	.058024	-2.496727	2.510008	.002353	-.153580	.154440	.282679
1.3000	1.899193	.085961	-2.493164	2.511865	.003676	-.154974	.156244	.362662
1.4000	2.529807	.119485	-2.447464	2.472172	.005395	-.154308	.156067	.442604
1.5000	3.166142	.155922	-2.361994	2.392631	.007441	-.151407	.153694	.513195
1.6000	3.737662	.191714	-2.249067	2.284844	.009684	-.146617	.149415	.566464
1.7000	4.190445	.223563	-2.127108	2.166608	.011967	-.140699	.143935	.598298
1.8000	4.499727	.249297	-2.014478	2.056075	.014158	-.134557	.138123	.608935
1.9000	4.667420	.268038	-1.925663	1.967713	.016163	-.129009	.132780	.601548
2.0000	4.711025	.279838	-1.870543	1.911566	.017923	-.124693	.128542	.580517
2.2000	4.510254	.284522	-1.890604	1.925877	.020530	-.121797	.125444	.511649
2.4000	4.008212	.265660	-2.166269	2.191180	.021505	-.131313	.134284	.49157
2.7000	2.252460	.156744	-4.434522	4.435147	.016560	-.235220	.235147	.143783
3.0000	4.845831	.544653	5.119223	-4.439867	.037472	.240703	-.228735	.434644
3.5000	4.031265	.269785	.401165	-.351459	.018029	.003215	.001517	.393963

HULL SEPARATION/HEAM = 9.3591

ADDED MASS COEFFICIENTS

FN = 0.000

OMEGA	A22	A24=A42	A26	A44	A46	A64	A66
.9000	5.258523	.321001	.018301	.051143	.000970	.000970	.426780
1.0000	5.409902	.329937	.018988	.051677	.001027	.001027	.438079
1.2000	5.612932	.345314	.019817	.052794	.001117	.001117	.453663
1.3000	5.611019	.348899	.019699	.053250	.001128	.001128	.453981
1.4000	5.515288	.347954	.019108	.053533	.001103	.001103	.447376
1.5000	5.330297	.342041	.018074	.053587	.001038	.001038	.434059
1.6000	5.082882	.331874	.016735	.053401	.000938	.000938	.415930
1.7000	4.813582	.319096	.015301	.053013	.000814	.000814	.396004
1.8000	4.563399	.305696	.013983	.052492	.000682	.000682	.377429
1.9000	4.364771	.293486	.012950	.051913	.000554	.000554	.362772
2.0000	4.240032	.283897	.012317	.051347	.000442	.000442	.353877
2.2000	4.278566	.277176	.012581	.050522	.000287	.000287	.359200
2.4000	4.885033	.297754	.015752	.050786	.000254	.000254	.411984
2.7000	9.943598	.527317	.039234	.061370	.000634	.000634	.889585
3.0000-11.275885	-5.26275	-.078144	-.078144	.002871	-.003483	-.003483	-.646136
3.5000	-.843749	-.001904	-.013342	.031993	-.000855	-.000855	-.018987

DAMPING COEFFICIENTS

FN = 0.000

OMEGA	H22	H24=H42	H44	H44 = BETA =	H66	M26	R62	R66	R66 = BETA =	R86	R86	R86 = BETA =	H44*
.9000	.322224	.012289	.001056	.001049	.023481	.001633	.001633	.001633	.001633	.000092	.000092	.000092	.000428
1.0000	.551575	.021941	.001439	.001449	.040201	.002776	.002776	.002776	.002776	.000164	.000164	.000164	.000803
1.2000	1.338374	.058024	.003072	.003084	.097802	.006640	.006640	.006640	.006640	.000430	.000430	.000430	.002353
1.3000	1.899193	.085961	.004433	.004445	.139124	.009351	.009351	.009351	.009351	.000635	.000635	.000635	.003676
1.4000	2.529807	.119485	.006163	.006197	.185860	.012354	.012354	.012354	.012354	.000880	.000880	.000880	.005395
1.5000	3.166142	.159922	.008256	.008273	.233287	.015319	.015319	.015319	.015319	.001144	.001144	.001144	.007441
1.6000	3.737662	.191714	.010517	.010540	.276042	.017878	.017878	.017878	.017878	.001399	.001399	.001399	.009684
1.7000	4.190445	.223563	.012812	.012844	.309873	.019750	.019750	.019750	.019750	.001618	.001618	.001618	.011967
1.8000	4.499727	.249297	.015008	.015052	.332680	.020799	.020799	.020799	.020799	.001783	.001783	.001783	.014158
1.9000	4.667420	.268038	.017011	.017071	.344407	.021025	.021025	.021025	.021025	.001886	.001886	.001886	.016163
2.0000	4.711025	.279838	.018764	.018844	.346243	.020511	.020511	.020511	.020511	.001925	.001925	.001925	.017923
2.2000	4.510254	.284522	.021344	.021482	.326325	.017637	.017637	.017637	.017637	.001823	.001823	.001823	.020530
2.4000	4.008212	.265660	.022287	.022491	.280737	.012456	.012456	.012456	.012456	.001486	.001486	.001486	.021505
2.7000	2.252460	.156744	.017326	.017546	.122322	.000293	.000293	.000293	.000293	-.000036	-.000036	-.000036	.016560
3.0000	8.845831	.544653	.038250	.038396	.639136	.090178	.090178	.090178	.090178	.005984	.005984	.005984	.037472
3.5000	4.031265	.269785	.018892	.018799	.328503	.024853	.024853	.024853	.024853	.002366	.002366	.002366	.018029

HULL SEPARATION/BEAM = 9.3591

ADJED MASS COEFFICIENTS

FN = .446

OMEGA	A22	A24=A42	A26	A62	A44	A66	A66	A64	A66	A66	A66	A66
.9000	5.258523	.321001	.369861	-.159121	.051143	.021608	-.005797	1.717257				
1.0000	5.409902	.329937	.406042	-.227014	.051677	.022049	-.008759	1.513478				
1.2000	5.612932	.345314	.532294	-.394707	.052794	.026891	-.016855	1.228513				
1.3000	5.611019	.348899	.604368	-.681508	.053250	.030462	-.021558	1.113984				
1.4000	5.515288	.347954	.666733	-.556552	.053533	.034025	-.026086	1.006744				
1.5000	5.330297	.342041	.708363	-.609526	.053587	.036939	-.029869	.904977				
1.6000	5.082882	.331874	.723004	-.634435	.053401	.038727	-.032463	.810598				
1.7000	4.813582	.319096	.710799	-.631391	.053013	.039203	-.033688	.727070				
1.8000	4.563399	.305696	.676924	-.605424	.052492	.038467	-.033635	.657372				
1.9000	4.364771	.293486	.628662	-.563690	.051913	.036782	-.032561	.603078				
2.0000	4.240032	.283897	.572859	-.512962	.051347	.034453	-.030760	.564550				
2.2000	4.278566	.277176	.457338	-.403034	.050522	.028826	-.025932	.534893				
2.4000	4.885033	.297754	.350598	-.294606	.050786	.022775	-.020316	.580559				
2.7000	9.943598	.527317	.196387	-.098571	.061370	.011765	-.008955	1.160809				
3.0000-11.275885	-.526275	.375888	.375888	-.516505	.002871	.024756	-.030474	-.895433				
3.5000	-.843749	-.001904	.144944	-.160113	.031993	.009885	-.010677	-.032747				

DAMPING COEFFICIENTS

FN = .446

OMEGA	B22	H24=H42	H44	H44	H66	H66	H62	B46	H64	B46	H46	
.9000	.638483	.037483	.052043	ETA = 135.0	.137414	-2.345278	2.345325	-.143291			1.43042	.051471
1.0000	.867833	.047135	.052473	.051962	.184722	-2.411649	2.413984	-.147205			1.47099	.051846
1.2000	1.654632	.083217	.054118	.053991	.317483	-2.448337	2.508399	-.153796			1.54223	.053396
1.3000	2.215452	.111154	.055480	.055345	.397466	-2.444773	2.510256	-.155190			1.56027	.054719
1.4000	2.846066	.144679	.057232	.057092	.477408	-2.444073	2.470563	-.154524			1.58851	.056438
1.5000	3.482401	.181116	.059305	.059165	.548000	-2.363603	2.391022	-.151623			1.53478	.058485
1.6000	4.053921	.216907	.061567	.061431	.601268	-2.250696	2.263235	-.146834			1.49198	.060727
1.7000	4.506703	.248757	.063862	.063737	.633101	-2.128717	2.164999	-.140915			1.43719	.063011
1.8000	4.815985	.274491	.066058	.065948	.643739	-2.016087	2.054466	-.134774			1.37907	.065201
1.9000	4.983679	.293232	.068061	.067972	.636392	-1.927272	1.966104	-.129225			1.32564	.067206
2.0000	5.027284	.305031	.069814	.069750	.615321	-1.872152	1.909956	-.124910			1.28326	.068967
2.2000	4.826513	.309715	.072391	.072386	.546493	-1.892213	1.924268	-.122013			1.25228	.071574
2.4000	4.324470	.290853	.073331	.073385	.453960	-2.167878	2.189571	-.131529			1.34068	.072548
2.7000	2.568719	.181937	.068363	.068462	.218586	-4.436161	4.433528	-.235436			.234931	.067404
3.0000	4.162090	.569846	.089294	.089414	.669448	5.117614	-4.940476	-.240486			-.244951	.088515
3.5000	4.347523	.294979	.069884	.070025	.428767	.399556	-.353068	.002999			.001300	.069072

EXCITING FORCE, MOMENTS AND PHASES

THE SWAY FORCE IS SCALED BY $M*G*A$.

THE ROLL AND YAW MOMENTS ARE SCALED BY $M*G*A$.

*MOMENT DENOTES THE MOMENT SCALED BY $M*G*A$ *(WAVE NUMBER).

M IS THE DISPLACED MASS.

G IS THE ACCELERATION DUE TO GRAVITY.

A IS THE WAVE AMPLITUDE.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*L).

BETA IS THE WAVE HEADING ANGLE IN DEGREES.

BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY SQRT(G/L).

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.

L/LAM = L/(WAVE LENGTH).

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE REGIONS SEPARATED BY TWO CRITICAL SWR, DENOTED CWR1 AND CWR2.

HULL SEPARATION/BEAM = 9.3591

EXCITING FORCE, MOMENTS AND PHASES

FN = 0.000

BETA = 90.0

OMEGA	L/LAM	SFORCE	PHASE	RMOMENT	PHASE	SMOMENT	YOMENT	PHASE	SMOMENT	LAM/L
.9000	.1289	4.72318	-93.207	.19614	-92.540	.24214	.01392	-95.550	.01719	7.7570
1.0000	.1592	5.85833	-94.801	.25357	-93.778	.25357	.01763	-98.110	.01763	6.2832
1.2000	.2292	8.32181	-99.277	.39328	-97.337	.27311	.02601	-105.054	.01805	4.3633
1.3000	.2690	9.52180	-102.027	.47143	-99.544	.27896	.03021	-109.262	.01787	3.7179
1.4000	.3119	10.58886	-104.889	.55025	-101.843	.28074	.03395	-113.687	.01732	3.2057
1.5000	.3581	11.44485	-107.609	.62537	-104.014	.27794	.03690	-118.018	.01640	2.7925
1.6000	.4074	12.04098	-109.914	.69308	-105.829	.27074	.03878	-121.902	.01515	2.4544
1.7000	.4600	12.36785	-111.571	.75111	-107.104	.25990	.03951	-125.001	.01367	2.1741
1.8000	.5157	12.44916	-112.427	.79870	-107.731	.24651	.03914	-127.019	.01208	1.9393
1.9000	.5745	12.32608	-112.411	.83605	-107.686	.23159	.03784	-127.722	.01048	1.7405
2.0000	.6366	12.04196	-111.516	.86367	-107.000	.21592	.03585	-126.924	.00896	1.5708
2.2000	.7703	11.12228	-107.233	.89041	-103.964	.18397	.03075	-120.236	.00635	1.2982
2.4000	.9167	9.82280	-99.912	.87491	-99.135	.15189	.02499	-107.442	.00434	1.0908
2.7000	1.1602	6.06824	-82.865	.70155	-89.697	.09623	.00500	51.929	.00069	.8619
3.0000	1.4324	13.18741	-50.890	1.00687	-69.071	.11187	.12055	-62.902	.01339	.6981
3.5000	1.9496	7.88661	-14.846	.54051	-23.775	.04412	.07070	-51.240	.00577	.5129

EXCITING FORCE, MOMENTS AND PHASES

FN = .446

BETA = 90.0

OMEGA	L/LAM	SFORCE	PHASE	RMOMENT	PHASE	SMOMENT	YOMENT	PHASE	SMOMENT	LAM/L
.9000	.1289	4.72480	-93.540	.19768	-97.071	.24405	1.47321	176.598	2.43606	7.7570
1.0000	.1592	5.86091	-95.092	.25589	-98.354	.25589	2.21552	174.789	2.21552	6.2832
1.2000	.2292	8.32733	-99.507	.39876	-101.956	.27691	2.45097	169.711	1.84095	4.3633
1.3000	.2690	9.52920	-102.234	.47956	-104.197	.28376	2.41198	166.590	1.66390	3.7179
1.4000	.3119	10.59823	-105.074	.56181	-106.560	.28664	2.91303	163.329	1.48624	3.2057
1.5000	.3581	11.45605	-107.785	.64104	-108.839	.28491	2.94408	160.208	1.30848	2.7925
1.6000	.4074	12.05362	-110.074	.71327	-110.815	.27862	2.90501	157.530	1.13477	2.4544
1.7000	.4600	12.38134	-111.728	.77588	-112.311	.26847	2.80553	155.464	.97077	2.1741
1.8000	.5157	12.46278	-112.578	.82772	-113.224	.25547	2.56130	154.504	.82139	1.9393
1.9000	.5745	12.33910	-112.557	.86864	-113.526	.24062	2.48931	154.462	.68956	1.7405
2.0000	.6366	12.05370	-111.657	.89883	-113.248	.22471	2.30434	155.483	.57608	1.5708
2.2000	.7703	11.12995	-107.359	.92684	-111.211	.19150	1.94362	160.653	.40004	1.2982
2.4000	.9167	9.82582	-100.012	.90658	-107.669	.15739	1.60034	169.447	.27785	1.0908
2.7000	1.1602	6.06801	-82.862	.71718	-101.983	.09838	.77533	-172.899	.13379	.8619
3.0000	1.4324	13.19485	-50.832	.96207	-77.840	.10690	2.14390	-150.335	.23821	.6981
3.5000	1.9496	7.92188	-14.779	.42083	-31.228	.03435	1.25088	-124.848	.10211	.5129

HULL SEPARATION/HEAM = 9.3591

EXCITING FORCE, MOMENTS AND PHASES
 FN = 0.000
 REIA = 135.0

OMEGA	L/LAM	SFORCE	PHASE	RMOMENT	PHASE	*MOMENT	YMOMENT	PHASE	*MOMENT	LAM/L
.9000	.1289	3.32058	-93.123	.13734	-92.672	.16956	.16067	-6.268	.19836	7.7570
1.0000	.1592	4.10690	-94.707	.17660	-93.893	.17660	.24483	-7.079	.24483	6.2832
1.2000	.2292	5.78365	-99.205	.26922	-97.499	.18696	.49700	-10.319	.34514	4.3633
1.3000	.2690	6.57658	-102.005	.31853	-99.792	.18848	.66586	-12.585	.39400	3.7179
1.4000	.3119	7.25631	-104.960	.36545	-102.249	.18646	.85779	-15.074	.43765	3.2057
1.5000	.3581	7.76592	-107.829	.40610	-104.675	.18049	1.06413	-17.554	.47295	2.7925
1.6000	.4074	8.07071	-110.350	.43701	-106.864	.17071	1.27448	-19.781	.49785	2.4544
1.7000	.4600	8.16516	-112.304	.45575	-108.648	.15770	1.47911	-21.544	.51180	2.1741
1.8000	.5157	8.06856	-113.542	.46105	-109.922	.14230	1.67050	-22.704	.51562	1.9393
1.9000	.5745	7.81435	-113.993	.45253	-110.636	.12535	1.84432	-23.189	.51089	1.7405
2.0000	.6366	7.44021	-113.649	.43049	-110.773	.10762	1.99817	-22.980	.49954	1.5708
2.2000	.7703	6.47436	-110.696	.35020	-109.119	.07236	2.25108	-20.481	.46510	1.2982
2.4000	.9167	5.42728	-105.171	.23783	-103.512	.04129	2.44583	-15.170	.43157	1.0908
2.7000	1.1602	3.97770	-96.602	.09183	-77.151	.01260	3.77133	-2.326	.51733	.8619
3.0000	1.4324	3.20539	-266.045	.41880	85.596	.04653	2.00860	-166.593	.22318	.6981
3.5000	1.9496	.35328	-216.050	.08258	104.701	.00674	.07611	65.858	.00621	.5129

EXCITING FORCE, MOMENTS AND PHASES
 FN = .446
 REIA = 135.0

OMEGA	L/LAM	SFORCE	PHASE	RMOMENT	PHASE	*MOMENT	YMOMENT	PHASE	*MOMENT	LAM/L
.9000	.0851	2.70335	-93.754	.11621	-96.028	.21728	1.07707	176.667	2.01381	11.7478
1.0000	.1015	3.32640	-95.356	.14721	-97.192	.23072	1.17105	174.801	1.83537	9.8475
1.2000	.1371	4.70553	-99.595	.22139	-100.816	.25693	1.30838	169.409	1.51844	7.2919
1.3000	.1562	5.40857	-102.912	.26285	-103.232	.26788	1.33734	165.978	1.36295	6.4035
1.4000	.1759	6.07239	-106.007	.30513	-105.893	.27604	1.33143	162.261	1.20446	5.6840
1.5000	.1964	6.66324	-109.028	.34639	-108.592	.28071	1.28855	158.504	1.04423	5.0918
1.6000	.2175	7.16191	-111.705	.38509	-111.100	.28179	1.21150	154.968	.88651	4.5977
1.7000	.2392	7.56978	-113.806	.42051	-113.208	.27977	1.10712	151.874	.73658	4.1803
1.8000	.2615	7.90707	-115.175	.45277	-114.773	.27556	.98393	149.356	.59884	3.8240
1.9000	.2843	8.20686	-115.737	.48275	-115.714	.27022	.84986	147.449	.47571	3.5171
2.0000	.3077	8.50960	-115.484	.51183	-115.999	.26477	.71073	146.074	.36766	3.2503
2.2000	.3557	9.32177	-112.678	.57563	-114.554	.25752	.42786	143.645	.19142	2.8110
2.4000	.4056	10.94506	-107.152	.67332	-110.271	.25422	.13668	122.615	.05364	2.4656
2.7000	.4832	21.52646	-94.689	1.23162	-97.400	.40564	1.07886	.372	.35533	2.0694
3.0000	.5640	26.59696	-254.249	1.44771	108.947	.40854	.21820	-64.414	.06158	1.7731
3.5000	.7045	3.03367	-208.547	.19896	163.886	.04495	.55724	-54.570	.12588	1.4194

MOTION AMPLITUDES AND PHASES

THE SWAY AMPLITUDE IS SCALED BY A.

THE ROLL AMPLITUDE IS SCALED BY $2 \cdot A/B$.

THE YAW AMPLITUDE IS SCALED BY $2 \cdot A/L$.

ROLL DENOTES ROLL AMPLITUDE SCALED BY A(WAVE NUMBER).

YAW DENOTES YAW AMPLITUDE SCALED BY A(WAVE NUMBER).

A IS THE WAVE AMPLITUDE.

B IS THE TOTAL HULL SEPARATION FOR TWIN-HULL SHIPS.

R IS THE BEAM AT MIDSHIP FOR MONO-HULL SHIPS.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/ $\text{SORT}(G \cdot L)$.

BETA IS THE WAVE HEADING ANGLE IN DEGREES.

BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $\text{SORT}(G/L)$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.

$L/LAM = L/(WAVE LENGTH)$.

FOR FOLLOWING SEAS THE FREQUENCY IS DIVIDED INTO THREE REGIONS SEPARATED BY TWO CRITICAL SWR, DENOTED CW1 AND CW2.

HULL SEPARATION/BEAM = 9.3591

MOTION AMPLITUDES AND PHASES

FN = 0.000
RETA = 90.0

OMEGA	L/LAM	SWAY	PHASE	ROLL	PHASE	*ROLL	YAW	PHASE	*YAW	LAM/L
0.9000	.1289	.99800	89.953	.32024	-92.085	1.87814	.00030	84.433	.00074	7.7570
1.0000	.1592	.92678	89.859	.07836	-104.921	.37223	.00020	86.856	.00041	6.2832
1.2000	.2292	.85267	89.919	.04902	121.493	.16172	.00026	95.564	.00036	4.3633
1.3000	.2690	.81518	89.998	.08215	110.154	.23092	.00030	100.069	.00035	3.7179
1.4000	.3119	.77487	-269.863	.11208	105.545	.27165	.00034	104.839	.00035	3.2057
1.5000	.3581	.73146	-269.644	.13892	102.604	.29331	.00039	109.674	.00035	2.7925
1.6000	.4074	.68503	-269.325	.16241	100.296	.30137	.00044	114.125	.00034	2.4544
1.7000	.4600	.63582	-268.895	.18210	98.354	.29332	.00049	117.726	.00034	2.1741
1.8000	.5157	.58410	-268.345	.19765	96.708	.28979	.00054	120.197	.00033	1.9393
1.9000	.5745	.53016	-267.668	.20890	95.334	.27489	.00057	121.485	.00031	1.7405
2.0000	.6366	.47425	-266.859	.21583	94.205	.25632	.00057	121.651	.00028	1.5708
2.2000	.7703	.35759	-264.780	.21705	92.540	.21303	.00060	118.615	.00018	1.2982
2.4000	.9167	.23610	-261.844	.20231	91.397	.16685	.00063	56.257	.00001	1.0908
2.7000	1.1602	.04502	-248.187	.15391	89.622	.10029	.00134	-82.286	.00037	.8619
3.0000	1.4324	.16133	-78.933	.09382	85.045	.04952	.00177	-117.981	.00039	.6981
3.5000	1.9496	.53697	-111.114	.05910	-114.130	.02292	.01873	-74.151	.00306	.5129

MOTION AMPLITUDES AND PHASES

FN = .446
RETA = 90.0

OMEGA	L/LAM	SWAY	PHASE	ROLL	PHASE	*ROLL	YAW	PHASE	*YAW	LAM/L
0.9000	.1289	.92553	-262.431	.07193	-16.288	.42186	.07337	-76.885	.18115	7.7570
1.0000	.1592	.90296	-263.883	.04050	-19.069	.19239	.06327	-75.622	.12653	6.2832
1.2000	.2292	.84467	-265.779	.03350	99.417	.11051	.04694	-76.322	.06519	4.3633
1.3000	.2690	.80940	-266.345	.06349	107.088	.17847	.04038	-77.309	.04778	3.7179
1.4000	.3119	.77027	-266.707	.09289	107.386	.22514	.03482	-78.725	.03553	3.2057
1.5000	.3581	.72754	-266.878	.12059	105.990	.29460	.03007	-80.791	.02672	2.7925
1.6000	.4074	.68154	-266.865	.14574	104.019	.27043	.02590	-83.756	.02024	2.4544
1.7000	.4600	.63267	-266.673	.16752	101.872	.27536	.02213	-87.836	.01531	2.1741
1.8000	.5157	.58129	-266.367	.18534	99.749	.27174	.01859	-93.221	.01148	1.9393
1.9000	.5745	.52774	-265.771	.19885	97.749	.26166	.01524	-100.117	.00845	1.7405
2.0000	.6366	.47228	-265.066	.20795	95.902	.24696	.01208	-108.838	.00604	1.5708
2.2000	.7703	.35657	-263.104	.21317	92.600	.20922	.00660	-134.382	.00273	1.2982
2.4000	.9167	.23591	-260.096	.20214	89.477	.16671	.00306	-174.256	.00106	1.0908
2.7000	1.1602	.04622	-242.173	.15962	83.315	.10401	.00051	-156.657	.00014	.8619
3.0000	1.4324	.16293	-82.295	.10516	73.282	.05550	.00417	-37.666	.00093	.6981
3.5000	1.9496	.47361	-110.513	.04298	-65.181	.01667	.10786	175.010	.01761	.5129

MOT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A

MULL SEPARATION/HEAM = 9.3591

MOTION AMPLITUDES AND PHASES

FN = 0.000
 BETA = 135.0

OMEGA	L/LAM	SWAY	PHASE	ROLL	PHASE	YAW	PHASE	YAW	PHASE	LAM/L
0.9000	.1289	.70414	-269.836	.23719	-88.881	1.39102	179.993	.18552	179.993	7.7570
1.0000	.1592	.65168	89.937	.06334	-97.844	.30087	-179.951	.46548	-179.951	4.6548
1.2000	.2292	.59542	89.865	.02153	135.169	.07104	-179.900	.45538	-179.900	6.2832
1.3000	.2690	.56667	89.837	.03982	117.011	.11193	-179.899	.43049	-179.899	4.3633
1.4000	.3119	.53571	89.812	.05510	111.649	.13355	-179.932	.41554	-179.932	3.7179
1.5000	.3581	.50236	89.790	.06680	108.977	.14104	-179.983	.39882	-179.983	3.2057
1.6000	.4074	.46675	89.769	.07459	107.310	.13840	179.830	.38024	179.830	2.7925
1.7000	.4600	.42914	89.741	.07811	106.277	.12839	179.597	.35971	179.597	2.4544
1.8000	.5157	.38993	89.695	.07722	105.882	.11322	179.284	.33718	179.284	2.1741
1.9000	.5745	.34958	89.618	.07207	106.313	.09483	178.908	.31266	178.908	1.9393
2.0000	.6366	.30865	89.501	.06311	107.989	.07495	178.504	.28627	178.504	1.7405
2.2000	.7703	.22783	89.105	.03764	120.196	.03694	177.874	.25831	177.874	1.5708
2.4000	.9167	.15334	88.281	.01944	179.753	.01607	174.061	.19979	174.061	1.2982
2.7000	1.1602	.05676	82.095	.03562	-119.574	.02321	-179.468	.14293	-179.468	1.0908
3.0000	1.4324	.05352	76.260	.07439	-99.789	.03927	172.904	.07172	172.904	.8619
3.5000	1.9496	.02930	49.332	.01149	-73.920	.00445	-64.965	.04237	-64.965	.6981
								.00383		.5129

MOTION AMPLITUDES AND PHASES

FN = .446
 BETA = 135.0

OMEGA	L/LAM	SWAY	PHASE	ROLL	PHASE	YAW	PHASE	YAW	PHASE	LAM/L
0.9000	.0851	.56447	-263.857	.01755	-58.880	.05278	-128.949	.19736	-128.949	11.7478
1.0000	.1015	.55680	-265.417	.00956	-142.363	.06239	-146.115	.19557	-146.115	9.8475
1.2000	.1371	.53773	-267.648	.03167	142.076	.09343	-165.387	.22549	-165.387	7.2919
1.3000	.1562	.52652	-268.496	.04281	133.420	.11063	-170.295	.22549	-170.295	6.4035
1.4000	.1759	.51422	-269.232	.05307	127.694	.12771	-173.600	.23106	-173.600	5.6840
1.5000	.1964	.50091	-269.870	.06250	123.195	.14428	-175.901	.23385	-175.901	5.0918
1.6000	.2175	.48673	89.584	.07095	119.298	.16013	-177.544	.23435	-177.544	4.5977
1.7000	.2392	.47187	89.131	.07825	115.798	.17514	-178.734	.23305	-178.734	4.1803
1.8000	.2615	.45656	88.772	.08429	112.658	.18923	-179.599	.23034	-179.599	3.8240
1.9000	.2843	.44103	88.508	.08907	109.866	.20238	-179.783	.22657	-179.783	3.5171
2.0000	.3077	.42546	88.339	.09271	107.490	.21459	179.365	.22202	179.365	3.2503
2.2000	.3557	.39513	88.302	.09725	103.804	.23647	179.062	.21159	179.062	2.8110
2.4000	.4056	.36750	88.688	.09994	101.568	.25848	179.476	.20129	179.476	2.4656
2.7000	.4832	.33343	89.518	.11440	100.044	.29437	-178.872	.19390	-178.872	2.0694
3.0000	.5640	.31733	86.606	.04594	92.314	.41255	176.281	.23284	176.281	1.7731
3.5000	.7045	.21660	44.4401	.04558	60.935	.17938	134.359	.08104	134.359	1.4194

MUT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A
 ABSOLUTE DISPLACEMENT, VELOCITY, AND ACCELERATION AT STATION 1.0 AND HEIGHT 9.0

SPEED = 0.0 KNOTS
 WAVE HEADING = 90.0 DEGREES

ENC PER(SEC)	ARS DISPL	VEL	ACCEL/G	WAVE L/L
16.43	.998	.382	.005	7.7570
14.78	.927	.394	.005	6.2832
12.32	.853	.435	.007	4.3633
11.37	.815	.451	.008	3.7179
10.56	.775	.461	.009	3.2057
9.86	.732	.467	.009	2.7925
9.24	.685	.466	.010	2.4544
8.70	.636	.460	.010	2.1741
8.21	.585	.447	.011	1.9393
7.78	.531	.428	.011	1.7405
7.39	.475	.404	.011	1.5708
6.72	.358	.335	.010	1.2982
6.16	.236	.241	.008	1.0908
5.48	.044	.050	.002	.8619
4.93	.163	.207	.008	.6981
4.22	.552	.822	.038	.5129

SPEED = 20.0 KNOTS
 WAVE HEADING = 90.0 DEGREES

ENC PER(SEC)	ARS DISPL	VEL	ACCEL/G	WAVE L/L
16.43	.851	.325	.004	7.7570
14.78	.839	.356	.005	6.2832
12.32	.797	.407	.006	4.3633
11.37	.768	.425	.007	3.7179
10.56	.735	.437	.008	3.2057
9.86	.697	.444	.009	2.7925
9.24	.655	.445	.009	2.4544
8.70	.610	.441	.010	2.1741
8.21	.562	.430	.010	1.9393
7.78	.513	.414	.010	1.7405
7.39	.461	.392	.010	1.5708
6.72	.352	.329	.010	1.2982
6.16	.236	.241	.008	1.0908
5.48	.046	.053	.002	.8619
4.93	.166	.212	.008	.6981
4.22	.514	.765	.035	.5129

MOT246 SWAY, ROLL AND YAW MOTIONS OF SWATH 6A
 ABSOLUTE DISPLACEMENT, VELOCITY, AND ACCELERATION AT STATION 1.0 AND HEIGHT 0.0

SPEED = 0.0 KNOTS
 WAVE HEADING = 135.0 DEGREES

ENC PER(SEC)	ARS DISPL	VEL	ACCEL/G	WAVE L/ZL
16.43	.731	.280	.003	7.7570
14.78	.692	.294	.004	6.2832
12.32	.674	.344	.005	4.3633
11.37	.670	.370	.006	3.7179
10.56	.668	.397	.007	3.2057
9.86	.666	.425	.008	2.7925
9.24	.664	.452	.010	2.4544
8.70	.660	.477	.011	2.1741
8.21	.652	.499	.012	1.9393
7.78	.639	.516	.013	1.7405
7.39	.618	.526	.014	1.5708
6.72	.551	.515	.015	1.2982
6.16	.450	.459	.015	1.0908
5.48	.266	.305	.011	.8619
4.93	.197	.251	.010	.6981
4.22	.029	.044	.002	.5129

SPEED = 20.0 KNOTS
 WAVE HEADING = 135.0 DEGREES

ENC PER(SEC)	ARS DISPL	VEL	ACCEL/G	WAVE L/ZL
16.43	.528	.202	.002	11.7478
14.78	.528	.225	.003	9.8475
12.32	.526	.268	.004	7.2919
11.37	.523	.269	.005	6.4035
10.56	.518	.308	.006	5.6840
9.86	.512	.327	.006	5.0918
9.24	.506	.344	.007	4.5977
8.70	.499	.360	.008	4.1803
8.21	.491	.376	.009	3.8240
7.78	.483	.390	.010	3.5171
7.39	.476	.404	.011	3.2503
6.72	.461	.431	.013	2.8110
6.16	.449	.458	.015	2.4656
5.48	.444	.509	.018	2.0694
4.93	.583	.743	.029	1.7731
4.22	.284	.423	.020	1.4194

SAMPLE RUN 2 - MOT35 OUTPUT (IG = 3) FOR COMPUTER
 RUN FOR TWO HEADINGS AND TWO FROUDE NUMBERS

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

DATA INPUT CARDS

	1	2	3	4	5	6	7	8
123456789012345678901234567890123456789012345678901234567890								
SWATH 6A								
0	1	2	3	3	0	1	50000	1.70000
0.00000	0.00000	1.20000	1.30000	1.40000	1.50000	1.60000	1.70000	1.70000
16	2	1	1	19	0	2.70000	3.00000	3.50000
.90000	1.00000	1.00000	1.20000	1.30000	1.40000	1.50000	1.60000	1.70000
1.80000	1.90000	2.00000	2.20000	2.40000	2.70000	3.00000	3.00000	3.50000
135.00000	180.00000							
0.00000	.44000							
37.50000								
1.00000								
0.00000								
178.14000	.31500	.22300	0.00000	7.44000	11.06000	19.17000	20.00000	
40.44000	25.75000	19.17000	8.50000	10.20000	1.28000	4.38000	1.20000	
188.12000	23.55000	19.17000	14.70000	17.60000	2.20000	3.43000	1.20000	
.50000	.07000	0.00000	0.00000	0	19			
-1.6000	0.0000	0.0000	0.0000	9	0			
-.8000	0.0000	0.0000	0.0000	9	0			
0.0000	0.0000	0.0000	0.0000	9	0			
1.0000	0.0000	0.0000	0.0000	9	0			
2.0000	0.0000	0.0000	0.0000	15	0			
3.0000	0.0000	0.0000	0.0000	15	0			
4.0000	0.0000	0.0000	0.0000	15	0			
6.0000	0.0000	0.0000	0.0000	15	0			
8.0000	0.0000	0.0000	0.0000	15	2			
10.0000	0.0000	0.0000	0.0000	15	1			
12.0000	0.0000	0.0000	0.0000	15	1			
14.0000	0.0000	0.0000	0.0000	15	1			
16.0000	0.0000	0.0000	0.0000	15	1			
18.0000	0.0000	0.0000	0.0000	15	0			
20.0000	0.0000	0.0000	0.0000	15	0			
22.0000	0.0000	0.0000	0.0000	9	0			
24.0000	0.0000	0.0000	0.0000	9	0			
24.5000	0.0000	0.0000	0.0000	9	0			
25.0000	0.0000	0.0000	0.0000	9	0			

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

0.0000	-2.0200	-2.7900	-1.9600	STATION -1.6000	0.0000	1.9800	2.8100	2.0000
0.0000								
10.3100	9.4500	7.5100	5.5000	4.7100	5.5300	7.5300	9.5000	9.5000
10.3100								
0.0000	-3.7420	-5.2920	-3.7420	STATION -5.8000	0.0000	3.7420	5.2920	3.7420
0.0000								
12.7920	11.2420	7.5000	3.7580	2.2080	3.7580	7.5000	11.2420	11.2420
12.7920								
0.0000	-4.3800	-6.1100	-4.3000	STATION 0.0000	0.0000	4.3600	6.1400	4.3300
0.0000								
13.6300	11.7800	7.5000	3.1500	1.4000	3.1900	7.5500	11.8400	11.8400
13.6300								
0.0000	-4.8500	-6.7800	-4.7500	STATION 1.0000	0.0000	4.8200	6.8200	4.8200
0.0000								
14.3200	12.2600	7.5300	2.6800	.7300	2.7100	7.5400	12.3000	12.3000
14.3200								
-1.0600	-1.0600	-1.0600	-1.0600	STATION 2.0000	-5.1600	-7.2400	-5.0700	0.0000
5.1100	7.2300	5.1200	1.0600	1.0600	1.0600	1.0600	1.0600	0.0000
26.6800	22.7200	19.7800	14.6800	12.5900	7.5200	2.3900	.3400	.3400
2.4300	7.5600	12.6500	14.6800	18.7800	22.7200	26.6800	26.6800	26.6800
2.4300								
-2.1700	-2.1700	-2.1700	-2.1700	STATION 3.0000	-5.3200	-7.4400	-5.2000	0.0000
5.2400	7.4200	5.2400	2.1700	2.1700	2.1700	2.1700	2.1700	0.0000
26.6600	22.6400	18.6400	14.6200	12.7200	7.5200	2.2500	.1100	.1100
2.2900	7.5600	12.7900	14.6200	18.6400	22.6400	26.6600	26.6600	26.6600
2.2900								
-3.0000	-3.0000	-3.0000	-3.0000	STATION 4.0000	-5.3600	-7.5300	-5.2800	0.0000
5.3100	7.5000	5.3000	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000
26.6600	22.5700	18.4600	14.3700	12.7700	7.5000	2.1800	0.0000	0.0000
2.2300	7.5600	12.8400	14.3700	18.4600	22.5700	26.6600	26.6600	26.6600
2.2300								
-3.5600	-3.5600	-3.5600	-3.5600	STATION 6.0000	-5.3700	-7.5300	-5.2700	0.0000
5.3400	7.5600	5.3700	3.5600	3.5600	3.5600	3.5600	3.5600	0.0000
26.6400	22.4800	18.3200	14.1600	12.7900	7.5200	2.1700	0.0000	0.0000
2.1800	7.5500	12.8500	14.1600	18.3200	22.4800	26.6400	26.6400	26.6400
2.1800								
-3.6200	-3.6200	-3.6200	-3.6200	STATION 8.0000	-5.3700	-7.5300	-5.2700	0.0000
5.3400	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	3.6200	0.0000
26.6400	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000	0.0000
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	26.6400	26.6400
2.1800								
-3.6200	-3.6200	-3.6200	-3.6200	STATION 10.0000	-5.3700	-7.5300	-5.2700	0.0000
5.3400	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	3.6200	0.0000
26.6400	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000	0.0000
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	26.6400	26.6400
2.1800								

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

-3.6200	-3.6200	-3.6200	STATION 12.0000	-5.3700	-7.5300	-5.2700	0.0000
5.3400	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	0.0000
26.6400	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	0.0000
			STATION 14.0000				
-3.6200	-3.6200	-3.6200	-5.3700	-7.5300	-5.2700	0.0000	0.0000
5.3400	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	0.0000
26.6400	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000
2.1800	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	0.0000
			STATION 16.0000				
-3.6100	-3.6100	-3.6100	-5.3700	-7.5300	-5.2700	0.0000	0.0000
5.3400	7.5600	5.3700	3.6100	3.6100	3.6100	3.6100	0.0000
26.7000	22.5200	18.3400	14.1500	12.7900	7.5200	2.1700	0.0000
2.1800	7.5500	12.8500	14.1500	18.3400	22.5200	26.7000	0.0000
			STATION 18.0000				
-3.1100	-3.1100	-3.1100	-5.3000	-7.4800	-5.2500	0.0000	0.0000
5.3300	7.4900	5.2700	3.1100	3.1100	3.1100	3.1100	0.0000
26.6800	22.5700	18.4500	14.3400	12.8200	7.5400	2.2400	0.0000
2.2700	7.5700	12.8200	14.3400	18.4500	22.5700	26.6800	0.0000
			STATION 20.0000				
-1.4300	-1.4300	-1.4300	-5.0100	-7.1000	-4.9800	0.0000	0.0000
5.0600	7.1100	5.0100	1.4300	1.4300	1.4300	1.4300	0.4500
26.6900	22.6100	18.5300	14.4600	12.5200	7.5500	2.5000	0.0000
2.5500	7.5700	12.5500	14.4600	18.5300	22.6100	26.6900	0.0000
			STATION 22.0000				
0.0000	-4.3500	-6.1600	-4.3400	0.0000	4.3900	6.1600	4.3600
0.0000	11.8800	7.5400	3.1600	1.3800	3.2100	7.5600	11.9000
13.6800							
			STATION 24.0000				
0.0000	-3.2500	-4.5700	-3.2300	0.0000	3.2800	4.6100	3.2500
0.0000	10.7800	7.5400	4.2800	2.9400	4.3100	7.5700	10.7800
12.1100							
12.1100							
			STATION 24.5000				
0.0000	-2.6500	-3.7800	-2.6500	0.0000	2.7000	3.7800	2.6600
0.0000	10.5100	7.5200	4.5200	3.2800	4.5200	7.5200	10.5100
11.7400							
11.7400							
			STATION 25.0000				
0.0000	-2.7390	-3.8740	-2.7390	0.0000	2.7390	3.8740	2.7390
0.0000	11.3740	10.2400	4.7600	3.6260	4.7600	7.5000	10.2400
11.3740							
11.3740							

MOTJ5 HEAVE AND PITCH MOTIONS OF SWATH 6A

STATION	BEAM	DRAFT AREA	COEFFICIENT
-1.6000	0.0000	5.6000	.7089
-.8000	0.0000	10.5840	.7071
0.0000	0.0000	12.2300	.7089
1.0000	0.0000	13.5900	.7068
2.0000	2.1200	26.3400	3.1311
3.0000	4.3400	26.5500	1.8257
4.0000	6.0000	26.6600	1.4655
6.0000	7.1200	26.6400	1.3154
8.0000	7.2400	26.6400	1.3013
10.0000	7.2400	26.6400	1.3013
12.0000	7.2400	26.6400	1.3013
14.0000	7.2400	26.6400	1.3013
16.0000	7.2200	26.7000	1.3032
18.0000	6.2200	26.6800	1.4244
20.0000	2.8600	26.2400	2.3867
22.0000	0.0000	12.3000	.7089
24.0000	0.0000	9.1700	.7087
24.5000	0.0000	8.4600	.6314
25.0000	0.0000	7.7480	.7072

CRITICAL ENC. FREQ. FOR STATION	-1.6000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	-.8000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	0.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	1.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	2.0000	=	16.2475
CRITICAL ENC. FREQ. FOR STATION	3.0000	=	11.3556
CRITICAL ENC. FREQ. FOR STATION	4.0000	=	9.6578
CRITICAL ENC. FREQ. FOR STATION	6.0000	=	8.8658
CRITICAL ENC. FREQ. FOR STATION	8.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	10.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	12.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	14.0000	=	8.7920
CRITICAL ENC. FREQ. FOR STATION	16.0000	=	8.8041
CRITICAL ENC. FREQ. FOR STATION	18.0000	=	9.4855
CRITICAL ENC. FREQ. FOR STATION	20.0000	=	13.9885
CRITICAL ENC. FREQ. FOR STATION	22.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	24.0000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	24.5000	=	0.0000
CRITICAL ENC. FREQ. FOR STATION	25.0000	=	0.0000

MINIMUM CRITICAL ENC. FREQ. = 0.0000 DUE TO STATION 25.0000

DATA FOR ONE HULL

LENGTH BETWEEN PERPENDICULARS = 178.14000 FEET
 BEAM AT MIDSHIP = 7.24000 FEET
 DRAFT AT MIDSHIP = 26.64000 FEET
 DISPLACEMENT = 1289.648 LONG TONS
 BLOCK COEFFICIENT = 1.34741
 LONGITUDINAL CENTER OF BUOYANCY = 100.37494 FEET AFT OF F.P.
 LONGITUDINAL CENTER OF FLOTATION = 11.26922 STATIONS
 LONGITUDINAL CENTER OF FLOTATION = 94.66327 FEET AFT OF F.P.
 VERTICAL CENTER OF BUOYANCY = 11.18932 STATIONS
 RADIUS OF GYRATION/L.B.P. = 15.46576 FEET FROM THE DESIGNED LOAD WATERLINE
 BEAM/DRAFT = .31500
 LENGTH/BEAM = 24.60497
 THE HEAVE-HEAVE RESTORING COEFFICIENT IS 4.12036
 THE HEAVE-PITCH RESTORING COEFFICIENT IS -.01646
 THE PITCH-PITCH RESTORING COEFFICIENT IS .12559

PROJECTED AREA OF THE SURMERGED HULL/L**2 = .103721E+00
 MOMENT/L**3 = .101487E-02 MOMENT OF INERTIA/L**4 = .135252E-01

HULL SEPARATION/BEAM = 9.3591

DYNAMIC COEFFICIENTS OF THE EQUATIONS OF MOTION

A33 IS SCALED BY M.

A35 AND A53 ARE SCALED BY M*L.

A55 IS SCALED BY M*L*L.

B33 IS SCALED BY M*SQRT(G/L).

B35 AND B53 ARE SCALED BY M*SQRT(G*L).

B55 IS SCALED BY M*L*SQRT(G*L).

M IS THE DISPLACED MASS.

G IS THE ACCELERATION DUE TO GRAVITY.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*L).

BETA IS THE WAVE HEADING ANGLE IN DEGREES.
BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY SQRT(G/L).

THE HULL SEPARATION/BEAM RATIO IS THE DISTANCE
BETWEEN THE HULLS DIVIDED BY THE BEAM OF ONE HULL.

HULL SEPARATION/BEAM = 9.3591

RAKE HULL POTENTIAL FLOW ADDED MASS AND DAMPING COEFFICIENTS

FN = 0.000

OMEGA	A33	A35	A53	A55	W33	W35	W53	W55
.9000	.641858	.002292	.002292	.090303	.209462	-.000695	-.000695	.011136
1.0000	.621823	.002338	.002338	.089485	.209609	-.000671	-.000671	.011321
1.2000	.594725	.002371	.002371	.088455	.199752	-.000606	-.000606	.011546
1.3000	.585825	.002369	.002369	.088092	.191391	-.000578	-.000578	.011698
1.4000	.578481	.002361	.002361	.087722	.181624	-.000560	-.000560	.011911
1.5000	.571012	.002356	.002356	.087251	.170116	-.000557	-.000557	.012133
1.6000	.561280	.002362	.002362	.086586	.152878	-.000575	-.000575	.012138
1.7000	.551175	.002410	.002410	.085822	.114994	-.000603	-.000603	.011248
1.8000	.562021	.002502	.002502	.085808	.053530	-.000465	-.000465	.009319
1.9000	.589159	.002466	.002466	.086352	.029044	-.000191	-.000191	.008499
2.0000	.604694	.002367	.002367	.086523	.029133	-.000049	-.000049	.008188
2.2000	.619083	.002203	.002203	.086682	.024717	-.000008	-.000008	.006298
2.4000	.631165	.002067	.002067	.087676	.013167	-.000072	-.000072	.003272
2.7000	.652075	.001930	.001930	.091054	.007888	-.000545	-.000545	.001605
3.0000	.669920	.001979	.001979	.094503	.041337	-.001286	-.001286	.010383
3.5000	.668213	.002223	.002223	.091980	.154891	-.001505	-.001505	.041815

RAKE HULL POTENTIAL FLOW ADDED MASS AND DAMPING COEFFICIENTS

FN = .446

OMEGA	A33	A35	A53	A55	W33	W35	W53	W55
.9000	.641858	-.113042	.117625	.247927	.209462	.285574	-.286963	.062575
1.0000	.621823	-.091148	.095824	.213175	.209609	.276662	-.278004	.053015
1.2000	.594725	-.059497	.064239	.170608	.199752	.264641	-.265854	.039139
1.3000	.585825	-.048141	.052878	.157045	.191391	.260700	-.261856	.034225
1.4000	.578481	-.038967	.043690	.146431	.181624	.257442	-.258563	.030343
1.5000	.571012	-.031365	.036077	.137733	.170116	.254114	-.255228	.027173
1.6000	.561280	-.024272	.028997	.130148	.152878	.249756	-.250906	.024017
1.7000	.551175	-.015336	.020157	.123758	.114994	.245221	-.246427	.019163
1.8000	.562021	-.004866	.009871	.120312	.053530	.250196	-.251127	.012606
1.9000	.589159	-.001122	.006055	.118815	.029044	.262574	-.262955	.010100
2.0000	.604694	-.000882	.005615	.116594	.029133	.269645	-.269743	.009636
2.2000	.619083	-.000075	.004481	.112125	.024717	.276120	-.276103	.007313
2.4000	.631165	.001048	.003087	.109473	.013167	.281427	-.281572	.003727
2.7000	.652075	.001447	.002412	.108847	.007888	.290281	-.291370	.001820
3.0000	.669920	-.000070	.004027	.109309	.041337	.297498	-.300070	.011297
3.5000	.668213	-.003417	.007862	.102830	.154891	.296518	-.2999528	.044330

HULL SEPARATION/BEAM = 9.3591

ADDED MASS COEFFICIENTS AND DAMPING COEFFICIENTS EXCLUDING CROSS-FLOW DRAG

FN = 0.000

OMEGA	A33	A35	A53	A55	H33	H35	H53	H55
.9000	.730421	-.033989	.033989	.109928	.209462	-.000695	-.000695	.011136
1.0000	.710386	.034035	.034035	.109110	.209609	-.000671	-.000671	.011321
1.2000	.683288	.034068	.034068	.108080	.199752	-.000606	-.000606	.011546
1.3000	.674387	.034066	.034066	.107717	.191391	-.000578	-.000578	.011698
1.4000	.667044	.034059	.034059	.107347	.181624	-.000560	-.000560	.011911
1.5000	.659574	.034053	.034053	.106877	.170116	-.000557	-.000557	.012133
1.6000	.649842	.034059	.034059	.106211	.152878	-.000575	-.000575	.012138
1.7000	.639737	.034108	.034108	.105447	.114994	-.000603	-.000603	.011248
1.8000	.650583	.034200	.034200	.105433	.053530	-.000465	-.000465	.009319
1.9000	.677721	.034164	.034164	.105977	.029044	-.000191	-.000191	.008499
2.0000	.693257	.034064	.034064	.106148	.029133	-.000049	-.000049	.008188
2.2000	.707646	.033900	.033900	.106307	.024717	-.000008	-.000008	.006298
2.4000	.719728	.033764	.033764	.107302	.013167	-.000072	-.000072	.003272
2.7000	.740638	.033627	.033627	.110679	.007888	-.000545	-.000545	.001605
3.0000	.758483	.033676	.033676	.114128	.041337	-.001286	-.001286	.010383
3.5000	.756775	.033920	.033920	.111605	.154891	-.001505	-.001505	.041815

ADDED MASS COEFFICIENTS AND DAMPING COEFFICIENTS EXCLUDING CROSS-FLOW DRAG

FN = .446

OMEGA	A33	A35	A53	A55	H33	H35	H53	H55
.9000	.730421	-.081345	.149322	.289301	1.494499	.592448	-.059087	.309989
1.0000	.710386	-.059451	.127521	.250417	1.494646	.583536	-.050128	.300429
1.2000	.683288	-.027800	.095936	.202466	1.484788	.571515	-.037978	.286553
1.3000	.674387	-.016443	.084575	.187094	1.476428	.567574	-.033980	.281640
1.4000	.667044	-.007270	.075387	.175044	1.466661	.564316	-.030687	.277758
1.5000	.659574	.000333	.067774	.165188	1.455152	.560988	-.027352	.274587
1.6000	.649842	.007425	.060694	.156705	1.437915	.556630	-.023030	.271431
1.7000	.639737	.016361	.051854	.149479	1.400031	.552094	-.018551	.266577
1.8000	.650583	.026831	.041568	.145375	1.338566	.557070	-.023251	.260020
1.9000	.677721	.030575	.037752	.143320	1.314080	.569448	-.035079	.257514
2.0000	.693257	.030816	.037312	.140623	1.314170	.576518	-.041867	.257051
2.2000	.707646	.031623	.036178	.135390	1.309753	.582993	-.048227	.254728
2.4000	.719728	.032745	.034784	.132157	1.298203	.588301	-.053696	.251141
2.7000	.740638	.033144	.034109	.130888	1.292924	.597155	-.063494	.249235
3.0000	.758483	.031627	.035724	.130892	1.326373	.604372	-.072194	.258711
3.5000	.756775	.028281	.039559	.123893	1.439928	.603392	-.071652	.291744

HULL SEPARATION/BEAM = 9.3591
 DRAG.

EQUATIONS OF MOTION SOLVED USING DAMPING COEFFICIENTS EXCLUDING CROSS-FLOW

FN = 0.000
 BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03857	.691	.75892	131.285	7.7570
1.000	1.07577	-.060	.41733	136.007	6.2832
1.200	1.22950	-2.646	.22450	167.254	4.3633
1.300	1.41397	-5.810	.22385	-175.964	3.7179
1.400	1.81668	-12.705	.26163	-170.256	3.2057
1.500	2.97479	-32.069	.35086	170.577	2.7925
1.600	4.76868	-115.859	.46620	55.933	2.4544
1.700	1.52849	-188.349	.34051	-48.345	2.1741
1.800	.41728	-230.219	.33589	-80.930	1.9393
1.900	.05970	-236.475	.30832	-92.929	1.7405
2.000	.04364	-146.531	.27946	-96.154	1.5708
2.200	.06133	-159.992	.22173	-95.770	1.2982
2.400	.06373	-172.889	.15236	-92.362	1.0908
2.700	.05209	-173.193	.05349	-77.253	.8619
3.000	.02685	-153.794	.01114	4.129	.6981
3.500	.00911	-111.917	.02121	-120.922	.5129

FN = 0.000
 BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03245	1.000	1.02035	125.058	7.7570
1.000	1.06805	.027	.54076	128.613	6.2832
1.200	1.21305	-2.551	.25094	162.677	4.3633
1.300	1.39074	-5.258	.24517	-174.679	3.7179
1.400	1.78620	-10.880	.29450	-164.326	3.2057
1.500	2.95086	-27.130	.39654	-177.868	2.7925
1.600	4.92107	-103.657	.41216	77.874	2.4544
1.700	1.84322	-160.333	.24377	-42.347	2.1741
1.800	.87373	-177.368	.26403	-74.023	1.9393
1.900	.52006	-182.338	.25833	-83.464	1.7405
2.000	.37737	-183.771	.23537	-86.487	1.5708
2.200	.26407	-184.626	.15082	-86.336	1.2982
2.400	.20755	-183.355	.03664	-68.876	1.0908
2.700	.12059	-179.563	.12672	81.743	.8619
3.000	.02078	-151.903	.16669	83.288	.6981
3.500	.04587	-115.075	.01517	-148.010	.5129

EQUATIONS OF MOTION SOLVED USING DAMPING COEFFICIENTS EXCLUDING CROSS-FLOW DRAG.
 FN = .446 HULL SEPARATION/BEAM = 9.3591
 BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/VL
.900	1.22637	-15.858	.42593	-171.785	11.7478
1.000	1.27278	-20.482	.43645	-175.821	9.8475
1.200	1.37092	-34.019	.44333	174.711	7.2919
1.300	1.40495	-43.798	.44308	168.612	6.4035
1.400	1.40087	-56.094	.42482	161.002	5.6840
1.500	1.32794	-70.723	.39316	151.916	5.0918
1.600	1.17238	-86.692	.34065	142.508	4.5977
1.700	.95145	-102.752	.27686	135.056	4.1803
1.800	.69677	-116.175	.22296	130.076	3.8240
1.900	.49668	-123.505	.17470	123.780	3.5171
2.000	.36241	-128.765	.12710	118.009	3.2503
2.200	.18651	-137.608	.05157	107.094	2.8110
2.400	.08360	-145.232	.00929	3.163	2.4656
2.700	.00611	-198.386	.06016	-60.433	2.0694
3.000	.02794	36.900	.09476	-66.778	1.7731
3.500	.03531	33.296	.11594	-73.270	1.4194

FN = .446
 BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/VL
.900	1.25478	-15.644	.44915	-170.243	13.2528
1.000	1.31062	-20.287	.46351	-174.465	11.1857
1.200	1.43291	-33.850	.47725	175.445	8.3833
1.300	1.48104	-43.577	.47571	168.921	7.4013
1.400	1.49086	-55.689	.46335	160.902	6.6021
1.500	1.42997	-69.849	.43226	151.021	5.9455
1.600	1.28716	-84.782	.37756	140.381	5.3879
1.700	1.09510	-99.210	.30375	130.619	4.9185
1.800	.88012	-113.192	.22918	125.028	4.5163
1.900	.66251	-124.402	.17562	122.216	4.1784
2.000	.49213	-132.140	.13136	118.701	3.8852
2.200	.27271	-142.734	.05824	110.762	3.3633
2.400	.14797	-150.326	.00702	38.563	2.9665
2.700	.05179	-159.194	.06038	-64.164	2.5082
3.000	.01310	-167.410	.09856	-72.355	2.1629
3.500	.00484	-216.872	.11429	-80.758	1.7474

EQUATIONS OF MOTION SOLVED USING EXCITING FORCE INCLUDING FIN AND BODY LIFT CONTRIBUTIONS.
 HULL SEPARATION/BEAM = 9.3591

FN = 0.000
 BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03857	.691	.75892	131.285	7.7570
1.000	1.07577	-.060	.41733	136.007	6.2832
1.200	1.22950	-2.646	.22450	167.254	4.3533
1.300	1.41397	-5.810	.22385	-175.964	3.7179
1.400	1.81668	-12.705	.26163	-170.256	3.2057
1.500	2.97479	-32.069	.35006	170.577	2.7425
1.600	4.76868	-115.859	.46620	55.933	2.4544
1.700	1.52849	-188.349	.34051	-48.345	2.1741
1.800	.41728	-230.219	.33589	-80.930	1.9393
1.900	.05970	-236.475	.30832	-92.929	1.7405
2.000	.04364	-146.531	.27946	-96.154	1.5708
2.200	.06133	-159.992	.22173	-95.770	1.2982
2.400	.06373	-172.889	.15236	-92.362	1.0908
2.700	.05209	-173.193	.05349	-77.253	.8619
3.000	.02685	-153.794	.01114	4.129	.6981
3.500	.00911	-111.917	.02121	-120.922	.5129

FN = 0.000
 BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03245	1.000	1.02035	125.058	7.7570
1.000	1.06805	.027	.54076	128.613	6.2832
1.200	1.21305	-2.551	.25094	162.677	4.3633
1.300	1.39074	-5.258	.24517	-174.679	3.7179
1.400	1.78620	-10.880	.29450	-164.326	3.2057
1.500	2.95086	-27.130	.39654	-177.868	2.7425
1.600	4.92107	-103.657	.41216	77.874	2.4544
1.700	1.84322	-160.333	.24377	-42.347	2.1741
1.800	.87373	-177.368	.26403	-74.023	1.9393
1.900	.52006	-182.338	.25833	-83.464	1.7405
2.000	.37737	-183.771	.23537	-86.487	1.5708
2.200	.26407	-184.626	.15082	-86.336	1.2982
2.400	.20755	-183.355	.03664	-68.876	1.0908
2.700	.12059	-179.563	.12672	81.793	.8619
3.000	.02078	-151.903	.16669	83.288	.6981
3.500	.04587	-15.075	.01517	-148.010	.5129

EQUATIONS OF MOTION SOLVED USING EXCITING FORCE INCLUDING FIN AND BODDY LIFT CONTRIBUTIONS.
 HULL SEPARATION/BEAM = 9.3591

FN = .446
 BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.12507	-2.495	.23387	-108.273	11.7478
1.000	1.17812	-4.516	.27179	-113.190	9.8475
1.200	1.31682	-12.479	.33977	-124.142	7.2919
1.300	1.38786	-19.383	.36473	-130.611	6.4035
1.400	1.43108	-28.769	.37683	-137.835	5.6840
1.500	1.40887	-40.396	.36943	-145.173	5.0918
1.600	1.29500	-53.013	.34222	-151.025	4.5977
1.700	1.10237	-64.546	.30726	-153.845	4.1803
1.800	.89072	-72.213	.27561	-154.359	3.8240
1.900	.73054	-76.752	.24625	-152.419	3.5171
2.000	.60166	-80.480	.22722	-148.249	3.2503
2.200	.40540	-84.600	.21210	-140.042	2.8110
2.400	.27591	-85.203	.20580	-134.347	2.4656
2.700	.15809	-81.997	.19516	-128.255	2.0694
3.000	.09219	-75.845	.18326	-123.358	1.7731
3.500	.03434	-63.630	.16159	-119.288	1.4194

FN = .446
 BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.16117	-2.800	.28131	-115.147	13.2528
1.000	1.22497	-5.100	.32292	-120.087	11.1857
1.200	1.38944	-13.814	.39458	-131.221	8.3833
1.300	1.47478	-21.129	.41945	-137.839	7.4013
1.400	1.53226	-30.875	.42963	-145.324	6.6021
1.500	1.52405	-42.734	.41716	-153.165	5.9415
1.600	1.42820	-55.442	.37935	-159.814	5.3879
1.700	1.26752	-67.653	.32648	-162.704	4.9185
1.800	1.06631	-79.066	.28636	-160.068	4.5163
1.900	.85161	-87.494	.26755	-156.938	4.1684
2.000	.67834	-92.656	.25200	-154.164	3.8652
2.200	.44354	-98.247	.23113	-147.943	3.3633
2.400	.29875	-100.601	.21883	-142.394	2.9665
2.700	.17146	-101.389	.20551	-135.535	2.5082
3.000	.10190	-102.656	.19541	-130.785	2.1629
3.500	.04393	-123.001	.17042	-130.023	1.7474

HULL SEPARATION/BEAM = 9.3591

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = 0.000

BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03857	.691	.75892	131.285	7.7570
1.000	1.07577	-.060	.41733	136.007	6.2832
1.200	1.22950	-2.646	.22450	167.254	4.3633
1.300	1.41397	-5.810	.22385	-175.964	3.7179
1.400	1.81668	-12.705	.26163	-170.256	3.2057
1.500	2.97479	-32.069	.35046	170.577	2.7925
1.600	4.76868	-115.859	.46620	55.933	2.4544
1.700	1.52849	-188.349	.34051	-48.345	2.1741
1.800	.41728	-230.219	.33589	-80.930	1.9393
1.900	.05970	-236.475	.30832	-92.929	1.7405
2.000	.04364	-146.531	.27946	-96.154	1.5708
2.200	.06133	-159.992	.22173	-95.770	1.2982
2.400	.06373	-172.889	.15236	-92.362	1.0908
2.700	.05209	-173.193	.05349	-77.253	.8619
3.000	.02685	-153.794	.01114	4.129	.6981
3.500	.00911	-111.917	.02121	-120.922	.5129

HULL SEPARATION/BEAM = 9.3591

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = 0.000

BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03806	.630	.75825	134.250	7.7570
1.000	1.07542	-.113	.42078	137.714	6.2832
1.200	1.22812	-2.827	.22964	168.256	4.3633
1.300	1.40950	-6.267	.23002	-175.441	3.7179
1.400	1.79301	-14.176	.26706	-170.301	3.2057
1.500	2.66422	-38.292	.31678	169.582	2.7925
1.600	2.58305	-102.410	.14724	77.361	2.4544
1.700	1.40742	-177.303	.29847	-47.680	2.1741
1.800	.40240	-226.330	.33302	-81.348	1.9393
1.900	.05385	-230.838	.30795	-93.313	1.7405
2.000	.04632	-140.849	.27945	-96.575	1.5708
2.200	.06203	-157.630	.22165	-96.241	1.2982
2.400	.06382	-171.850	.15199	-92.905	1.0908
2.700	.05201	-173.101	.05275	-77.936	.8619
3.000	.02657	-154.090	.01098	6.510	.6981
3.500	.00847	-111.055	.02107	-120.383	.5129

HULL SEPARATION/BEAM = 9.3591

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = 0.000
 BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03245	1.000	1.02035	125.058	7.7570
1.000	1.06805	.027	.54076	128.613	6.2832
1.200	1.21305	-2.551	.25094	162.677	4.3633
1.300	1.39074	-5.258	.24517	-174.679	3.7179
1.400	1.78620	-10.880	.29450	-164.326	3.2057
1.500	2.95086	-27.130	.39654	-177.868	2.7925
1.600	4.92107	-103.657	.41216	77.874	2.4544
1.700	1.84322	-160.333	.24377	-42.347	2.1741
1.800	.87373	-177.368	.26403	-74.023	1.9393
1.900	.52006	-182.338	.25833	-83.464	1.7405
2.000	.37737	-183.771	.23537	-86.487	1.5708
2.200	.26407	-184.626	.15082	-86.336	1.2982
2.400	.20755	-183.355	.03664	-68.876	1.0908
2.700	.12059	-179.563	.12672	81.793	.8619
3.000	.02078	-151.903	.16669	83.288	.6981
3.500	.04587	-15.075	.01517	-148.010	.5129

HULL SEPARATION/BEAM = 9.3591

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = 0.000
 BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.03155	.902	1.01693	129.229	7.7570
1.000	1.06757	-.048	.54610	131.057	6.2832
1.200	1.21137	-2.779	.25939	164.064	4.3633
1.300	1.38570	-5.800	.25483	-174.220	3.7179
1.400	1.76164	-12.528	.30348	-164.629	3.2057
1.500	2.64237	-33.801	.36806	-178.320	2.7925
1.600	2.69834	-91.435	.15571	131.026	2.4544
1.700	1.72340	-149.354	.18506	-45.561	2.1741
1.800	.86720	-172.995	.25430	-75.570	1.9393
1.900	.51874	-179.965	.25549	-84.448	1.7405
2.000	.37665	-182.160	.23389	-87.242	1.5708
2.200	.26374	-183.760	.14989	-87.174	1.2982
2.400	.20733	-182.914	.03547	-70.833	1.0908
2.700	.12032	-179.475	.12695	82.145	.8619
3.000	.02050	-152.173	.16604	83.354	.6981
3.500	.04588	-15.012	.01517	-146.838	.5129

HULL SEPARATION/BEAM = 9.3591

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = .446

BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.12507	-2.495	.23387	-108.273	11.7478
1.000	1.17812	-4.516	.27179	-113.190	9.8475
1.200	1.31682	-12.479	.33977	-124.142	7.2919
1.300	1.38786	-19.383	.36473	-130.611	6.4035
1.400	1.43108	-28.769	.37683	-137.835	5.6840
1.500	1.40887	-40.396	.36943	-145.173	5.0918
1.600	1.29500	-53.013	.34222	-151.025	4.5977
1.700	1.10237	-64.546	.30726	-153.845	4.1803
1.800	.89072	-72.213	.27561	-154.359	3.8240
1.900	.73054	-76.752	.24625	-152.419	3.5171
2.000	.60166	-80.480	.22722	-148.249	3.2503
2.200	.40540	-84.600	.21210	-140.042	2.8110
2.400	.27591	-85.203	.20580	-134.347	2.4656
2.700	.15809	-81.997	.19516	-128.255	2.0694
3.000	.09219	-75.845	.18326	-123.358	1.7731
3.500	.03434	-63.630	.16159	-119.288	1.4194

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

HULL SEPARATION/BEAM = 9.3591

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = .446

BETA = 135.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.12478	-2.528	.23364	-108.296	11.7478
1.000	1.17734	-4.575	.27136	-113.206	9.8475
1.200	1.31255	-12.615	.33841	-124.113	7.2919
1.300	1.37904	-19.540	.36240	-130.504	6.4035
1.400	1.41528	-28.861	.37328	-137.544	5.6840
1.500	1.38632	-40.255	.36525	-144.542	5.0918
1.600	1.27113	-52.488	.33912	-150.002	4.5977
1.700	1.04398	-63.638	.30644	-152.653	4.1803
1.800	.88073	-71.069	.27640	-153.299	3.8240
1.900	.72660	-75.581	.24783	-151.514	3.5171
2.000	.60085	-79.369	.22923	-147.525	3.2503
2.200	.40690	-83.651	.21413	-139.651	2.8110
2.400	.27780	-84.405	.20755	-134.150	2.4656
2.700	.15970	-81.389	.19647	-128.208	2.0694
3.000	.09337	-75.413	.18427	-123.385	1.7731
3.500	.03494	-63.503	.16225	-119.349	1.4194

HULL SEPARATION/BEAM = 9.3591

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = .446

BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.16117	-2.800	.28131	-115.147	13.2528
1.000	1.22497	-5.100	.32292	-120.087	11.1857
1.200	1.38944	-13.814	.39458	-131.221	8.3933
1.300	1.47478	-21.129	.41945	-137.839	7.4013
1.400	1.53226	-30.875	.42963	-145.324	6.6021
1.500	1.52405	-42.734	.41716	-153.165	5.9415
1.600	1.42820	-55.442	.37935	-159.814	5.3879
1.700	1.26752	-67.653	.32648	-162.704	4.9185
1.800	1.06631	-79.066	.28636	-160.066	4.5163
1.900	.85161	-87.494	.26755	-156.938	4.1684
2.000	.67834	-92.656	.25200	-154.164	3.8652
2.200	.44354	-98.247	.23113	-147.943	3.3633
2.400	.29875	-100.601	.21883	-142.394	2.9665
2.700	.17146	-101.389	.20551	-135.535	2.5082
3.000	.10190	-102.656	.19541	-130.785	2.1629
3.500	.04393	-123.001	.17042	-130.023	1.7474

HULL SEPARATION/BEAM = 9.3591

EQUATIONS OF MOTION SOLVED WITH VISCOUS CROSS-FLOW DAMPING EFFECTS.

FN = .446

BETA = 180.0

OMEGA	HEAVE	PHASE	PITCH	PHASE	LAM/L
.900	1.16067	-2.847	.28099	-115.143	13.2528
1.000	1.22374	-5.179	.32236	-120.067	11.1857
1.200	1.39338	-13.986	.39288	-131.129	8.3833
1.300	1.46272	-21.324	.41658	-137.651	7.4013
1.400	1.51122	-30.992	.42530	-144.927	6.6021
1.500	1.49437	-42.584	.41207	-152.389	5.9415
1.600	1.39638	-54.865	.37553	-158.573	5.3879
1.700	1.24100	-66.653	.32558	-161.170	4.9185
1.800	1.04885	-77.771	.28774	-158.645	4.5163
1.900	.84293	-86.125	.26980	-155.783	4.1684
2.000	.67483	-91.346	.25467	-153.262	3.8652
2.200	.44398	-97.123	.23378	-147.450	3.3633
2.400	.30008	-99.640	.22109	-142.156	2.9665
2.700	.17273	-100.601	.20716	-135.502	2.5082
3.000	.10280	-101.945	.19661	-130.828	2.1629
3.500	.04424	-122.087	.17127	-130.074	1.7474

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

DAMPING COEFFICIENTS INCLUDING CROSS-FLOW DRAG
FN = 0.000

OMEGA	BETA = 135.0				BETA = 180.0			
	B33	B35	B53	B55	B33	B35	B53	B55
.9000	.219953	.000148	.000148	.013223	.223772	.000620	.000620	.014023
1.0000	.218291	-.000271	-.000271	.012960	.211052	.000082	.000082	.013565
1.2000	.211142	-.000737	-.000737	.013413	.213131	-.000480	-.000480	.013931
1.3000	.207792	-.000872	-.000872	.014249	.209512	-.000696	-.000696	.014747
1.4000	.209499	-.000893	-.000893	.016098	.210938	-.000842	-.000842	.016572
1.5000	.232017	-.000596	-.000596	.021183	.232919	-.000845	-.000845	.021576
1.6000	.288089	.001313	.001313	.031383	.288048	-.000099	-.000099	.031251
1.7000	.174240	.001623	.001623	.019447	.178552	.000298	.000298	.019605
1.8000	.079732	.001754	.001754	.012777	.090614	.000564	.000564	.013746
1.9000	.047655	.001033	.001033	.010889	.055530	.000724	.000724	.011315
2.0000	.047757	.000773	.000773	.010565	.051406	.000815	.000815	.010420
2.2000	.044195	.000855	.000855	.008841	.044994	.000921	.000921	.008476
2.4000	.033421	.000980	.000980	.006027	.033621	.000990	.000990	.006670
2.7000	.028558	.000761	.000761	.004565	.027510	.000477	.000477	.003958
3.0000	.060953	.000042	.000042	.013262	.058920	-.000480	-.000480	.012567
3.5000	.171088	-.000323	-.000323	.044209	.170775	-.000478	-.000478	.044070

DAMPING COEFFICIENTS INCLUDING CROSS-FLOW DRAG
FN = .446

OMEGA	BETA = 135.0				BETA = 180.0			
	B33	B35	B53	B55	B33	B35	B53	B55
.9000	1.500268	.592600	-.058935	.310840	1.501327	.592480	-.059055	.310989
1.0000	1.502428	.583687	-.049977	.301575	1.503780	.583522	-.050142	.301764
1.2000	1.498457	.571702	-.037790	.288561	1.500607	.571434	-.038058	.288861
1.3000	1.494107	.567829	-.033724	.284236	1.496756	.567504	-.034050	.284606
1.4000	1.488788	.564691	-.030312	.281007	1.491952	.564304	-.030699	.281448
1.5000	1.481363	.561529	-.026811	.278435	1.484985	.561079	-.027262	.278936
1.6000	1.466729	.557362	-.022298	.275659	1.470784	.556853	-.022807	.276214
1.7000	1.429244	.552991	-.017655	.270860	1.434153	.552496	-.018149	.271528
1.8000	1.366257	.557983	-.022337	.264069	1.372332	.557767	-.022553	.264907
1.9000	1.340219	.570286	-.034241	.261314	1.345773	.570327	-.034200	.262087
2.0000	1.339042	.577340	-.041045	.260641	1.343517	.577421	-.040964	.261260
2.2000	1.332272	.583804	-.047417	.257925	1.335332	.583837	-.047383	.258332
2.4000	1.318878	.589061	-.052937	.254017	1.321065	.589033	-.052964	.254287
2.7000	1.311821	.597814	-.062835	.251782	1.313013	.597660	-.062988	.251879
3.0000	1.344501	.605017	-.071549	.261121	1.344838	.604654	-.071913	.261034
3.5000	1.458160	.604178	-.070866	.294195	1.4457901	.603565	-.071479	.293971

EXCITING FORCE, MOMENT AND PHASES

THE FORCE AMPLITUDE IS SCALED BY THE HEAVE RESTORING FORCE
 $C33 = \rho \cdot g \cdot A \cdot (\text{WATERPLANE AREA})$.

THE MOMENT AMPLITUDE IS SCALED BY THE PITCH RESTORING MOMENT
 $C55 = \rho \cdot g \cdot A \cdot (\text{MOMENT OF INERTIA OF WATERPLANE}) / L$.

*MOMENT DENOTES THE MOMENT AMPLITUDE SCALED BY $L \cdot (\text{WAVE NUMBER}) \cdot C55$.

G IS THE ACCELERATION DUE TO GRAVITY.

A IS THE WAVE AMPLITUDE.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

ρ IS THE WATER DENSITY.

FN IS THE FROUDE NUMBER = $(\text{FORWARD SPEED}) / \text{SQRT}(g \cdot L)$.

BETA IS THE WAVE HEADING ANGLE IN DEGREES.
BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $\text{SQRT}(g/L)$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.
L/LAM IS $L / (\text{WAVE LENGTH})$.

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE
REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWR1 AND CWR2.

HULL SEPARATION/HEAM = 9.3591

EXCITING FORCE, MOMENT AND PHASES

FN = 0.000

BETA = 135.0

OMEGA	L/LAM	FORCE	PHASE	MOMENT	PHASE	*MOMENT	LAM/L
.9000	.1289	.69712	3.704	.24307	-101.407	.30009	7.7570
1.0000	.1592	.63866	4.386	.22044	-100.414	.22044	6.2832
1.2000	.2292	.51825	5.436	.08237	-101.474	.05720	4.3633
1.3000	.2690	.45934	5.553	.03743	92.610	.02215	3.7179
1.4000	.3119	.40324	4.954	.18801	85.372	.09592	3.2057
1.5000	.3581	.35014	3.172	.36945	83.305	.16420	2.7925
1.6000	.4074	.29442	-1.185	.59107	81.343	.23089	2.4544
1.7000	.4600	.21940	-20.975	.87706	92.766	.30348	2.1741
1.8000	.5157	.10334	-47.324	1.25243	90.768	.38655	1.9393
1.9000	.5745	.01657	1.652	1.47023	83.965	.40727	1.7405
2.0000	.6366	.04671	55.612	1.55136	80.983	.38784	1.5708
2.2000	.7703	.07352	34.533	1.53837	81.045	.31784	1.2982
2.4000	.9167	.09382	16.731	1.28394	83.997	.22291	1.0908
2.7000	1.1602	.10777	9.932	.58072	96.293	.07966	.8619
3.0000	1.4024	.07388	25.435	.12434	179.805	.01382	.6981
3.5000	1.9496	.04230	66.223	.42305	56.481	.03453	.5129

EXCITING FORCE, MOMENT AND PHASES

FN = 0.000

BETA = 180.0

OMEGA	L/LAM	FORCE	PHASE	MOMENT	PHASE	*MOMENT	LAM/L
.9000	.1289	.69468	3.643	.33787	-95.948	.41712	7.7570
1.0000	.1592	.63495	4.212	.30670	-94.209	.30670	6.2832
1.2000	.2292	.51208	5.460	.11869	-81.278	.08243	4.3633
1.3000	.2690	.45277	6.124	.06512	41.201	.03853	3.7179
1.4000	.3119	.39801	6.864	.25783	68.864	.13154	3.2057
1.5000	.3581	.35058	8.047	.49271	69.794	.21898	2.7925
1.6000	.4074	.31328	9.949	.75289	66.384	.29410	2.4544
1.7000	.4600	.28168	6.123	.94212	75.718	.32599	2.1741
1.8000	.5157	.25713	2.827	1.12350	79.158	.34676	1.9393
1.9000	.5745	.24230	.978	1.25001	80.390	.34626	1.7405
2.0000	.6366	.24133	-2.06	1.28639	80.892	.32160	1.5708
2.2000	.7703	.26402	-2.300	1.02287	81.102	.21134	1.2982
2.4000	.9167	.28978	-3.048	.28204	73.982	.04897	1.0908
2.7000	1.1602	.24847	-3.654	1.39015	-93.236	.19069	.8619
3.0000	1.4324	.04904	.841	2.33866	-97.338	.25985	.6981
3.5000	1.9496	.19185	-177.711	.24428	42.465	.01994	.5129

HULL SEPARATION/BEAM = 9.3591

MOT35 HEAVE AND PITCH MOTIONS OF SWATH BA

EXCITING FORCE, MOMENT AND PHASES

FN = .446
BETA = 135.0

OMEGA	L/LAM	FORCE	PHASE	MOMENT	PHASE	*MOMENT	LAM/L
.9000	.0851	.83128	17.464	.26278	-109.846	.49133	11.7478
1.0000	.1015	.80530	19.448	.22565	-90.824	.35366	9.8475
1.2000	.1371	.75177	23.238	.26508	-35.330	.30764	7.2919
1.3000	.1562	.72414	24.967	.36366	-16.126	.37062	6.4035
1.4000	.1759	.69548	26.478	.50091	-4.319	.45315	5.6840
1.5000	.1964	.66425	27.602	.61175	2.901	.54438	5.0918
1.6000	.2175	.62543	28.116	.87772	6.622	.64227	4.5977
1.7000	.2392	.56627	28.547	1.10169	6.120	.73297	4.1803
1.8000	.2615	.49626	32.966	1.22845	2.887	.74765	3.8240
1.9000	.2843	.47384	39.645	1.25906	5.115	.70477	3.5171
2.0000	.3077	.46606	43.017	1.35208	10.569	.69944	3.2503
2.2000	.3557	.42915	46.231	1.65007	18.710	.73821	2.8110
2.4000	.4056	.37824	48.480	1.96266	24.171	.77018	2.4656
2.7000	.4832	.29738	50.693	2.40885	30.960	.79337	2.0694
3.0000	.5640	.22274	49.784	2.85021	36.273	.80432	1.7731
3.5000	.7045	.12307	26.699	3.41945	39.417	.77247	1.4194

EXCITING FORCE, MOMENT AND PHASES

FN = .446
BETA = 180.0

OMEGA	L/LAM	FORCE	PHASE	MOMENT	PHASE	*MOMENT	LAM/L
.9000	.0755	.84664	16.069	.33458	-92.214	.70572	13.2528
1.0000	.0894	.82308	17.757	.34163	-75.862	.60820	11.1857
1.2000	.1193	.77383	20.997	.43660	-43.619	.58253	8.3833
1.3000	.1351	.74836	22.550	.52506	-31.231	.61850	7.4013
1.4000	.1515	.72261	24.045	.63501	-21.484	.66724	6.6021
1.5000	.1683	.69686	25.436	.76235	-13.728	.72089	5.9415
1.6000	.1856	.67124	26.605	.90599	-7.358	.77690	5.3879
1.7000	.2033	.64392	27.323	1.07151	-2.221	.83878	4.9185
1.8000	.2214	.60867	27.823	1.25230	.919	.90013	4.5163
1.9000	.2399	.57171	28.998	1.40768	3.094	.93389	4.1684
2.0000	.2587	.54024	30.279	1.55041	5.702	.95375	3.8652
2.2000	.2973	.48298	32.064	1.83897	11.128	.98438	3.3633
2.4000	.3371	.42873	32.870	2.12732	16.389	1.00438	2.9665
2.7000	.3987	.35674	31.767	2.58288	23.853	1.03106	2.5082
3.0000	.4623	.30323	25.824	3.09333	28.954	1.06485	2.1629
3.5000	.5723	.26880	.584	3.68293	28.733	1.02422	1.7474

MOTION AMPLITUDES AND PHASES

THE HEAVE AMPLITUDE IS SCALED BY A.

THE PITCH AMPLITUDE IS SCALED BY $2 \cdot A/L$.

PITCH DENOTES PITCH AMPLITUDE SCALED BY A(WAVE NUMBER).

A IS THE WAVE AMPLITUDE.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/ $\sqrt{G \cdot L}$.

BETA IS THE WAVE HEADING ANGLE IN DEGREES.

BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $\sqrt{G/L}$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.

L/LAM IS L/(WAVE LENGTH).

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWR1 AND CWR2.

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

MOTION AMPLITUDES AND PHASES
 FN = 0.000
 BETA = 135.0

OMEGA	L/LAM	HEAVE	PHASE	PITCH	PHASE	*PITCH	LAM/L
.9000	.1289	1.03806	.630	.75825	134.250	1.87223	7.7570
1.0000	.1592	1.07542	-.113	.42078	137.714	.84157	6.2832
1.2000	.2292	1.22812	-2.827	.22964	168.256	.31895	4.3633
1.3000	.2690	1.40950	-6.267	.23002	-175.441	.27222	3.7179
1.4000	.3119	1.79301	-14.176	.26706	-170.301	.27251	3.2057
1.5000	.3581	2.66422	-38.292	.31678	169.582	.28158	2.7925
1.6000	.4074	2.58305	-102.410	.14724	77.361	.11503	2.4544
1.7000	.4600	1.40742	-177.303	.29847	-47.680	.20655	2.1741
1.8000	.5157	4.0240	-226.330	.33302	-81.348	.20557	1.9393
1.9000	.5745	.05385	-230.838	.30795	-93.313	.17061	1.7405
2.0000	.6366	.04632	-140.849	.27945	-96.575	.13973	1.5708
2.2000	.7703	.06203	-157.630	.22165	-96.241	.09159	1.2982
2.4000	.9167	.06382	-171.850	.15199	-92.905	.05277	1.0908
2.7000	1.1602	.05201	-173.101	.05275	-77.936	.01447	.8619
3.0000	1.4324	.02657	-154.090	.01098	6.510	.00244	.6981
3.5000	1.9496	.00897	-111.055	.02107	-120.383	.00344	.5129

MOTION AMPLITUDES AND PHASES
 FN = .446
 BETA = 135.0

OMEGA	L/LAM	HEAVE	PHASE	PITCH	PHASE	*PITCH	LAM/L
.9000	.0851	1.12478	-2.528	.23364	-108.296	.87368	11.7478
1.0000	.1015	1.17734	-4.575	.27136	-113.206	.85061	9.8475
1.2000	.1371	1.31255	-12.615	.33841	-124.113	.78547	7.2919
1.3000	.1562	1.37904	-19.540	.36240	-130.504	.73868	6.4035
1.4000	.1759	1.41528	-28.861	.37328	-137.544	.67537	5.6840
1.5000	.1964	1.38632	-40.255	.36525	-144.542	.59200	5.0918
1.6000	.2175	1.27113	-52.488	.33912	-150.002	.49629	4.5977
1.7000	.2392	1.08398	-63.638	.30644	-152.653	.40775	4.1803
1.8000	.2615	.88073	-71.069	.27640	-153.299	.33644	3.8240
1.9000	.2843	.72660	-75.581	.24783	-151.514	.27745	3.5171
2.0000	.3077	.60085	-79.369	.22923	-147.525	.23716	3.2503
2.2000	.3557	.40690	-83.651	.21413	-139.651	.19160	2.8110
2.4000	.4056	.27780	-84.405	.20755	-134.150	.16289	2.4656
2.7000	.4832	.15970	-81.369	.19649	-128.208	.12943	2.0694
3.0000	.5640	.09337	-75.413	.18427	-123.385	.10400	1.7731
3.5000	.7045	.03494	-63.503	.16225	-119.349	.07331	1.4194

HULL SEPARATION/BEAM = 9.3591

MOTION AMPLITUDES AND PHASES

FN = 0.000

RETA = 180.0

OMEGA	L/LAM	HEAVE	PHASE	PITCH	PHASE	*PITCH	LAM/L
.9000	.1289	1.03155	.902	1.01693	129.229	2.51095	7.7570
1.0000	.1592	1.06757	-.048	.54610	131.057	1.09221	6.2832
1.2000	.2292	1.21137	-2.779	.25939	164.064	.36027	4.3633
1.3000	.2690	1.38570	-5.800	.25483	-174.220	.30158	3.7179
1.4000	.3119	1.76164	-12.528	.30348	-164.629	.30967	3.2057
1.5000	.3581	2.64237	-33.801	.36806	-178.320	.32716	2.7925
1.6000	.4074	2.69834	-91.435	.15571	131.026	.12165	2.4544
1.7000	.4600	1.72340	-149.354	.18506	-45.561	.12807	2.1741
1.8000	.5157	.86720	-172.995	.25430	-75.570	.15697	1.9393
1.9000	.5745	.51874	-179.965	.25549	-84.448	.14154	1.7405
2.0000	.6366	.37665	-182.160	.23389	-87.282	.11695	1.5708
2.2000	.7703	.26374	-183.760	.14989	-87.174	.06194	1.2982
2.4000	.9167	.20733	-182.914	.03547	-70.833	.01232	1.0908
2.7000	1.1602	.12032	-179.475	.12695	82.145	.03483	.8619
3.0000	1.4324	.02050	-152.173	.16664	83.354	.03703	.6981
3.5000	1.9496	.04588	-15.012	.01517	-146.838	.00248	.5129

MOTION AMPLITUDES AND PHASES

FN = .446

RETA = 180.0

OMEGA	L/LAM	HEAVE	PHASE	PITCH	PHASE	*PITCH	LAM/L
.9000	.0755	1.16067	-2.847	.28099	-115.143	1.18536	13.2528
1.0000	.0894	1.22374	-5.179	.32236	-120.067	1.14777	11.1857
1.2000	.1193	1.38338	-13.986	.39288	-131.129	1.04840	8.3833
1.3000	.1351	1.46272	-21.324	.41658	-137.651	.98143	7.4013
1.4000	.1515	1.51122	-30.942	.42530	-144.927	.89379	6.6021
1.5000	.1683	1.49437	-42.584	.41207	-152.389	.77933	5.9415
1.6000	.1856	1.39638	-54.865	.37553	-158.573	.64404	5.3879
1.7000	.2033	1.24100	-66.653	.32558	-161.170	.50973	4.9185
1.8000	.2214	1.04885	-77.771	.28774	-158.645	.41365	4.5163
1.9000	.2399	.84293	-86.125	.26980	-155.783	.35799	4.1684
2.0000	.2587	.67483	-91.346	.25467	-153.262	.31332	3.8652
2.2000	.2973	.44398	-97.123	.23378	-147.450	.25028	3.3633
2.4000	.3371	.30008	-99.640	.22109	-142.156	.20877	2.9665
2.7000	.3987	.17273	-100.601	.20716	-135.502	.16539	2.5082
3.0000	.4623	.10280	-101.945	.19661	-130.828	.13536	2.1629
3.5000	.5723	.04424	-122.087	.17127	-130.074	.09526	1.7474

M0135 HEAVE AND PITCH MOTIONS OF SWATH 6A

RELATIVE AND ABSOLUTE DISPLACEMENT, VELOCITY, AND ACCELERATION AT STATION 1.0

SPEED = 0.0 KNOTS
 WAVE HEADING = 135.00 DEGREES

ENC PER(SEC)	REL DISPL	ABS DISPL	VEL	ACCEL/G	WAVE L/L
16.43	1.044	1.673	.640	.008	7.7570
14.78	.795	1.425	.606	.008	6.2832
12.32	.848	1.462	.745	.012	4.3633
11.37	1.084	1.642	.907	.016	3.7179
10.56	1.631	2.047	1.218	.023	3.2057
9.86	2.988	2.956	1.884	.037	2.7925
9.24	3.669	2.734	1.859	.039	2.4544
8.70	2.226	1.620	1.171	.026	2.1741
8.21	.772	.710	.543	.013	1.9393
7.78	.667	.358	.289	.007	1.7405
7.39	.747	.256	.217	.006	1.5708
6.72	.795	.205	.192	.006	1.2982
6.16	.845	.157	.160	.005	1.0908
5.48	.922	.078	.090	.003	.8619
4.93	.964	.037	.048	.002	.6981
4.22	1.012	.013	.019	.001	.5129

SPEED = 20.0 KNOTS
 WAVE HEADING = 135.00 DEGREES

ENC PER(SEC)	REL DISPL	ABS DISPL	VEL	ACCEL/G	WAVE L/L
16.43	.218	1.212	.464	.006	11.7478
14.78	.317	1.294	.550	.007	9.8475
12.32	.607	1.476	.753	.012	7.2919
11.37	.802	1.552	.857	.015	6.4035
10.56	1.013	1.580	.940	.017	5.6840
9.86	1.204	1.523	.971	.019	5.0918
9.24	1.325	1.361	.926	.020	4.5977
8.70	1.349	1.124	.812	.018	4.1803
8.21	1.300	.888	.679	.016	3.8240
7.78	1.250	.709	.573	.014	3.5171
7.39	1.199	.558	.474	.013	3.2503
6.72	1.096	.337	.315	.009	2.8110
6.16	1.016	.215	.219	.007	2.4656
5.48	.942	.149	.171	.006	2.0694
4.93	.905	.144	.184	.007	1.7731
4.22	.895	.150	.223	.010	1.4194

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

RELATIVE AND ABSOLUTE DISPLACEMENT, VELOCITY, AND ACCELERATION AT STATION 1.0

SPEED = 0.0 KNOTS

WAVE HEADING = 180.00 DEGREES

ENC PER(SEC)	REL DISPL	ABS DISPL	VEL	ACCEL/G	WAVE L/L
16.43	1.427	1.868	.715	.008	7.7570
14.78	1.075	1.497	.636	.008	6.2832
12.32	1.085	1.472	.751	.012	4.3633
11.37	1.324	1.643	.908	.016	3.7179
10.56	1.875	2.042	1.215	.022	3.2057
9.86	3.216	2.958	1.886	.037	2.7925
9.24	3.792	2.818	1.916	.041	2.4544
8.70	2.434	1.778	1.285	.029	2.1741
8.21	1.189	.937	.717	.017	1.9393
7.78	.748	.603	.487	.012	1.7405
7.39	.636	.464	.394	.010	1.5708
6.72	.682	.320	.299	.009	1.2982
6.16	.776	.224	.228	.007	1.0908
5.48	.813	.190	.218	.008	.8619
4.93	.818	.184	.234	.009	.6981
4.22	.943	.057	.085	.004	.5129

SPEED = 20.0 KNOTS

WAVE HEADING = 180.00 DEGREES

ENC PER(SEC)	REL DISPL	ABS DISPL	VEL	ACCEL/G	WAVE L/L
16.43	.314	1.298	.496	.006	13.2528
14.78	.439	1.396	.593	.008	11.1857
12.32	.793	1.608	.820	.013	8.3833
11.37	1.020	1.696	.937	.016	7.4013
10.56	1.259	1.735	1.032	.019	6.6021
9.86	1.469	1.685	1.074	.021	5.9415
9.24	1.600	1.534	1.043	.022	5.3879
8.70	1.641	1.310	.947	.021	4.9185
8.21	1.594	1.044	.798	.019	4.5163
7.78	1.483	.791	.638	.016	4.1684
7.39	1.375	.598	.508	.013	3.8652
6.72	1.208	.344	.322	.009	3.3633
6.16	1.095	.203	.207	.007	2.9665
5.48	.994	.122	.140	.005	2.5082
4.93	.945	.122	.156	.006	2.1629
4.22	.938	.132	.197	.009	1.7474

SAMPLE RUN 3 - MOT35 OUTPUT (IG = 2) FOR COMPUTER
 RUN FOR FOLLOWING SEAS AND ONE FROUDE NUMBER

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

DATA INPUT CARDS		1	2	3	4	5	6	7	8
SWATH 6A		1	2	1	1	1	1	1	1
0	0.00000	0.00000	0.00000						
1	1.00000	1.00000							
2	0.00000	0.00000							
3	0.00000	0.00000							
4	0.00000	0.00000							
5	0.00000	0.00000							
6	0.00000	0.00000							
7	0.00000	0.00000							
8	0.00000	0.00000							
9	0.00000	0.00000							
10	0.00000	0.00000							
11	0.00000	0.00000							
12	0.00000	0.00000							
13	0.00000	0.00000							
14	0.00000	0.00000							
15	0.00000	0.00000							
16	0.00000	0.00000							
17	0.00000	0.00000							
18	0.00000	0.00000							
19	0.00000	0.00000							
20	0.00000	0.00000							
21	0.00000	0.00000							
22	0.00000	0.00000							
23	0.00000	0.00000							
24	0.00000	0.00000							
25	0.00000	0.00000							
26	0.00000	0.00000							
27	0.00000	0.00000							
28	0.00000	0.00000							
29	0.00000	0.00000							
30	0.00000	0.00000							
31	0.00000	0.00000							
32	0.00000	0.00000							
33	0.00000	0.00000							
34	0.00000	0.00000							
35	0.00000	0.00000							
36	0.00000	0.00000							
37	0.00000	0.00000							
38	0.00000	0.00000							
39	0.00000	0.00000							
40	0.00000	0.00000							
41	0.00000	0.00000							
42	0.00000	0.00000							
43	0.00000	0.00000							
44	0.00000	0.00000							
45	0.00000	0.00000							
46	0.00000	0.00000							
47	0.00000	0.00000							
48	0.00000	0.00000							
49	0.00000	0.00000							
50	0.00000	0.00000							
51	0.00000	0.00000							
52	0.00000	0.00000							
53	0.00000	0.00000							
54	0.00000	0.00000							
55	0.00000	0.00000							
56	0.00000	0.00000							
57	0.00000	0.00000							
58	0.00000	0.00000							
59	0.00000	0.00000							
60	0.00000	0.00000							
61	0.00000	0.00000							
62	0.00000	0.00000							
63	0.00000	0.00000							
64	0.00000	0.00000							
65	0.00000	0.00000							
66	0.00000	0.00000							
67	0.00000	0.00000							
68	0.00000	0.00000							
69	0.00000	0.00000							
70	0.00000	0.00000							
71	0.00000	0.00000							
72	0.00000	0.00000							
73	0.00000	0.00000							
74	0.00000	0.00000							
75	0.00000	0.00000							
76	0.00000	0.00000							
77	0.00000	0.00000							
78	0.00000	0.00000							
79	0.00000	0.00000							
80	0.00000	0.00000							
81	0.00000	0.00000							
82	0.00000	0.00000							
83	0.00000	0.00000							
84	0.00000	0.00000							
85	0.00000	0.00000							
86	0.00000	0.00000							
87	0.00000	0.00000							
88	0.00000	0.00000							
89	0.00000	0.00000							
90	0.00000	0.00000							
91	0.00000	0.00000							
92	0.00000	0.00000							
93	0.00000	0.00000							
94	0.00000	0.00000							
95	0.00000	0.00000							
96	0.00000	0.00000							
97	0.00000	0.00000							
98	0.00000	0.00000							
99	0.00000	0.00000							
100	0.00000	0.00000							

MOT35 HEAVE AND PITCH MOTIONS OF SWATH BA

0.000J	-2.0200	-2.7900	STATION	-1.6000					
0.000J			-1.9600	0.0000	1.9800	2.8100	2.0000		
10.310J	9.4500	7.5100	5.5000	4.7100	5.5300	7.5300	9.5000		
10.310J			STATION	-8.0000					
0.000J	-3.7420	-5.2920	-3.7420	0.0000	3.7420	5.2920	3.7420		
0.000J			STATION	0.0000					
12.792J	11.2420	7.5000	3.7580	2.2080	3.7580	7.5000	11.2420		
12.792J			STATION	0.0000					
0.000J	-4.3800	-6.1100	-4.3000	0.0000	4.3600	6.1400	4.3300		
0.000J			STATION	0.0000					
13.630J	11.7800	7.5000	3.1500	1.4000	3.1900	7.5500	11.8400		
13.630J			STATION	1.0000					
0.000J	-4.8500	-6.7800	-4.7500	0.0000	4.8200	6.8200	4.8200		
0.000J			STATION	0.0000					
14.320J	12.2600	7.5300	2.6800	0.7300	2.7100	7.5400	12.3000		
14.320J			STATION	2.0000					
-1.060J	-1.0600	-1.0600	-1.0600	-5.1160	-7.2400	-5.0700	0.0000		
5.110J	7.2300	5.1200	1.0600	1.0600	1.0600	1.0600	0.0000		
26.680J	22.7200	18.7800	14.6800	12.5900	7.5200	2.3900	.3400		
2.430J	7.5600	12.6500	14.6800	18.7800	22.7200	26.6800			
STATION	3.0000								
-2.170J	-2.1700	-2.1700	-2.1700	-5.3200	-7.4400	-5.2000	0.0000		
5.240J	7.4200	5.2400	2.1700	2.1700	2.1700	2.1700	0.0000		
26.660J	22.6400	18.6400	14.6200	12.7200	7.5200	2.2500	.1100		
2.290J	7.5600	12.7900	14.6200	18.6400	22.6400	26.6600			
STATION	4.0000								
-3.000J	-3.0000	-3.0000	-3.0000	-5.3600	-7.5300	-5.2800	0.0000		
5.310J	7.5000	5.3000	3.0000	3.0000	3.0000	3.0000	0.0000		
26.660J	22.5700	18.4600	14.3700	12.7700	7.5000	2.1800	0.0000		
2.230J	7.5600	12.8400	14.3700	18.4600	22.5700	26.6600			
STATION	6.0000								
-3.560J	-3.5600	-3.5600	-3.5600	-5.3700	-7.5300	-5.2700	0.0000		
5.340J	7.5600	5.3700	3.5600	3.5600	3.5600	3.5600	0.0000		
26.640J	22.4800	18.3200	14.1600	12.7900	7.5200	2.1700	0.0000		
2.180J	7.5500	12.8500	14.1600	18.3200	22.4800	26.6400			
STATION	8.0000								
-3.620J	-3.6200	-3.6200	-3.6200	-5.3700	-7.5300	-5.2700	0.0000		
5.340J	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	0.0000		
26.640J	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000		
2.180J	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400			
STATION	10.0000								
-3.620J	-3.6200	-3.6200	-3.6200	-5.3700	-7.5300	-5.2700	0.0000		
5.340J	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	0.0000		
26.640J	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000		
2.180J	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400			

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

-3.620	-3.6200	-3.6200	STATION 12.0000	-5.3700	-7.5300	-5.2700	0.0000
5.340	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	0.0000
26.640	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000
2.180	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	0.0000
			STATION 14.0000				
-3.620	-3.6200	-3.6200	-3.6200	-5.3700	-7.5300	-5.2700	0.0000
5.340	7.5600	5.3700	3.6200	3.6200	3.6200	3.6200	0.0000
26.640	22.4600	18.2800	14.1100	12.7900	7.5200	2.1700	0.0000
2.180	7.5500	12.8500	14.1100	18.2800	22.4600	26.6400	0.0000
			STATION 16.0000				
-3.610	-3.6100	-3.6100	-3.6100	-5.3700	-7.5300	-5.2700	0.0000
5.340	7.5600	5.3700	3.6100	3.6100	3.6100	3.6100	0.0000
26.700	22.5200	18.3400	14.1500	12.7900	7.5200	2.1700	0.0000
2.180	7.5500	12.8500	14.1500	18.3400	22.5200	26.7000	0.0000
			STATION 18.0000				
-3.110	-3.1100	-3.1100	-3.1100	-5.3000	-7.4800	-5.2500	0.0000
5.330	7.4900	5.2700	3.1100	3.1100	3.1100	3.1100	0.0000
26.680	22.5700	18.4500	14.3400	12.8200	7.5400	2.2400	0.0000
2.270	7.5700	12.8200	14.3400	18.4500	22.5700	26.6800	0.0000
			STATION 20.0000				
-1.430	-1.4300	-1.4300	-1.4300	-5.0100	-7.1000	-4.9800	0.0000
5.060	7.1100	5.0100	1.4300	1.4300	1.4300	1.4300	0.4500
26.690	22.6100	18.5300	14.4600	12.5300	7.5500	2.5000	0.0000
2.550	7.5700	12.5500	14.4600	18.5300	22.6100	26.6900	0.0000
			STATION 22.0000				
0.000	-4.3500	-6.1600	-4.3400	0.0000	4.3900	6.1600	4.3600
0.000	11.8800	7.5400	3.1600	1.3800	3.2100	7.5600	11.9000
13.680							
13.680							
			STATION 24.0000				
0.000	-3.2500	-4.5700	-3.2300	0.0000	3.2800	4.6100	3.2500
0.000	10.7800	7.5400	4.2800	2.9400	4.3100	7.5700	10.7800
12.110							
12.110							
			STATION 24.5000				
0.000	-2.6500	-3.7800	-2.6500	0.0000	2.7000	3.7800	2.6600
0.000	10.5100	7.5200	4.5200	3.2800	4.5200	7.5200	10.5100
11.740							
11.740							
			STATION 25.0000				
0.000	-2.7390	-3.8740	-2.7390	0.0000	2.7390	3.8740	2.7390
0.000	10.2400	7.5000	4.7600	3.6200	4.7600	7.5000	10.2400
11.374							
11.374							

DATA FOR ONE HULL

LENGTH BETWEEN PERPENDICULARS = 174.14000 FEET
 BEAM AT MIDSHIP = 7.24000 FEET
 DRAFT AT MIDSHIP = 26.64000 FEET
 DISPLACEMENT = 1289.648 LONG TONS
 BLOCK COEFFICIENT = 1.34741
 LONGITUDINAL CENTER OF BUOYANCY = 100.37494 FEET AFT OF F.P.
 LONGITUDINAL CENTER OF BUOYANCY = 11.26922 STATIONS
 LONGITUDINAL CENTER OF FLOTATION = 99.66327 FEET AFT OF F.P.
 LONGITUDINAL CENTER OF FLOTATION = 11.18932 STATIONS
 VERTICAL CENTER OF BUOYANCY = 15.46576 FEET FROM THE DESIGNED LOAD WATERLINE
 RADIUS OF GYRATION/L.B.P. = .31500
 HEAM/DRAFT = .27177
 LENGTH/BEAM = 24.60497

THE HEAVE-HEAVE RESTORING COEFFICIENT IS 4.12036
 THE HEAVE-PITCH RESTORING COEFFICIENT IS -.01646
 THE PITCH-PITCH RESTORING COEFFICIENT IS .12559

BETA = 0.0

QUARTERING SEA CASE=1 HIGH FREQUENCY WAVES FASTER THAN SHIP

SPEED RANGE OF INTEREST FROM FROUDE NUMBER .1608 TO .9476

AT FROUDE NUMBER= .4460 FREQUENCY RANGE IS .0500 TO .5605 AND WAVE LENGTH RANGE IS 1.3089 TO 4.9993

ANALYSIS WILL BE BASED ON 16 FREQUENCIES FROM .0500 TO .5605

PROJECTED AREA OF THE SUBMERGED HULL/L**2 = .103721E+00
 MOMENT/L**3 = .101497E-02 MOMENT OF INERTIA/L**4 = .135252E-01

DYNAMIC COEFFICIENTS OF THE EQUATIONS OF MOTION

A33 IS SCALED BY M.

A33 AND A53 ARE SCALED BY M*L.

A53 IS SCALED BY M*L*L.

R33 IS SCALED BY M*SQRT(G/L).

R53 AND H53 ARE SCALED BY M*SQRT(G*L).

H53 IS SCALED BY M*L*SQRT(G*L).

M IS THE DISPLACED MASS.

G IS THE ACCELERATION DUE TO GRAVITY.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*L).

RETA IS THE WAVE HEADING ANGLE IN DEGREES.
RETA = 140. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY SQRT(G/L).

THE HULL SEPARATION/BEAM RATIO IS THE DISTANCE
BETWEEN THE HULLS DIVIDED BY THE BEAM OF ONE HULL.

HULL SEPARATION/BEAM = 9.3591

RAVE HULL POTENTIAL FLOW ADDED MASS AND DAMPING COEFFICIENTS

FN = .446

OMEGA	A33	A35	A33	A55	B33	B35	B53	B55
.0500	1.380747	-3.405210	3.404081109	.989945	.019084	.615738	-.615888	1.519494
.1694	1.074671	-.981018	.982314	7.525488	.063472	.479054	-.479552	.441220
.2566	.966948	-.631597	.633759	3.028796	.093375	.430895	-.431622	.287161
.3214	.906757	-.490939	.493582	1.849588	.114015	.403973	-.404854	.225625
.3710	.867969	-.415342	.418293	1.355619	.128659	.386621	-.387607	.192746
.4097	.841065	-.368568	.371731	1.096719	.139315	.374585	-.375646	.172488
.4403	.821536	-.337129	.340445	.942101	.147243	.365848	-.366963	.158913
.4647	.806904	-.314831	.318262	.841634	.153251	.359302	-.360457	.149305
.4843	.795698	-.298421	.301938	.772475	.157874	.354289	-.355474	.142244
.5002	.786977	-.286024	.289609	.722871	.161476	.350388	-.351596	.136916
.5131	.780112	-.276483	.280121	.686223	.164309	.347317	-.348543	.132818
.5307	.771100	-.264239	.267945	.641111	.168016	.343286	-.344535	.127563
.5427	.765490	-.256243	.259945	.612803	.170476	.340599	-.341862	.124133
.5509	.761105	-.251014	.254779	.594779	.172100	.338816	-.340089	.121891
.5562	.758548	-.247689	.251491	.583515	.173138	.337673	-.338952	.120466
.5695	.756494	-.245035	.248802	.574633	.173969	.336755	-.338038	.119328

EXCITING FORCE, MOMENT AND PHASES

THE FORCE AMPLITUDE IS SCALED BY THE HEAVE RESTORING FORCE
 $C33 = \rho_0 * g * A * (\text{WATERPLANE AREA})$.

THE MOMENT AMPLITUDE IS SCALED BY THE PITCH RESTORING MOMENT
 $C55 = \rho_0 * g * A * (\text{MOMENT OF INERTIA OF WATERPLANE}) / L$.

*MOMENT DENOTES THE MOMENT AMPLITUDE SCALED BY $L * (\text{WAVE NUMBER}) * C55$.

G IS THE ACCELERATION DUE TO GRAVITY.

A IS THE WAVE AMPLITUDE.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

PHU IS THE WATER DENSITY.

FN IS THE FROUDE NUMBER = $(\text{FORWARD SPEED}) / \text{SQRT}(g * L)$.

BETA IS THE WAVE HEADING ANGLE IN DEGREES.

BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $\text{SQRT}(g/L)$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.

L/LAM IS $L / (\text{WAVE LENGTH})$.

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE
REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWR1 AND CWR2.

HULL SEPARATION/BEAM = 9.3591

EXCITING FORCE, MOMENT AND PHASES

FN = .446
 BETA = 0.0
 REGION 1CWR1 = .2000 CWR2 = .8001

OMEGA	L/LAM	FORCE	PHASE	MOMENT	PHASE	*MOMENT	LAM/L
.0500	.7640	.25388	-42.788	2.80456	-148.638	.58423	1.3089
.1698	.6735	.18962	-27.127	3.12781	-154.316	.73917	1.4849
.2566	.6031	.16767	-4.070	3.26700	-157.561	.86214	1.6581
.3214	.5467	.18335	15.709	3.28062	-160.109	.95512	1.8293
.3710	.5003	.21682	27.300	3.22376	-162.451	1.02562	1.9990
.4097	.4614	.25457	33.213	3.12989	-164.510	1.07970	2.1675
.4403	.4283	.29139	36.054	3.01851	-166.396	1.12180	2.3351
.4547	.3997	.32570	37.260	2.90078	-168.133	1.15512	2.5020
.4843	.3747	.35720	37.572	2.78300	-169.740	1.18195	2.6685
.5002	.3528	.38600	37.381	2.66862	-171.230	1.20394	2.8346
.5131	.3333	.41237	36.904	2.55942	-172.611	1.22228	3.0006
.5307	.3030	.45464	35.608	2.37768	-174.858	1.24880	3.3000
.5427	.2777	.49141	34.295	2.21516	-176.835	1.26968	3.6014
.5509	.2559	.52396	32.873	2.06930	-178.588	1.28697	3.9077
.5562	.2367	.55350	31.465	1.93623	-179.832	1.30211	4.2254
.5605	.2000	.61188	28.449	1.67429	-176.813	1.33217	4.9993

HULL SEPARATION/BEAM = 9.3591

MOTION AMPLITUDES AND PHASES

THE HEAVE AMPLITUDE IS SCALED BY A.

THE PITCH AMPLITUDE IS SCALED BY $2 \cdot A/L$.

*PITCH DENOTES PITCH AMPLITUDE SCALED BY $A \cdot (\text{WAVE NUMBER})$.

A IS THE WAVE AMPLITUDE.

FN IS THE FROUDE NUMBER = $(\text{FORWARD SPEED})/\text{SQRT}(G \cdot L)$.

BETA IS THE WAVE HEADING ANGLE IN DEGREES.
BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $\text{SQRT}(G/L)$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CO.
L/LAM IS $L/(\text{WAVE LENGTH})$.

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE
REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWR1 AND CWR2.

HULL SEPARATION/BEAM = 9.3591

MOTION AMPLITUDES AND PHASES

FN = .446

BEI = 0.0

REGION1 CWR1 =

.2000 CWR2 = .001

OMEGA	L/LAM	HEAVE	PHASE	PITCH	PHASE	*PITCH	LAM/L
.0500	.7640	1.16994	-73.100	3.47110	95.654	1.44617	1.3089
.1098	.6735	1.10539	-45.681	3.12530	121.551	1.47716	1.4849
.2566	.6031	.99549	-38.899	2.71776	122.818	1.43439	1.6581
.3214	.5467	.92460	-35.612	2.43932	120.558	1.42036	1.8293
.3710	.5003	.87285	-33.334	2.22167	117.566	1.41362	1.9990
.4097	.4614	.83297	-31.407	2.04079	114.504	1.40799	2.1675
.4403	.4283	.80177	-29.614	1.88626	111.564	1.40202	2.3351
.4647	.3997	.77746	-27.886	1.75226	108.804	1.39553	2.5020
.4843	.3747	.75878	-26.208	1.63497	106.234	1.38875	2.6685
.5002	.3528	.74473	-24.586	1.53155	103.845	1.38190	2.8346
.5131	.3333	.73451	-23.033	1.43981	101.623	1.37519	3.0006
.5307	.3030	.72360	-20.436	1.29838	97.989	1.36386	3.3000
.5427	.2777	.71975	-18.121	1.16099	94.753	1.35384	3.6014
.5509	.2559	.72076	-16.079	1.08150	91.828	1.34525	3.9077
.5562	.2367	.72518	-14.272	.99483	89.118	1.33803	4.2254
.5605	.2000	.74300	-10.948	.83378	83.595	1.32682	4.9993

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

RELATIVE AND ABSOLUTE DISPLACEMENT, VELOCITY, AND ACCELERATION AT STATION 1.0

SPEED = 20.0 KNOTS

WAVE HEADING = 0.00 DEGREES

ENC PER(SEC)	REL DISPL	ABS DISPL	VEL	ACCEL/G	WAVE L/L
295.69	4.300	4.718	.100	.000	1.3089
87.06	4.050	4.294	.310	.001	1.4849
57.63	3.347	3.749	.409	.001	1.6581
46.00	2.802	3.372	.461	.002	1.8293
39.85	2.367	3.074	.485	.002	1.9990
36.09	2.013	2.824	.492	.003	2.1675
33.58	1.723	2.611	.488	.003	2.3351
31.82	1.484	2.425	.479	.003	2.5020
30.53	1.288	2.261	.465	.003	2.6685
29.56	1.125	2.118	.450	.003	2.8346
28.31	.990	1.990	.434	.003	3.0006
27.86	.804	1.794	.405	.003	3.3000
27.24	.671	1.633	.377	.003	3.6014
26.84	.577	1.499	.351	.003	3.9077
26.58	.519	1.383	.327	.002	4.2254
26.38	.424	1.177	.280	.002	4.9993

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

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BETA = 0.0

QUARTERING SEA KASE=2, LOW FREQUENCY WAVES FASTER THAN SHIP

SPEED RANGE OF INTEREST FROM FROUDE NUMBER .0000 TO .4987

AT FROUDE NUMBER= .4460 FREQUENCY RANGE IS .5521 TO .5605 AND WAVE LENGTH RANGE IS 4.9993 TO 6.5000

ANALYSIS WILL BE BASED ON 4 FREQUENCIES FROM .5521 TO .5605

PROJECTED AREA OF THE SUBMERGED HULL/L**2 = .103721E+00
MOMENT/L**3 = .101487E-02 MOMENT OF INERTIA/L**4 = .135252E-01

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

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HULL SEPARATION/BEAM = 9.3591

DYNAMIC COEFFICIENTS OF THE EQUATIONS OF MOTION

A33 IS SCALED BY M.

A35 AND A53 ARE SCALED BY M*L.

A55 IS SCALED BY M*L*L.

B33 IS SCALED BY M*SQRT(G/L).

B35 AND B53 ARE SCALED BY M*SQRT(G*L).

B55 IS SCALED BY M*L*SQRT(G*L).

M IS THE DISPLACED MASS.

G IS THE ACCELERATION DUE TO GRAVITY.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*L).

BETA IS THE WAVE HEADING ANGLE IN DEGREES.

BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY SQRT(G/L).

THE HULL SEPARATION/BEAM RATIO IS THE DISTANCE BETWEEN THE HULLS DIVIDED BY THE BEAM OF ONE HULL.

BEST AVAILABLE COPY

PAGE 1A

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

MULL SEPARATION/BEAM = 9.3591

RAVE HULL POTENTIAL FLOW ADDED MASS AND DAMPING COEFFICIENTS

FN = .446	A33	A35	A33	A55	H33	H35	H53	H55
.5521	.760549	-.250290	.254076	.592312	.172326	.338568	-.339842	.121581
.5552	.759059	-.248352	.252150	.585749	.172930	.337902	-.339179	.120750
.5583	.757578	-.246435	.250243	.579304	.173530	.337239	-.338520	.119928
.5605	.756494	-.245035	.248852	.574633	.173969	.336755	-.338038	.119328

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MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

MULL SEPARATION/BEAM = 9.3591

ADDED MASS COEFFICIENTS AND DAMPING COEFFICIENTS EXCLUDING CROSS-FLOW DRAG

FN = .446	A33	A35	A33	A55	H33	H35	H53	H55
.5521	.849112	-.218593	.285773	.669740	1.457362	.645442	-.111966	.368995
.5552	.847622	-.216655	.283847	.662533	1.457967	.644776	-.111303	.368164
.5583	.846141	-.214738	.281940	.655456	1.458567	.644113	-.110644	.367342
.5605	.845357	-.213338	.280549	.650326	1.459006	.643629	-.110162	.366742

ITERATION NOT USED. MAX AMP = .78243E+00

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MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

MULL SEPARATION/BEAM = 9.3591

DAMPING COEFFICIENTS INCLUDING CROSS-FLOW DRAG

FN = .446	HETA = 0.0	H33	H35	H33	H55
.5521	1.457362	.645442	-.111966	.368995	
.5552	1.457967	.644776	-.111303	.368164	
.5583	1.458567	.644113	-.110644	.367342	
.5605	1.459006	.643629	-.110162	.366742	

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HULL SEPARATION/BEAM = 9.3591

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

EXCITING FORCE, MOMENT AND PHASES

THE FORCE AMPLITUDE IS SCALED BY THE HEAVE RESTORING FORCE
 $C33 = \rho H_0 G A A (WATERPLANE AREA)$.

THE MOMENT AMPLITUDE IS SCALED BY THE PITCH RESTORING MOMENT
 $C55 = \rho H_0 G A A (MOMENT OF INERTIA OF WATERPLANE)/L$.

*MOMENT DENOTES THE MOMENT AMPLITUDE SCALED BY $L * (WAVE NUMBER) * C55$.

G IS THE ACCELERATION DUE TO GRAVITY.

A IS THE WAVE AMPLITUDE.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

ρ IS THE WATER DENSITY.

FN IS THE FRICTION NUMBER = (FORWARD SPEED)/ $\sqrt{SURT(G*L)}$.

HEIA IS THE WAVE HEADING ANGLE IN DEGREES.

HEIA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $\sqrt{SURT(G/L)}$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE LIP.

L/LAM IS $L/(WAVE LENGTH)$.

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWR1 AND CWR2.

HULL SEPARATION/BEAM = 9.3591

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

EXCITING FORCE, MOMENT AND PHASES

FN = .446
 HEIA = 0.0
 REGION 2CWR1 = .2000 CWR2 = .5001

OMEGA	L/LAM	FORCE	PHASE	MOMENT	PHASE	*MOMENT	LAM/L
.5021	.1538	.68925	24.000	1.32998	173.328	1.37587	6.5000
.5052	.1627	.67379	24.876	1.39614	173.940	1.36531	6.1444
.5083	.1753	.65230	26.671	1.48898	174.868	1.35175	5.7041
.5095	.2000	.61113	28.301	1.66946	175.835	1.32833	4.9993

MOTION AMPLITUDES AND PHASES

THE HEAVE AMPLITUDE IS SCALED BY A.

THE PITCH AMPLITUDE IS SCALED BY $2\pi\lambda/L$.

PITCH DENOTES PITCH AMPLITUDE SCALED BY $A(WAVE\ NUMBER)$.

A IS THE WAVE AMPLITUDE.

FN IS THE FROUDE NUMBER = $(FORWARD\ SPEED)/\sqrt{G*L}$.

BETA IS THE WAVE HEADING ANGLE IN DEGREES.

BETA = 140. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $SOFT(G/L)$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.

L/LAM IS $L/(WAVE\ LENGTH)$.

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWK1 AND CWK2.

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HULL SEPARATION/HEAM = 9.3591

MOTION AMPLITUDES AND PHASES

FN = .446
 REIA = 0.0
 REGION2 CWR1 = .2000 CWR2 = .2001

OMEGA	L/LAM	HEAVE	PHASE	PITCH	PHASE	PITCH	LAM/L
.521	.1534	.78243	-7.330	.63942	75.789	1.32296	6.5000
.552	.1627	.77344	-7.900	.67591	77.376	1.32196	6.1444
.583	.1753	.76186	-8.938	.72809	79.546	1.32197	5.7041
.595	.2000	.74307	-11.007	.83301	83.599	1.32560	4.9993

RELATIVE AND ABSOLUTE DISPLACEMENT, VELOCITY, AND ACCELERATION AT STATION 1.0

SPEED = 20.0 KNOTS
 WAVE HEADING = 0.0 DEGREES

ENC PER (SEC)	REL DISPL	AHS DISPL	VEL	ACCEL/G	WAVE L/L
26.78	.371	.759	.225	.002	6.5000
26.63	.378	.976	.235	.002	6.1444
26.44	.391	1.023	.250	.002	5.7041
26.34	.424	1.177	.280	.002	4.9993

BETA = 0.0

QUARTERING SEA KASE=3, SHIP FASTER THAN WAVES

SPEED RANGE OF INTEREST FROM FROUDE NUMBER .3787 TO 1.5549

AT FROUDE NUMBER= .4460 FREQUENCY RANGE IS .5521 TO .5605 AND WAVE LENGTH RANGE IS .8577 TO .8616

ANALYSIS WILL BE BASED ON 2 FREQUENCIES FROM .5521 TO .5605

PROJECTED AREA OF THE SUBMERGED HULL/L**2 = .103721E+00

MOMENT/L**3 = .101487E-02 MOMENT OF INERTIA/L**4 = .135252E-01

HULL SEPARATION/BEAM = 9.3591

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DYNAMIC COEFFICIENTS OF THE EQUATIONS OF MOTION

A33 IS SCALED BY M.

A35 AND A53 ARE SCALED BY M*L.

A55 IS SCALED BY M*L*L.

B33 IS SCALED BY M*SQRT(G/L).

B35 AND B53 ARE SCALED BY M*SQRT(G*L).

B55 IS SCALED BY M*L*SQRT(G*L).

M IS THE DISPLACED MASS.

G IS THE ACCELERATION DUE TO GRAVITY.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*L).

BETA IS THE WAVE HEADING ANGLE IN DEGREES.

BETA = 140. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY SQRT(G/L).

THE HULL SEPARATION/BEAM RATIO IS THE DISTANCE BETWEEN THE HULLS DIVIDED BY THE BEAM OF ONE HULL.

HULL SEPARATION/BEAM = 9.3591

RAVE HULL POTENTIAL FLOW ADDED MASS AND DAMPING COEFFICIENTS

FN = .446	A33	A35	A53	A55	B33	B35	B53	B55
OMEGA	.760549	-.250290	.254076	.592312	.172326	.338568	-.339842	.121581
.5605	.756494	-.245035	.248852	.574633	.173969	.336755	-.338038	.119328

HULL SEPARATION/BEAM = 9.3591

ADDED MASS COEFFICIENTS AND DAMPING COEFFICIENTS EXCLUDING CROSS-FLOW URAG

FN = .446	A33	A35	A53	A55	B33	B35	B53	B55
OMEGA	.849112	-.218593	.245773	.669740	1.457362	.645442	-.111966	.368995
.5605	.845057	-.213338	.240549	.650326	1.459006	.643629	-.110162	.366742

ITERATION NOT USED. MAX AMP = .34850E+00

HULL SEPARATION/BEAM = 9.3591

DAMPING COEFFICIENTS INCLUDING CROSS-FLOW URAG

FN = .446	A33	A35	A53	A55	B33	B35	B53	B55
OMEGA	1.457362	.645442	-.111966	.368995	1.459006	.643629	-.110162	.366742
.5605	1.459006	.643629	-.110162	.366742				

HULL SEPARATION/BEAM = 9.3591

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

EXCITING FORCE, MOMENT AND PHASES

THE FORCE AMPLITUDE IS SCALED BY THE HEAVE RESTORING FORCE
 $C33 = \rho \cdot g \cdot A \cdot (\text{WATERPLANE AREA})$.

THE MOMENT AMPLITUDE IS SCALED BY THE PITCH RESTORING MOMENT
 $C55 = \rho \cdot g \cdot A \cdot (\text{MOMENT OF INERTIA OF WATERPLANE})/L$.

*MOMENT DENOTES THE MOMENT AMPLITUDE SCALED BY $L \cdot (\text{WAVE NUMBER}) \cdot C55$.

G IS THE ACCELERATION DUE TO GRAVITY.

A IS THE WAVE AMPLITUDE.

L IS THE DISTANCE BETWEEN PERPENDICULARS.

RHU IS THE WATER DENSITY.

FN IS THE FROUDE NUMBER = $(\text{FORWARD SPEED})/\text{SQRT}(g \cdot L)$.

BETA IS THE WAVE HEADING ANGLE IN DEGREES.
 BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY $\text{SQRT}(g/L)$.

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.
 L/LAM IS $L/(\text{WAVE LENGTH})$.

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE
 REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWR1 AND CWR2.

HULL SEPARATION/BEAM = 9.3591

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

EXCITING FORCE, MOMENT AND PHASES

FN = .446
 BETA = 0.0
 REGION 3CWR1 = .2000 CWR2 = .0001

OMEGA	L/LAM	FORCE	PHASE	MOMENT	PHASE	*MOMENT	LAM/L
.521	1.1607	.41535	-+2.301	.42324	42.971	.05804	.8616
.5005	1.1654	.41474	-+2.177	.46434	43.040	.06394	.8577

HULL SEPARATION/BEAM = 9.3591

MOTION AMPLITUDES AND PHASES

THE HEAVE AMPLITUDE IS SCALED BY A.

THE PITCH AMPLITUDE IS SCALED BY C*A/L.

PITCH DENOTES PITCH AMPLITUDE SCALED BY A(WAVE NUMBER).

A IS THE WAVE AMPLITUDE.

FN IS THE FROUDE NUMBER = (FORWARD SPEED)/SQRT(G*L).

BETA IS THE WAVE HEADING ANGLE IN DEGREES.
BETA = 180. FOR HEAD SEAS.

OMEGA IS THE ENCOUNTER FREQUENCY NON-DIMENSIONALIZED BY SQRT(G/L).

THE PHASE ANGLE IS MEASURED IN DEGREES WITH RESPECT TO THE WAVE AT THE CG.

L/LAM IS L/(WAVE LENGTH).

FOR FOLLOWING SEAS THE FREQUENCY DOMAIN IS DIVIDED INTO THREE
REGIONS SEPARATED BY TWO CRITICAL L/LAM DENOTED CWR1 AND CWR2.

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MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

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HULL SEPARATION/BEAM = 9.3591

MOTION AMPLITUDES AND PHASES

FN = .446

BETA = 0.0

REGION3 CWR1 = .2000 CWR2 = .5001

OMEGA	L/LAM	HEAVE	PHASE	PITCH	PHASE	*PITCH	LAM/L
.521	1.1607	.34850	-58.639	.31316	-62.177	.08588	.8616
.5005	1.1658	.34128	-59.556	.33428	-60.984	.09127	.8577

MOT35 HEAVE AND PITCH MOTIONS OF SWATH 6A

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RELATIVE AND ABSOLUTE DISPLACEMENT, VELOCITY, AND ACCELERATION AT STATION 1.0

SPEED = 20.0 KNOTS

WAVE HEADING = 0.00 DEGREES

ENC PCH(SEC)	REL DISPL	ARS DISPL	VEL	ACCEL/G	WAVE L/L
26.7A	1.033	.034	.008	.000	.8616
26.3A	1.002	.009	.002	.000	.8577

APPENDIX F
PROGRAM FOR IRREGULAR SEA CALCULATIONS

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Irregular-sea calculations can be made for any wave heading with the use of transfer functions from MOT246 and MOT35 and the Center's SMOTION program. The program SMOTION is used to calculate ship responses using the Pierson-Moskowitz formula as well as results of spectral analysis of 323 samples of real sea conditions measured at Station INDIA in the North Atlantic.⁸ Data for these spectra is not included in the program and must be provided on separate permanent files. SMOTION can be used to calculate the single amplitude ship responses. In these results the significant wave height is given in feet.

The program SMOTION has been modified to include the option of providing transfer functions from a tape. As discussed in the section on output, transfer functions can be written on tape (or a permanent file) by defining IND as 1 in the programs when the wave heading angle, β , is between 90 and 180 degrees.

SMOTION is written such that heave and pitch or sway, roll and yaw transfer functions can be provided. Heave and pitch must be provided on a device using the local file name TAPE22; sway, roll and yaw are provided on a device using the local file name TAPE23. If data is provided from both programs, the same data deck must be used for both programs. If both sets of data are not provided, the undefined data will be defined as zero. These transfer functions can be used in SMOTION to calculate absolute and relative motion transfer functions at specified locations. All length units should be given in feet.

When running the programs MOT35 and MOT246 care should be taken to define the range of the dimensional wave frequency from 0.025 to 2.0 rad/sec. Although the transfer function may be constant for some of the range, it is important to provide data at intervals of the frequency of about 0.3 in the constant region in order to assure proper evaluation in the interpolation routine.

For wave heading angles less than 90 degrees the transfer functions must be provided on computer cards. The absolute and relative motion transfer functions for locations must also be provided on computer cards. In this case values must be provided for frequencies of 0.025 to 2.0 in constant intervals of 0.025 or for specified (wave length)/(ship length) values which span the frequency range from 0.025 to 2.0.

Results can be plotted using the CALCOMP plotting routine. A listing of SMOTION is provided below. Data input descriptions are included in the program listing.

PROGRAM SMOTION(INPUT=512,OUTPUT=512,TAPE7,TAPE2=512,
X TAPE4=512,TAPE22=512,TAPE23=512,TAPE5=INPUT,TAPE6=OUTPUT)

C THIS PROGRAM COMPUTES SHIP RESPONSES -- SINGLE AMPLITUDE
C (A) SIGNIFICANT VALUES, (B) MOST PROBABLE EXTREME VALUES,
C AND (C) EXTREME VALUE FOR DESIGN CONSIDERATION
C FOR ANY OF THE FOLLOWING TRANSFER FUNCTIONS
C (1) RELATIVE BOW MOTION (RBM), (2) HEAVE, (3) PITCH,
C (4) ROLL, (5) VERTICAL SHEAR, (6) BENDING MOMENT,
C (7) ABSOLUTE MOTION, OR (8) HYDROFOIL LOADING
C IF RBM IS INPUT, ONE OF THE FOLLOWING MAY ALSO BE COMPUTED
C (1) WATER CONTACTS *, (2) DECK WETNESSES,
C (3) HULL SLAMS, (4) HYDROFOIL BROACHINGS,
C (5) SIGNIFICANT PRESSURES *, OR (6) C-S SLAMS *
C * RELATES TO CATAMARAN CROSS-STRUCTURE
C IF ROLL IS INPUT, LATERAL ACCELERATIONS MAY BE COMPUTED
C IF ABSOLUTE MOTION IS INPUT, VERTICAL ACCELERATIONS MAY BE COMPUTED

C WAVE SPECTRA USED ARE (A)PIERSON-MUSKOWITZ FORMULATION AND
C (B) 323 ACTUAL SEA SPECTRA MEASURED AT STATION INDIA

C RESPONSE AMPLITUDES AS A FUNCTION OF SIGNIFICANT WAVE HEIGHT
C AND PERCENTAGE EXCEEDANCE ARE TABULATED AND WRITTEN ON TAPE7
C FOR PLOTTING ON CALCOMP 936

COMMON /BL1/ SHIPN(6), TFT(8), YT(24), YT2(32), TCLR(16), XTIT(3),
• PCTIT(3), BUFF(1024), XP(325), YP(325), XMIN, XMAX, XINC, XLG,
• YMIN, YINC, ZMIN, ZINC, ISYM, TWS(3), V, L, CLR, RPL, DISPL, M
COMMON /BL2/ SWH(323), RA(323,3), R2(323), NK,
• SWHPM(51), RAPM(51,3), R2PM(51)
COMMON /BL3/ GP(36), GP2(36), YPE(36,2), ZPE(36)
COMMON /BL4/ W(81), W2(81), WLL(81), SW(81), FR(81), RAU(81),
• WE(81)
COMMON /BL5/ WAVEL(50), TRAO(50), YR(50), XR(50), XW(50), TW(50)
COMMON /BL6/ OWSPC(21), SINDIA(21), PRB(323), MI(323)
COMMON /BL7/ GPP(36), YSUM(36,2), ZSUM(36)
COMMON /BL8/ HA(4,30,3),HP(4,30,3),PA(4,30,3),PP(4,30,3),
X ROLLA(4,30,3),ROLLP(4,30,3)
COMMON /BL9/ FN(4),OMEGAE(30),WN(30),BETA(3),WFR(4,30,3)
COMMON /BL10/ NFN,NFR,NBTA,IFN,IBETA

DATA PCTIT / 10HPERCENTAGE, 10H EXCEEDANC, 1HE /
DATA XTIT / 10HSIGNIFICAN, 10HT WAVE HEI, 10HGHT IN FT. /
DATA XMIN, XMAX, XINC, XLG / 0.0, 45.0, 5.0, 9.0/
DATA TWS / 10HSTATION IN, 10HDIA WAVE S, 10HPECTRA /
DATA YT / 10H R.B.M. , 10HAMPLITUDE , 10HIN FEET ,
• 10H HEAVE , 10HAMPLITUDE , 10HIN FEET ,
• 10H PITCH , 10HAMPLITUDE , 10HIN DEGREES,
• 10H ROLL , 10HAMPLITUDE , 10HIN DEGREES,
• 10HVERTICAL S, 10HHEAR AMP. , 10HIN TONS ,
• 10HBENDING MO, 10HMENT AMP. , 10HIN FT-TONS,
• 10HABSOLUTE M, 10HOTIUN AMP., 10HIN FEET ,
• 10H FOIL, 10H LOADING , 10HIN TONS /

DATA YT2/

. 10H NUMBE, 10HR OF WATER, 10H CONTACTS , 10H PER HOUR ,
 . 10H NUMBE, 10HR OF DECK , 10H WETNESSES , 10H PER HOUR ,
 . 10H N, 10H NUMBER OF H, 10H HULL SLAMS , 10H PER HOUR ,
 . 10H NUMBER, 10H OF FOIL B, 10H RUACHINGS , 10H PER HOUR ,
 . 10H S, 10H SIGNIFICANT, 10H PRESSURE , 10H IN PSI ,
 . 10H L, 10H LATERAL ACC, 10H ACCELERATION , 10H / G ,
 . 10H VE, 10H VERTICAL ACC, 10H ACCELERATION , 10H / G ,
 . 10H NO. OF CR, 10H CROSS-STRUCT, 10H HULL SLAMS , 10H PER HOUR /
 DATA TFT / 10H RBM/WA , 10H HEAVE/WA, 10H PITCH/WA,
 . 10H ROLL/WA , 10H SHEAR/WA, 10H BMT/WA, 10H AM/WA ,
 . 10H FOIL LD/WA /
 DATA TCLR / 10H WL TO CRUS, 10H-STRUCTURE,
 . 10H WL TO DECK, 10H ,
 . 10H WL TO BOTT, 10H UM OF HULL,
 . 10H WL TO FOIL, 10H ,
 . 10H , 10H ,
 . 10H CG TO DECK, 10H ,
 . 10H , 10H ,
 . 10H WL TO CRUS, 10H-STRUCTURE /
 DATA GPP/ 500., 400., 300., 250., 200., 150., 100., 90., 80., 70.,
 1 50., 50., 40., 30., 25., 20., 18., 16., 15., 14., 13., 12., 11.,
 1 10., 9., 8., 7., 6., 5., 4., 3., 2.5, 2., 1.5, 1.0, 0.5 /

C OWSPC -- AREA 2 OCEAN WAVE STATISTICS FROM "HOGBEN + LUMB" IN PERCENT

DATA OWSPC / 3.34580, 5.94340, 15.04857, 18.75943, 14.38183,
 1 12.34236, 8.42032, 6.78815, 4.41381, 4.40777, .73915, .80553,
 2 1.19773, 1.02576, .47366, .48573, .50685, .40729, .48573,
 2 .01508, .00603 /

C INDIA -- NUMBER OF INDIA SPECTRA IN EACH O.W.S. GROUP

DATA SINDIA / 86., 24., 21., 26., 27., 15., 16., 22., 14., 8., 8.,
 1 8., 8., 4., 6., 10., 5., 2., 2., 8., 3. /
 DATA MI / 86*1, 24*2, 21*3, 26*4, 27*5, 15*6, 16*7, 22*8, 14*9,
 1 8*10, 8*11, 8*12, 8*13, 4*14, 6*15, 10*16, 5*17, 2*18, 2*19,
 2 8*20, 3*21 /

G = 32.174
 TPIG = 6.283185 * G
 A = 0.0081 * G * G
 RAD = 0.0174533
 RHU2 = 0.5 * 1.9905

C W(I) -- WAVE FREQUENCY (RAD/SEC), INCREMENTS OF 0.05 FROM 0 TO 2.0

NW = 81
 W(1) = 0.0
 WZ(1) = 0.0
 DO 2 I=2,NW
 W(I) = W(I-1) + 0.025
 WZ(I) = W(I) * W(I)
 2 CONTINUE

CALL PLOTS (BUFF, 1024, 7)
 READ(5,502) ITHPM,ITSRYM,ICHECK

C IF ITHPM = ITSRYM = 0 TRANSFER FUNCTION DATA IS ON COMPUTER CARDS

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C IF ITHPM = ITSRYM = 1 TRANSFER FUNCTION DATA IS ON TAPES 22 AND 23
C IF ITHPM = 1 AND ITSRYM = 0 HEAVE AND PITCH T.F. DATA
C IS ON TAPE 22. ROLL = 0.
C IF ITHPM = 0 AND ITSRYM = 1 ROLL T.F. DATA IS ON TAPE 23
C AND HEAVE = PITCH = 0.

C DEFINE ICHECK AS 0. UNLESS ITHPM = ITSRYM = 1
C
C IF ICHECK = 0 READ DATA -- DO NOT CHECK.
C IF ICHECK = 1 CHECK DATA AND RUN PROGRAM.
C IF ICHECK = 2 CHECK HPM AND SRYM DATA FOR COMPATIBILITY.
C
      ITAPE=ITHPM+ITSRYM
      IF (ITAPE.EQ.0) GO TO 11
      YT(1)=10HRELATIVE M
      YT(2)=10HOTION AMP.
      TFT(1) =10H RM/WA
      READ(5,501) XLND

C XLND = LENGTH IN FEET USED IN HPM AND SRYM.
C
      CALL DATAIN(XLND,ITHPM,ITSRYM,ICHECK)
      IF(ICHECK.EQ.777) GO TO 777
11 READ(5,502) NSHIPS

C      NSHIPS -- NUMBER OF SHIPS INPUT
C
      DU 200 NSH=1,NSHIPS
      REWIND 2
      REWIND 4

      READ (5,500) (SHIPN(I), I=1,6)
C      SHIPN -- TITLE SUCH AS SHIP NAME, ETC. (UP TO 60 CHARACTERS)

      READ (5,502) L, INO, NWL, M, IP
C      L -- 1 FOR RELATIVE BOW MOTIUN, 2 FOR HEAVE, 3 FOR PITCH,
C           4 FOR ROLL, 5 FOR VERTICAL SHEAR, 6 FOR BENDING MOMENT,
C           7 FOR ABSOLUTE MOTIUN, 8 FOR FOIL LOAD
C      M -- 1 FOR CROSS-STRUCTURE WATER CONTACTS, 2 FOR DECK WETNESSES,
C           3 FOR HULL SLAMS, 4 FOR FOIL BROACHINGS,
C           5 FOR CROSS-STRUCTURE SIGNIFICANT PRESSURES,
C           6 FOR LATERAL ACCELERATIONS,
C           7 FOR VERTICAL ACCELERATIONS,
C           8 FOR CROSS-STRUCTURE SLAMS
C      IP -- 1 PLOTS ONLY SIGNIFICANT VALUES OF THE RESPONSE (L)
C           2 PLOTS SIGNIFICANT AND MOST PROBABLE EXTREME VALUES
C           3 PLOTS ONLY EXTREME VALUES FOR DESIGN CONSIDERATION
C           4 PLOTS ONLY ADDITIONAL RESPONSE SPECIFIED BY (M)
C           5 PLOTS ALL CALCULATED RESPONSES SPECIFIED BY (L) AND (M)
C           6 PLOTS SIGNIFICANT VALUES FOR (L) AND (M)
C           EXCEEDANCE PLOTS ARE MADE IN ALL CASES
C           0 OMTS ALL PLOTS
C      INO -- 1 IF TRANSFER FUNCTION INPUT DIRECTLY FOR W(I),I=2,41
C           2 IF T.F. INPUT AS FUNCTION OF (WAVE LENGTH / SHIP LENGTH)

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C      INO  -- 3 IF T.F. INPUT FOR EVEN INCREMENTS OF NON-DIM.ENC.FREQ.
C      NWL  -- NO. OF WAVE LENGTHS INPUT IF INO=2 (40 IS MAX.)

      READ(5,508) BPL,DISPL,V,CLR,ALPHA,XKK,RDOT,TBETA,XX,YY
C      BPL  -- SHIP LENGTH IN FEET
C      DISPL -- DISPLACEMENT IN TONS (BOTH HULLS OF CATAMARAN)
C      V    -- SHIP SPEED IN KNOTS
C      CLR  -- VERTICAL DISTANCES IN FEET FOR CALC. IF M=1,2,3,4,6,8
C             IF M=1, CLR = WL TO CROSS-STRUCTURE
C             IF M=2, CLR = WL TO DECK
C             IF M=3, CLR = WL TO BOTTOM OF HULL
C             IF M=4, CLR = WL TO TOP OF FOIL
C             IF M=6, CLR = CG TO DECK
C             IF M=8, CLR = WL TO CROSS-STRUCTURE
C             IF M=5 OR M=7, CLR IS NOT USED
C      ALPHA -- CONSTANT FOR EXTREME VALUE CALCULATION
C             USE ALPHA = 0.01 FOR 99 PERCENT ASSURANCE
C      XKK  -- CONSTANT (K) FOR CALC. OF SIGN.PRESSURE ON CROSS-STRUCTURE
C      RDOT -- THRESHOLD VELOCITY IN FT/SEC FOR SLAM CALCULATIONS
C      TBETA -- HEADING IN DEGREES (180 = HEAD SEAS)
C      USE XX AND YY WHEN ITHPM OR ITSRYM IS NOT ZERO.
C      XX AND YY ARE COORDINATES FOR CALCULATION OF
C      ABSOLUTE AND RELATIVE MOTION.
C      XX -- DIST. FROM CG ALONG CL (+ FORWARD)
C      YY -- DIST. FROM CG PERPENDICULAR TO CL (+ PORT SIDE)

      IF (RDOT .LE. 0.0) RDOT = 12.0 * SQRT(BPL/520.)

      SRLG = 1.0 / SQRT(BPL/G)
      VG = V * 1.6878 / G
      VG2 = 2.0 * VG
      VG4 = 4.0 * VG
      CLRSQ = CLR * * 2
      L1 = L * 3 - 2
      L2 = L1 + 1
      L3 = L2 + 1
      M1 = M * 4 - 3
      M2 = M1 + 1
      M3 = M2 + 1
      M4 = M3 + 1
      IF (M .GT. 0) GO TO 4
      MA = 12
      MB = 12
      GO TO 3
4 MA = M * 2 - 1
  MB = MA + 1
3 CONTINUE

      READ(5,506) YMIN,YINC,ZMIN,ZINC,ISYM
C      YMIN, YINC -- SCALING FACTORS FOR PLOTS OF RESPONSES (L)
C      YMIN IS MINIMUM VALUE FOR RESPONSE AMPLITUDE AXIS (GENERALLY 0.0)
C      YINC IS INCREMENT OF RESPONSE AMP. FOR 1.0 INCH ON AXIS
C      ZMIN, ZINC -- SCALING FACTORS FOR PLOTS OF RESPONSES (M)
C      IF NOT INPUT, PROGRAM WILL ESTABLISH A SUITABLE SCALE

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C      TOTAL LENGTH OF AXIS IS 8. INCHES
C      ISYM -- CONTROL FOR TYPE OF SYMBOL ON PLOTS (ISYM=3 FOR *)
C      IF ISYM=0 IS DESIRED, 0 MUST BE TYPED ON THE CARD

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      RAO(1) = 0.0
      GO TO (6, 8, 208), INO

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6 READ (5,504) (RAO(I), I=2,81)
C      RAO(I) -- VALUE OF INPUT FUNCTION AT FREQUENCY W(I)
C      IF L=1 (R.B.M.AMPLITUDE)/(WAVE AMPLITUDE) IS INPUT
C      IF L=2 (HEAVE AMPLITUDE)/(WAVE AMPLITUDE) IS INPUT
C      IF L=3 (PITCH AMPLITUDE)/(WAVE SLOPE) IS INPUT
C      IF L=4 (ROLL AMPLITUDE)/(WAVE SLOPE) IS INPUT
C      IF L=5 (VERT.SHEAR AMP.)/(WAVE AMP.*DISPL/L) IS INPUT
C      IF L=6 (REND.MOMENT AMP.)/(WAVE AMP.*DISPL) IS INPUT
C      IF L=7 (ABSOLUTE MOTION AMP.)/(WAVE AMP.) IS INPUT
C      IF L=8 (FOIL LOADING)/(WAVE AMP.*DISPL/L) IS INPUT

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      GO TO 19

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8 READ (5,504) (WAVEL(N), N=1,NWL)
C      WAVEL -- VALUES OF (WAVE LENGTH / SHIP LENGTH)
C      CAN BE IN EITHER ASCENDING OR DESCENDING ORDER
      READ (5,504) (TRAO (N), N=1,NWL)
C      TRAO -- VALUES OF TRANSFER FUNCTION CORRESPONDING TO WAVEL
      IF (WAVEL(2).GT.WAVEL(1)) GO TO 9
      DO 5 N=1,NWL
      NN = NWL + 1 - N
      XR(NN) = WAVEL(N)
5  YR(NN) = TRAO(N)
      DO 7 N=1,NWL
      WAVEL(N) = XR(N)
7  TRAO(N) = YR(N)
9  DO 10 N=1,NWL
10 WAVEL(N) = WAVEL(N) * BPL
      DO 18 I=2,NW
      WLI = TPIG / W2(I)
      IF (WLI .GE. WAVEL(1) .AND. WLI .LE. WAVEL(NWL)) GO TO 17
      GO TO (12, 14, 14, 14, 16, 16, 14, 16), L
12 IF (WLI .LT. WAVEL(1)) RAO(I) = 1.0
      IF (WLI .GT. WAVEL(NWL)) RAO(I) = 0.0
      GO TO 18
14 IF (WLI .LT. WAVEL(1)) RAO(I) = 0.0
      IF (WLI .GT. WAVEL(NWL)) RAO(I) = 1.0
      GO TO 18
16 RAO(I) = 0.0
      GO TO 18
17 RAO(I) = YINTP(WLI, WAVEL, TRAO, NWL)
18 CONTINUE
      GO TO 19

208 IF (ITAPE.EQ.0) GO TO 331
      NIW=NFR
      TFN=V*1.688/SQRT(32.174*XLND)
      DO 310 I=1,NFN

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```

      IFN=I
      XI=FN(I)
      IF (1.01*XI.GE.TFN .AND. .99*XI.LE.TFN) GO TO 311
310 CONTINUE
      WRITE(6,314) TFN
      GO TO 777
311 DO 312 I=1,NBTA
      IBETA=I
      XI=BETA(I)
      IF (1.01*XI.GE.TBETA .AND. .99*XI.LE.TBETA) GO TO 313
312 CONTINUE
      WRITE(6,315) TBETA
      GO TO 777
C   TRA0 -- VALUES OF TRANSFER FUNCTION FOR FREQUENCIES.
313 DO 210 I=1,NTW
      XW(I)=OMEGAE(I)
      DUM=WFR(IFN,I,IBETA)
      TW(I)=DUM
210 W(I)=DUM*DUM/32.174
      GO TO(301,302,303,304,305,305,307,305),L
301 CALL RELABS(1,XX,YY)
      GO TO 330
302 DO 322 I=1,NTW
322 TRA0(I)=HA(IFN,I,IBETA)
      GO TO 330
303 DO 323 I=1,NTW
323 TRA0(I)=PA(IFN,I,IBETA)
      GO TO 330
304 DO 324 I=1,NTW
324 TRA0(I)=ROLLA(IFN,I,IBETA)
      GO TO 330
305 WRITE(6,316)
316 FORMAT(5X,*DATA NOT AVAILABLE*)
      GO TO 777
307 CALL RELABS(2,XX,YY)
      GO TO 330
331 READ(5,508) TWMIN,TWMAX,TWINC
C   TWMIN, TWMAX, TWINC ARE INCREMENTS OF NON-DIM. ENC. FREQ.
      NTW=(TWMAX-TWMIN)/TWINC+1.1
      READ(5,508) (TRA0(I),I=1,NTW)
C   TRA0 -- VALUES OF TRANSFER FUNCTION FOR FREQ. FROM TWMIN TO TWMAX
      XW(1) = TWMIN
      DO 213 I=2,NTW
213 XW(I)=XW(I-1) +TWINC
      DO 211 I=1,NTW
      TW(I) = XW(I) * SRLG
      IF (V.EQ. 0.0) GO TO 211
      TW(I) = (-1.0 + SQRT(1.0 + VG4*TW(I))) / VG2
211 CONTINUE
330 CONTINUE
      DO 218 I=1,NW
      IF (W(I).GE.TW(1) .AND. W(I).LE.TW(NTW)) GO TO 217
      GO TO (212,214,214,214,216,216,214,216), L
212 IF (W(I) .LT. TW(1) ) RAO(I) = 0.0

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```

      IF (W(I) .GT. TW(NTW)) RAO(I) = 1.0
      GO TO 218
214  IF (W(I) .LT. TW(1) ) RAO(I) = 1.0
      IF (W(I) .GT. TW(NTW)) RAO(I) = 0.0
      GO TO 218
216  RAO(I) = 0.0
      GO TO 218
217  RAO(I) = YINTP (W(I), TW, TRAO, NTW)
218  CONTINUE

19  CONTINUE
      WRITE(6,600) (SHIPN(I),I=1,6), BPL, DISPL, V, TCLR(MA), TCLR(MB),
      . CLR, ALPHA
      WRITE (6,604) TFT(L)
      WRITE (6,603) W(1), RAO(1)
      VGC=VG*COS(TBETA*RAD)
      DO 30 I=2,NW
      WE(I)=W(I)-VGC*W2(I)
      GO TO (28, 28, 22, 22, 24, 26, 28, 24), L
22  WL = TPIG / W2(I)
      RAO(I) = RAO(I) * 360. / WL
      GO TO 28
24  RAO(I) = RAO(I) * DISPL / BPL
      GO TO 28
26  RAO(I) = RAO(I) * DISPL
28  WLL(I) = TPIG / W2(I) / BPL
      WRITE(6,606) WLL(I), WE(I), W(I), RAO(I)
      RAO(I) = RAO(I) * * 2
30  CONTINUE
      WRITE(6,607)

```

```

C      CALCULATION OF RESPONSE AMPLITUDES WITH 323 ACTUAL SEA SPECTRA
      NR = 323
      SW(1) = 0.0
      SUMPRB = 0.0
      EXTREME = -0.0
      DO 50 K=1,NK
      READ (2) NREC, SWH(K), (SW(I),I=2,NW)
      MIK = MI(K)
      PRB(K) = OWSPC(MIK) / SINDIA(MIK)
      IF (K.EQ.1 .OR. K.EQ.51 .OR. K.EQ.101 .OR. K.EQ.151 .OR. K.EQ.201
      1 .OR. K.EQ.251 .OR. K.EQ.299) GO TO 34
      GO TO 36
34  WRITE(6,600) (SHIPN(I),I=1,6), BPL, DISPL, V, TCLR(MA), TCLR(MB),
      . CLR, ALPHA
      IF (M .EQ. 0) WRITE (6,608) YT(L1), YT(L2), YT(L3),
      . TCLR(4), TCLR(4), TCLR(4), TCLR(4)
      IF (M .GT. 0) WRITE (6,608) YT(L1), YT(L2), YT(L3), YT2(M1),
      . YT2(M2), YT2(M3), YT2(M4)
36  DO 40 I=1,NW
40  FR(I) = RAO(I) * SW(I)
      EU = SIMPUN (W, FR, NW)
      DO 42 I=2,NW
42  FR(I) = FR(I) * WE(I) * WE(I)

```

```

EV = SIMPUN (W, FR, NW)
DU 47 I=2,NW
47 FR(I) = FR(I) * WE(I) * WE(I)
EA = SIMPUN (W, FR, NW)
WW = SQRT(EV/ED)
EVED = 572.9578 * WW
SQRTED = SQRT(ED)
RA(K,1) = 2.0 * SQRTED
DTIME = 68.0 - 1.4 * SWH(K)
EVEDT = EVED * DTIME
FRA2 = 2.0 * ALOG(EVEDT)
RA(K,2) = SQRT(FRA2) * SQRTED
IF (ALPHA .GT. 0.0) GO TO 41
RA(K,3) = -0.0
GU TO 44
41 FRA3 = 2.0 * ALOG (EVEDT/ ALPHA)
RA(K,3) = SQRT(FRA3) * SQRTED
IF (RA(K,3) .GT. EXTREME) EXTREME = RA(K,3)
44 CONTINUE
IF (M .GT. 0) GO TO 46
WRITE (6,610) NREC, SWH(K), (RA(K,J), J=1,3)
GU TO 48
46 GU TO (51, 51, 53, 51, 54, 56, 57, 53), M
51 ECST = CLRSQ / (2.0*ED)
IF (ECST .GT. 600.0) GO TO 59
R2(K) = EVED * EXP(-ECST)
GU TO 58
53 ECST = CLR * * 2 / (2.0 * ED) + ROOT * * 2 / (2.0 * EV)
IF (ECST .GT. 600.0) GO TO 59
R2(K) = EVED * EXP(-ECST)
GU TO 58
54 R2 (K) = XKK * 4.2 * EV
GU TO 58
56 R2 (K) = 2.0 * SQRT(EA) * RAD * CLR / G
GU TO 58
57 R2 (K) = 2.0 * SQRT(EA) / G
GU TO 58
59 R2(K) = 0.0
58 WRITE (6,610) NREC, SWH(K), (RA(K,J), J=1,3), R2(K)
48 SUMPRB = SUMPRB + PRB(K)
50 CONTINUE
WRITE (6,611) EXTREME

```

C CALCULATION OF RESPONSE AMPLITUDES WITH PIERSON-MOSKOWITZ SPECTRA

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SWHPM(1) = 0.0
R2PM(1) = 0.0
RAPM(1,1) = 0.0
RAPM(1,2) = 0.0
RAPM(1,3) = 0.0
WRITE(6,600) (SHIPN(I),I=1,6), BPL, DISPL, V, TCLR(MA), TCLR(MB),
. CLR, ALPHA
IF (M .EQ. 0) WRITE (6,608) YT(L1), YT(L2), YT(L3),
. TCLR(4), TCLR(4), TCLR(4), TCLR(4)
IF (M .GT. 0) WRITE (6,608) YT(L1), YT(L2), YT(L3), YT2(M1),

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```

. YT2(M2), YT2(M3), YT2(M4)
WRITE(6,618)
DU 70 K=2,46
READ (4) SWHPM(K), (SW(I),I=2,NW)
DU 60 I=1,NW
60 FR(I) = RAO(I) * SW(I)
EU = SIMPUN (W, FR, NW)
IF (ED.GT.0) GO TO 63
RAPM(K,1) = 0.0
RAPM(K,2) = 0.0
RAPM(K,3) = 0.0
R2PM(K) = 0.0
GU TO 65
63 SQRTED = SQRT(ED)
DU 62 I=2,NW
62 FR(I) = FR(I) * WE(I) * WE(I)
EV = SIMPUN (W, FR, NW)
DU 67 I=2,NW
67 FR(I) = FR(I) * WE(I) * WE(I)
EA = SIMPUN (W, FR, NW)
WW = SQRT(EV/ED)
EVED = 572.9578 * WW
RAPM(K,1) = 2.0 * SQRTED
DTIME = 68.0 - 1.4 * SWHPM(K)
EVEDT = EVED * DTIME
FRA2 = 2.0 * ALOG(EVEDT)
RAPM(K,2) = SQRT(FRA2) * SQRTED
IF (ALPHA.GT. 0.0) GO TO 61
RAPM(K,3) = -0.0
GU TO 64
61 FRA3 = 2.0 * ALOG(EVEDT / ALPHA)
RAPM(K,3) = SQRT(FRA3) * SQRTED
64 CONTINUE
IF (M.GT. 0) GO TO 66
65 WRITE(6,610) K, SWHPM(K), (RAPM(K,J), J=1,3)
GU TO 68
66 GU TO (71, 71, 73, 71, 74, 76, 77, 73), M
71 ECST = CLRSQ / (2.0*ED)
IF (ECST.GT. 600.0) GO TO 79
R2PM(K) = EVED * EXP(-ECST)
GU TO 78
73 ECST = CLR * * 2 / (2.0 * ED) + RDOT * * 2 / (2.0 * EV)
IF (ECST.GT. 600.0) GO TO 79
R2PM(K) = EVED * EXP(-ECST)
GU TO 78
74 R2PM(K) = XKK * 4.2 * EV
GU TO 78
76 R2PM(K) = 2.0 * SQRT(EA) * RAD * CLR / G
GU TO 78
77 R2PM(K) = 2.0 * SQRT(EA) / G
GU TO 78
79 R2PM(K) = 0.0
78 WRITE (6,610) K, SWHPM(K), (RAPM(K,J), J=1,3), R2PM(K)
68 CONTINUE
70 CONTINUE

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C      PROBABILITY COMPUTATIONS
      WRITE(6,600) (SHIPN(I),I=1,6), BPL, DISPL, V, TCLR(MA), TCLR(MB),
      CLR, ALPHA
      NPC = 36
      GPM = 1.0
      IF (L .EQ. 5) GPM = 10.0
      IF (L .EQ. 6) GPM = 1000.0
      GPM2 = 1.0
      IF (M .EQ. 6) GPM2 = 0.01
      IF (M.EQ.7) GPM2 = 0.01
      DO 80 I=1,NPC
      GP2(I) = GPP(I) * GPM2
80    GP(I) = GPP(I) * GPM
      WRITE (6,646)
      WRITE (6,628) YT(L1), YT(L2), YT2(M1), YT2(M2), YT2(M3)
      DO 92 I=1,NPC
      ZSUM(I) = 0.0
      ZPE(I) = 0.0
      DO 92 J=1,2
      YSUM(I,J) = 0.0
      YPE (I,J) = 0.0
92    CONTINUE
      DO 100 J=1,2
      DO 100 K=1,323
      DO 94 I=1,NPC
      IF (RA (K,J) .LE. GP(I)) GO TO 94
      YSUM(I,J) = YSUM(I,J) + PRB(K)
      GO TO 95
94    CONTINUE
95    IF (J .EQ. 2) GO TO 100
      IF (M .EQ. 0) GO TO 100
      DO 96 I=1,NPC
      IF (R2(K) .LE. GP2(I)) GO TO 96
      ZSUM(I) = ZSUM(I) + PRB(K)
      GO TO 100
96    CONTINUE
100   CONTINUE
      DO 110 I=1,NPC
      II = I-1
      IF (I.EQ.1) II=I
      DO 102 J=1,2
102   YPE(I,J) = YPE(II,J) + YSUM(I,J)
      IF (M .GT. 0) GO TO 105
      WRITE (6,630) GP(I), (YPE(I,J), J=1,2)
      GO TO 110
105   ZPE(I) = ZPE(II) + ZSUM(I)
      WRITE(6,630) GP(I), (YPE(I,J),J=1,2), GP2(I), ZPE(I)
110   CONTINUE
      IF (IP .EQ. 0) GO TO 200

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C      PLOTS OF PERCENTAGE EXCEEDANCE DIAGRAMS
      GO TO(112,112,115,114,112,112),IP
112   CALL PLOTPR (1, GPM)
      IF (M .EQ. 0) GO TO 115

```

114 CALL PLOTPR (2,GPM2)
115 CONTINUE

C PLOTS OF RESPONSES VS. SIGNIFICANT WAVE HT.

GO TO (122,122,124,126,122,122),IP

122 CALL PLOTFR (1,1)
IF (IP .EQ. 1) GO TO 200
IF (IP.EQ.6) GO TO 126
CALL PLOTFR (1,2)
IF (IP .EQ. 2) GO TO 200
124 CALL PLOTFR (1,3)
IF (IP .EQ. 3) GO TO 200
IF (M .EQ. 0) GO TO 200
126 CALL PLOTFR (2,1)

200 CONTINUE

CALL PLOT (0.0, 0.0, -3)
CALL PLOT (0.0, 0.0, 999)

314 FORMAT(10X,*TFN = *,E12.5, *NOT FOUND*)
315 FORMAT(10X,*TBETA = *,E12.5, *NOT FOUND*)

500 FORMAT (6A10)
501 FORMAT (9F8.2)
502 FORMAT (10I3)
504 FORMAT (10F6.2)
506 FORMAT (4F6.3, I6)
508 FORMAT (10F8.3)

600 FORMAT (1H1, 10X, 6A10 // 17H SHIP LENGTH =, F6.1, 3H FT, 5X,
• 14HDISPLACEMENT =, F7.1, 5H TONS, 5X, 7HSPEED =, F5.1, 6H KNOTS,
• 5X, 2A10, 2H =, F5.1, 3H FT, 5X,
• 7HALPHA =, F5.2 / 3X, 129(1H*)

603 FORMAT (24X, 2F12.3)

604 FORMAT (70H0 TRANSFER FUNCTION INTERPOLATED AT .025 INCREMENTS OF
• WAVE FREQUENCY // 17X, 22HENC.FREQ. WAVE FREQ. /
• 38H WL/L (RAD/SEC) (RAD/SEC) , A10)

606 FORMAT (4F12.3)

607 FORMAT (19H0 WL = WAVE LENGTH, 8X, 15HL = SHIP LENGTH, 8X,
1 25HWA = WAVE AMPLITUDE (FT) / 33H RBM = RELATIVE BOW MOTION (F
2T), 5X, 28HHEAVE = HEAVE AMPLITUDE (FT), 5X, 29HPITCH = PITCH AM
3PLITUDE (DEG), 5X, 27HROLL = ROLL AMPLITUDE (DEG) /
4 36H VSH = VERTICAL SHEAR FORCE (TONS),
1 5X, 30HBMT = BENDING MOMENT (FT-TONS) /
2 32H ABM = ABSOLUTE MOTION (FT) , 5X,
• 26HFOIL LD = FOIL LOAD (TONS))

608 FORMAT (1H0, 33X, 3A10 / 28X, 42(1H-) / 69H WAVE SIGNIFIC
•ANT SIGNIFICANT MOST PROBABLE EXTREME VALUE,7X,
• 4A10 / 72 H SPECTRA WAVE HT. (FT) VALUE EXT
•REME VALUE FOR DESIGN USE , 4X, 40(1H-))

610 FORMAT (19, F13.2, 3F14.2, F32.2)

611 FORMAT (1H0, 43X, 10HEXTREME = , F10.2)

618 FORMAT (18HOPIERSON-MOSKOWITZ)

628 FORMAT (1H0, 2A10, 26H PERCENTAGE EXCEEDANCE , 3A10 / 23X,
• 21HSIGN. MOST PROB.EXT., 28X, 8HPC.EXC.)

630 FORMAT (F16.1, F12.2, F10.2, 14X, F14.1, F12.2)

646 FORMAT (75HOPROBABILITY BASED ON OCEAN WAVE STATISTICS FROM AREA 2
• - HOGBEN + LUMB)

777 CONTINUE
END

```

SUBROUTINE RELABS(ITAB,X,Y)
C ITAB = 1 TO COMPUTE RELATIVE MOTION
C ITAB = 2 TO COMPUTE ABSOLUTE MOTION
COMMON /BL5/ WAVEL(50),TRAO(50),YR(50),XR(50),XW(50),TW(50)
COMMON /BL8/ HA(4,30,3),HP(4,30,3),PA(4,30,3),PP(4,30,3),
X RA(4,30,3),RP(4,30,3)
COMMON /BL9/ FN(4),WE(30),WN(30),BETA(3),WFR(4,30,3)
COMMON /BL10/ NFN,NFR,NBTA,IFN,IBETA
DIMENSION PRAO(30)
COMPLEX ZA,II
RAD=.0174533
II=CMPLX(0.,1.)
BCT=BETA(IBETA)*RAD
XY=X*COS(BET)-Y*SIN(BET)
DO 10 N=1,NFR
H=AVE=HA(IFN,N,IBETA)
PITCH=WN(N)*PA(IFN,N,IBETA)
ROLL=WN(N)*RA(IFN,N,IBETA)
H=AVEP=RAD*HP(IFN,N,IBETA)
PITCHP=RAD*PP(IFN,N,IBETA)
ROLLP=RAD*RP(IFN,N,IBETA)
ZA=HEAVE*CEXP(-II*HEAVEP)+Y*ROLL*CEXP(-II*ROLLP)
X -X*PITCH*CEXP(-II*PITCHP)
IF (ITAB.EQ.1) ZA=ZA-CEXP(II*WN(N)*XY)
TRAU(N)=CABS(ZA)
PRAU(N)=ATAN2(-AIMAG(ZA),REAL(ZA))
10 CONTINUE
IF (ITAB.EQ.1) WRITE(6,100) FN(IFN),BETA(IBETA),X,Y
IF (ITAB.EQ.2) WRITE(6,200) FN(IFN),BETA(IBETA),X,Y
WRITE(6,300) (WE(N),TRAO(N),PRAO(N),N=1,NFR)
100 FORMAT(///10X,*RELATIVE MOTION AND PHASE//10X,*FN = *,F8.2/
X 10X,*BETA = *,F8.2/10X,*X = *,F8.2/10X,*Y = *,F8.2/)
200 FORMAT(///10X,*ABSOLUTE MOTION AND PHASE//10X,*FN = *,F8.2/
X 10X,*BETA = *,F8.2/10X,*X = *,F8.2/10X,*Y = *,F8.2/)
300 FORMAT(12X,*WE*,9X,*AMPLITUDE*,10X,*PHASE*/(10X,F7.3,2(SX,E12.5)))
RETURN
END
*DECK DATN
SUBROUTINE DATAIN(XLND,IHPM,ITSRYM,ICHECK)
COMMON /BL8/ HA(4,30,3),HP(4,30,3),PA(4,30,3),PP(4,30,3),
X RA(4,30,3),RP(4,30,3)
COMMON /BL9/ FN(4),WE(30),WN(30),BETA(3),WFR(4,30,3)
COMMON /BL10/ NFN,NFR,NBTA,IFN,IBETA
DIMENSION BFN(4),BWE(30),BBETA(3)
SQRTGL=SQRT(32.174/XLND)
IF(IHPM+ITSRYM.EQ.2) GO TO 15
IF(IHPM.EQ.0) GO TO 25
READ(22) NFN,NFR,NBTA
READ(22) (FN(I),I=1,NFN),(WE(I),I=1,NFR),(BETA(I),I=1,NBTA)
READ(22) (((WFR(JJ,N,MM),HA(JJ,N,MM),HP(JJ,N,MM),PA(JJ,N,MM)),
X PP(JJ,N,MM),JJ=1,NFN),N=1,NFR),MM=1,NBTA)
DO 35 N=1,NFR
WE(N)=WE(N)*SQRTGL

```

```

DU 35 JJ=1,NFN
DU 35 MM=1,NBTA
WFR(JJ,N,MM)=WFR(JJ,N,MM)*SQRTGL
RA(JJ,N,MM)=0.
35 RP(JJ,N,MM)=0.
RETURN
25 READ(23) NFN,NFR,NBTA
READ(23) (FN(I),I=1,NFN),(WE(I),I=1,NFR),(BETA(I),I=1,NBTA)
READ(23) ((WFR(JJ,N,MM),DUM,DUM,RA(JJ,N,MM),RP(JJ,N,MM),DUM,DUM,
X JJ=1,NFN),N=1,NFR),MM=1,NBTA)
DU 45 N=1,NFR
WE(N)=WE(N)*SQRTGL
DU 45 JJ=1,NFN
DU 45 MM=1,NBTA
WFR(JJ,N,MM)=WFR(JJ,N,MM)*SQRTGL
HA(JJ,N,MM)=0.
HP(JJ,N,MM)=0.
PA(JJ,N,MM)=0.
45 PP(JJ,N,MM)=0.
RETURN
15 READ(22) NFN,NFR,NBTA
C IF(NFN.EQ.777) GO TO 777
C NOTE -- NEED TO ACCOMMODATE DATA FOR 0.LE.BETA.LT.90.
C DATA RECORD BEFORE EOF IS 777,777,777.
READ(23)MFN,MFR,MBTA
IF(NFN.EQ.MFN.AND.NFR.EQ.MFR.AND.NBTA.EQ.MBTA) GO TO 10
WRITE(6,100) NFN,NFR,NBTA,MFN,MFR,MBTA
ICHECK=777
RETURN
10 READ(22) (FN(I),I=1,NFN),(WE(I),I=1,NFR),(BETA(I),I=1,NBTA)
READ(23) (BFN(I),I=1,NFN),(BWE(I),I=1,NFR),(BBETA(I),I=1,NBTA)
IF(ICHECK.EQ.0) GO TO 60
DU 20 I=1,NFN
BI=BFN(I)
XI=FN(I)
IF(1.01*XI.LT.BI .OR. .99*XI.GT.BI) GO TO 50
20 CONTINUE
DU 30 I=1,NFR
BI=BWE(I)
XI=WE(I)
IF(1.01*XI.LT.BI .OR. .99*XI.GT.BI) GO TO 50
30 CONTINUE
DU 40 I=1,NBTA
BI=BBETA(I)
XI=BETA(I)
IF(1.01*XI.LT.BI .OR. .99*XI.GT.BI) GO TO 50
40 CONTINUE
WRITE(6,101)
IF(ICHECK.EQ.1) GO TO 60
ICHECK=777
RETURN
50 WRITE(6,200)
WRITE(6,201) (FN(I),I=1,NFN)
WRITE(6,201) (WE(I),I=1,NFR)

```

```

WRITE(6,201) (BETA(I),I=1,NBTA)
WRITE(6,202)
WRITE(6,201) (BFN(I),I=1,NFN)
WRITE(6,201) (BWE(I),I=1,NFR)
WRITE(6,201) (BBETA(I),I=1,NBTA)
ICHECK=777
RETURN
60 READ(22) (((DUM,HA(JJ,N,MM),HP(JJ,N,MM),PA(JJ,N,MM),PP(JJ,N,MM),
X JJ=1,NFN),N=1,NFR),MM=1,NBTA)
READ(23) (((WFR(JJ,N,MM),DUM,DUM,RA(JJ,N,MM),RP(JJ,N,MM),DUM,
X DUM,JJ=1,NFN),N=1,NFR),MM=1,NBTA)
C WFR, SWAY AMPLITUDE, SWAY PHASE, YAW AMPLITUDE AND YAW PHASE ARE
C LOCATED IN THE *DUM* LOCATIONS.
C THEY ARE NOT USED AT PRESENT AND THEREFORE ARE NOT DIMENSIONED ETC.
DU 55 N=1,NFR
WE(N)=WE(N)*SQRTGL
DU 55 JJ=1,NFN
DU 55 MM=1,NBTA
55 WFR(JJ,N,MM)=WFR(JJ,N,MM)*SQRTGL
100 FORMAT(1H1,9X,*DATA SETS DO NOT MATCH*/ 10X, *FOR HPM NFN = *,
X I3,*, NFR = *,I3,*, NBTA = *,I3/10X,*FOR SRYM NFN = *,I3,
X *, NFR = *,I3,*, NBTA = *,I3)
101 FORMAT(///10X,*DATA FROM TAPES IS COMPATIBLE*)
200 FORMAT(1H1,9X,*HPM - FN, WE, BETA*/)
201 FORMAT(10X,10F10.5)
202 FORMAT(///9X,*SRYM - FN, WE, BETA*/)
RETURN
END
*DECK YINT
FUNCTION YINTP(XA,X,Y,N)
DIMENSION X(1), Y(1)
1 DU 10 I=1,N
IF (X(I)-XA) 10,10,2
2 IV=I-2
IF (IV) 4,4,6
4 IV=1
GO TO 12
6 NV=N-3
IF (IV-NN) 12,12,8
8 IV=NN
GO TO 12
10 CONTINUE
12 IU=IN+3
YINTP=0.
DU 20 I=IN,IU
PROD=Y(I)
DU 16 J=IN,IU
IF (I-J) 15,16,15
15 PROD=PROD*(XA-X(J))/(X(I)-X(J))
16 CONTINUE
20 YINTP=YINTP+PROD
21 RETURN
END

```

```

C   FUNCTION SIMPUN(X,Y,N)
C   FORTRAN IV FUNCTION FOR SIMPSONS RULE INTEGRATION
C   EQUAL OR UNEQUAL INTERVALS. W. FRANK. DTMB, CODE 584, 7-16-65

      DIMENSION X(50),Y(50)
2   FORMAT(23H NON MONOTONE X SIMPUN           I4,1PE12.4)
      IF(N-2) 7,5,4
5   S=(Y(1)+Y(2))*(X(2)-X(1))/2.
      GO TO 6
7   S=0.
      GO TO 6
4   M=N-1
      S=(X(2)-X(1))/6.*(Y(1)*((X(2)-X(3))/(X(1)-X(3))+2.)+Y(2)*((X(1)-X(
X3))/(X(2)-X(3))+2.)-Y(3)*(X(2)-X(1))*2/((X(1)-X(3))*(X(2)-X(3))))
      LH=2
      IF(N.EQ.3) GO TO 8
      S=S+(X(3)-X(2))/6.*(Y(2)*((X(3)-X(4))/(X(2)-X(4))+2.)+Y(3)*((X(2)-
XX(4))/(X(3)-X(4))+2.)-Y(4)*(X(3)-X(2))*2/((X(2)-X(4))*(X(3)-X(4))
X))
      LH=3
8   DO 1 K=LH,M
      IF(ABS(X(K+1)-X(1)).GE.ABS(X(K)-X(1))) GO TO 1
3   WRITE(6,2) K,X(K)
      GO TO 7
1   S=S+(X(K+1)-X(K))/6.*(Y(K)*((X(K+1)-X(K-1))/(X(K)-X(K-1))+2.)+Y(K+
X1)*((X(K)-X(K-1))/(X(K+1)-X(K-1))+2.)-Y(K-1)*(X(K+1)-X(K))*2/((X(
XK)-X(K-1))*(X(K+1)-X(K-1))))
6   SIMPUN=S
      RETURN
      END

```

```

SUBROUTINE PLOTPR (N, GPM)
C   INSTRUCTIONS FOR PLOTTING PERCENTAGE EXCEEDANCE DIAGRAMS
COMMON /BL1/ SHIPN(6), TFT(8), YT(24), YT2(32), TCLR(16), XTIT(3),
. PCTIT(3), BUFF(1024), XP(325), YP(325), XMIN, XMAX, XINC, XLG,
. YMIN, YINC, ZMIN, ZINC, ISYM, TWS(3), V, L, CLR, BPL, DISPL, M
COMMON /BL3/ GP(36), GP2(36), YPE(36,2), ZPE(36)
CALL PLOT (10.5, 0.0, -3)
CALL AXIS (0.0, 0.0, PCTIT, 21, 5.0, 90.0, 0.0, 20.0)
1 YY1 = 8.6
  YY2 = 8.2
  CALL SYMBOL (0.2, YY1, 0.12, SHIPN, 0.0, 60)
  CALL SYMBOL (1.0, YY2, 0.12, 3HL =, 0.0, 3)
  CALL NUMBER (1.4, YY2, 0.12, BPL, 0.0, 1)
  CALL SYMBOL (2.05, YY2, 0.12, 2HFT, 0.0, 2)
  CALL SYMBOL (3.0, YY2, 0.12, 3HV =, 0.0, 3)
  CALL NUMBER (3.4, YY2, 0.12, V, 0.0, 1)
  CALL SYMBOL (3.95, YY2, 0.12, 5HKNOTS, 0.0, 5)
84 CALL SYMBOL (1.0, 7.4, 0.10, TWS, 0.0, 30)
  IF (N.EQ.1) GO TO 10
  IF (M.EQ.7) GO TO 10
  MM = M * 2 - 1
  CALL SYMBOL (5.0, YY2, 0.12, TCLR(MM), 0.0, 20)
  CALL SYMBOL (7.4, YY2, 0.12, 1H=, 0.0, 1)
  CALL NUMBER (7.6, YY2, 0.12, CLR, 0.0, 1)
  CALL SYMBOL (8.2, YY2, 0.12, 2HFT, 0.0, 2)
10 IF (N.EQ.2) GO TO 12
  LL=L*3-2
  CYCLE = 1.0 / 3.75
  CALL LBAXS (0.0, 0.0, YT(LL), -30, 7.5, 0.0, GPM, CYCLE)
  NB = 7
  NP = 29
  GO TO 15
12 MM = M * 4 - 3
  CYCLE = 0.5
  CALL LBAXS (0.0, 0.0, YT2(MM), -40, 6.0, 0.0, GPM, CYCLE)
  NB = 1
  NP = 35
15 CONTINUE
  XP(NP+1) = GPM
  XP(NP+2) = CYCLE
  YP(NP+1) = 0.0
  YP(NP+2) = 20.0
  DO 18 I=1,NP
  II = NB - 1 + I
  IF (N.EQ.2) GO TO 17
  XP(I)=GP(II)
  GO TO 18
17 XP(I) = GP2(II)
18 CONTINUE
  DO 25 I=1,NP
  II = NB - 1 + I
  IF (N.EQ.2) GO TO 22
  YP(I)=YPE(II,1)
  GO TO 25

```

```
22 YP(I) = ZPE(II)
25 CONTINUE
   CALL LGLIN (XP, YP, NP, 1, 0, ISYM, -1)
   IF (N .GT. 1) GO TO 30
   DO 28 I=1, NP
     II = NB-1 + I
28  YP(I) = YPE(II, 2)
   CALL LGLIN (XP, YP, NP, 1, 0, ISYM, -1)
30  CONTINUE
   RETURN
   END
```

```

SUBROUTINE PLOTRS (N, J)
C   INSTRUCTIONS FOR PLOTTING RESPONSE AMPLITUDES VS. SIGN.WAVE HT.
COMMON /BL1/ SHIPN(6), TFT(8), YT(24), YT2(32), TCLR(16), XTIT(3),
. PCTIT(3), BUFF(1024), XP(325), YP(325), XMIN, XMAX, XINC, XLG,
. YMIN, YINC, ZMIN, ZINC, ISYM, TWS(3), V, L, CLR, BPL, DISPL, M
COMMON /BL2/ SWH(323), RA(323,3), R2(323), NK,
. SWHPM(51), RAPM(51,3), R2PM(51)
DIMENSION ST1(2), ST2(3), ST3(4)
DATA ST1 / 10MSIGNIFICAN, 10HT VALUES /
DATA ST2 / 10HMOST PROBA, 10HBL E EXTREM, 10HE VALUES /
DATA ST3 / 10HEXTREME VA, 10HLUES FOR D, 10HESIGN CONS,
. 10HIDERATION /
CALL PLOT (10.5, 0.0, -3)
IF (N.EQ.2) GO TO 12
IF (YINC.GT.0.) YPMAX=10.*YINC
GO TO 14
12 IF (ZINC .GT. 0.0) YPMAX = 10.0 * ZINC
14 NP = 0
DO 35 K=1,NK
IF (SWH(K) .GT. XMAX) GO TO 35
IF (N.EQ.2) GO TO 22
IF (RA(K,J).GT.YPMAX .AND. YINC.GT.0.) GO TO 35
GO TO 24
22 IF (R2(K) .GT. YPMAX .AND. ZINC .GT. 0.0) GO TO 35
24 NP = NP + 1
XP(NP) = SWH(K)
IF (N.EQ.2) GO TO 32
YP(NP)=RA(K,J)
GO TO 35
32 YP(NP) = R2(K)
35 CONTINUE
NP1 = NP + 1
NP2 = NP + 2
XP(NP1) = XMIN
XP(NP2) = XINC
IF (N.EQ.2) GO TO 42
IF (YINC.LE.0.) GO TO 44
YP(NP1) = YMIN
YP(NP2) = YINC
GO TO 45
42 IF (ZINC .LE. 0.0) GO TO 44
YP(NP1) = ZMIN
YP(NP2) = ZINC
GO TO 45
44 CALL SCALE (YP, 8.0, NP, 1)
45 CALL AXIS (0.0, 0.0, XTIT, -30, XLG, 0.0, XMIN, XINC)
IF (N.EQ.2) GO TO 52
LL=L*3-2
CALL AXIS (0.0, 0.0, YT(LL),30, 8.0, 90.0, YP(NP1), YP(NP2))
GO TO 54
52 MM = M * 4 - 3
CALL AXIS (0.0, 0.0, YT2(MM), 40, 8.0, 90.0, YP(NP1), YP(NP2))
54 CALL SYMBOL (0.5, 9.2, 0.12, SHIPN, 0.0, 60)

```

```

CALL SYMBOL (1.0, 8.6, 0.12, 3HL =, 0.0, 3)
CALL NUMBER (1.4, 8.6, 0.12, BPL, 0.0, 1)
CALL SYMBOL (2.05, 8.6, 0.12, 2HFT, 0.0, 2)
CALL SYMBOL (3.0, 8.6, 0.12, 3HV =, 0.0, 3)
CALL NUMBER (3.4, 8.6, 0.12, V, 0.0, 1)
CALL SYMBOL (3.95, 8.6, 0.12, 5HKNOTS, 0.0, 5)
CALL SYMBOL (1.0, 7.6, 0.10, TWS, 0.0, 30)
IF (N.EQ.2) GO TO 58
GO TO (91,92,93),J
91 CALL SYMBOL (1.0, 8.0, 0.10, ST1, 0.0, 20)
GO TO 94
92 CALL SYMBOL (1.0, 8.0, 0.10, ST2, 0.0, 30)
GO TO 94
93 CALL SYMBOL (1.0, 8.0, 0.10, ST3, 0.0, 40)
94 GO TO 60
58 IF (M .EQ. 7) GO TO 60
MM = M * 2 - 1
CALL SYMBOL (5.0, 8.6, 0.12, TCLR(MM), 0.0, 20)
CALL SYMBOL (7.4, 8.6, 0.12, 1H=, 0.0, 1)
CALL NUMBER (7.6, 8.6, 0.12, CLR, 0.0, 1)
CALL SYMBOL (8.2, 8.6, 0.12, 2HFT, 0.0, 2)
60 CALL LINE (XP, YP, NP, 1, -1, ISYM)
YPMAX = 10.0 * YP(NP2)
NP = 0
DO 75 K=1,46
  IF (SWHPM(K) .GT. XMAX) GO TO 75
  IF (N.EQ.2) GO TO 62
  IF (RAPM(K,J).GT.YPMAX) GO TO 75
  GO TO 64
62 IF (R2PM(K) .GT. YPMAX) GO TO 75
64 NP = NP + 1
XP(NP) = SWHPM(K)
IF (N.EQ.2) GO TO 72
YP(NP)=RAPM(K,J)
GO TO 75
72 YP(NP) = R2PM(K)
75 CONTINUE
XP(NP+1) = XP(NP1)
XP(NP+2) = XP(NP2)
YP(NP+1) = YP(NP1)
YP(NP+2) = YP(NP2)
CALL LINE (XP, YP, NP, 1, 0, 3)
RETURN
END

```

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