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REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM ANALYSIS TECHNIQUES

VOLUME II -- SOFTWARE SURVEY

F. Rajabi and S. Ghosh
Brown & Root Development, Inc.

D. R. Shields
Naval Civil Engineering Laboratory

Prepared for:

Naval Civil Engineering Laboratory
Ocean Structures Division
Port Hueneme, California 93043

and

Minerals Management Service
Technology Assessment and Research Branch
Reston, Virginia 22091

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RESPONSE NUMBER	ORGANIZATION	MORISON APPROACH		DIFFRACTION APPROACH	
		FREQ.	TIME	FREQ.	TIME
1	TECNOMARE S.P.A. Venice, Italy	XX			
2	PMB SYSTEMS ENGINEERING San Francisco, CA, USA		XX		
3	J. R. PAULLING, INC. Point Richmond, CA, USA (These programs also represent similar capabilities resident at the AMERICAN BUREAU OF SHIPPING and SANTA FE ENGINEERING SERVICES)	XX	XX	XX (See Sec. 50 Vol II)	
4	SCIENCE APPLICATIONS Annapolis, MD, USA			XX	XX
5	VERITAS TECHNICAL SERVICES, INC Houston, TX, USA	XX	XX	XX	XX
6	ATKINS RESEARCH AND DEVELOPMENT (W. S. ATKINS, Inc) Epsom Surrey, England	XX	XX	XX	XX
7	LONDON CENTRE FOR MARINE TECHNOLOGY London, England	XX	XX	XX	
8	NMI, Ltd. Feltham, Middlesex, England			XX	XX
9	ULTRAMARINE ENGINEERING Houston, TX, USA	XX	XX	XX	XX
10	BATTELLE PETROLEUM TECHNOLOGY CENTER Houston, TX, USA	NA	NA Riser Analysis	NA	NA
11	VO OFFSHORE LIMITED London, England	XX	XX		
12	NETHERLAND SHIP MODEL BASIN Wageningen, The Netherlands			XX	XX

RESPONSE NUMBER	ORGANIZATION	MORISON APPROACH		DIFFRACTION APPROACH	
		FREQ.	TIME	FREQ.	TIME
13	SHELL DEVELOPMENT COMPANY Houston, TX, USA	XX	XX		
14	JOHN HALKYARD San Diego, CA, USA				XX
15	BROWN & ROOT, INC. Houston, TX, USA			XX	XX
16	ROBERT T. HUDSPETH Corvallis, OR, USA	XX		XX	
A	MCDONNELL DOUGLAS AUTOMATION COMPANY Saint Louis, MS, USA	XX	XX		
B	C. J. GARRISON Pebble Beach, CA, USA			XX	XX
C	JAMES R. MORGAN, TEXAS A & M UNIVERSITY College Station, TX, USA		XX		

The following organizations provided responses which were inadequate to facilitate preparation of matrices. They also failed to fill in the matrices when the opportunity was provided. The non-responsiveness of these organizations is interpreted to be primarily out of concern for the proprietary nature of their programs. The capabilities indicated have been developed from limited information which was supplied.

RESPONSE NUMBER	ORGANIZATION	MORISON APPROACH		DIFFRACTION APPROACH	
		FREQ.	TIME	FREQ.	TIME
	DANISH HYDRAULIC INSTITUTE Horsholm, Denmark			??	??
	EARL AND WRIGHT San Francisco, CA, USA	XX	XX	XX	
	RICHARD J. HARTMAN Escondido, CA, USA			XX	
	LLOYD'S REGISTER OF SHIPPING London, England		??	??	
	MCDERMOTT MARINE CONSTRUCTION New Orleans, LA, USA		XX		
	NORWEGIAN HYDRODYNAMIC LABORATORIES Trondheim, Norway			XX	XX
	STEVENS INSTITUTE OF TECHNOLOGY Hoboken, NJ, USA			XX	
	BRIAN WATT ASSOCIATES Houston, TX, USA	XX	XX		
	SWAN WOOSTER Vancouver, B.C., Canada			??	
	YARD CONSULTING ENGINEERS Glasgow, Scotland		XX	XX	
	FLOUR SUBSEA SERVICES Irvine, CA, USA	XX	XX		

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1.0 INTRODUCTION

In the last decade, software has been developed by various organizations to carry out analyses related to semisubmersibles and tension leg platforms. These analyses, in particular, are to determine or estimate current, wind and wave forces, platform stability and motion responses, mooring system requirements, structural strength, and fatigue life. The capabilities of various software suites are widely ranged and it is not easy to choose the most appropriate suite for a particular application. To alleviate the problem, this volume of work is organized to compile the capabilities of various software in the market place.

2.0 SOFTWARE CAPABILITIES SURVEY

2.1 Objective of the Survey

The objective of the survey on software for motion and structural analysis of tension leg platforms and semisubmersibles was to collect and compile worldwide information on those analytical tools which are

- o commercially available for sale or lease,
- o available through computer bureaus,
- o available to an engineering contractor whose services may be retained for a design.

This data was to be represented in an easy to understand and unified basis. No attempt was made to evaluate or compare one software against another since this was beyond the scope of this project.

2.2 Methodology and Organizations Contacted

Various organizations all over the world known to have software capabilities related to design and analysis of semisubmersibles and tension leg platforms were contacted and were requested to supply:

- general information on their software,
- theoretical manual or theoretical background,
- user's manual,
- availability (purchase, computer bureau, etc.),
- software validation status.

The organizations contacted cover a wide spectrum of activities, including research centers, academic institutions, engineering consultants, and contractors. A list of various organizations with their addresses and the name of the person contacted is given in Table 2.1. As can be seen in the table, these organizations are representative of eight countries, namely the USA, UK, Japan, the Netherlands, Denmark, France, and Italy.

The response received from various organizations to the first request for information varied significantly. It ranged from material which included research theses, user's manuals, published papers, sales brochures, etc. to a mere letter or telex. Some of the organizations did not even respond.

Since standard universally accepted definitions are not in use for most of the parameters included in the motion and structural analysis of semisubmersibles and tension leg platforms and because some of the information received was not complete, it was difficult to compile and represent this data in a meaningful and easy to understand manner. At this point it was decided to prepare a questionnaire to request uniform information from various organizations. Details of the questionnaire survey are presented in the following sections.

2.3 Questionnaire for Survey

As mentioned earlier, due to lack of uniformity of the responses from various organizations, it was very difficult to represent their capabilities in a meaningful way. To avoid reflecting the capabilities of some software suites erroneously, it was decided to prepare a questionnaire which would generate a common base for the survey.

The wave force calculation, which is one of the most important capabilities is customarily carried out basically by two well known methods, Morison's equation and the diffraction theory. The questionnaire is divided into two classifications, one based on Morison's Equation and the other based on diffraction theory or combination of diffraction theory, strip theory and Morison's Equation. Furthermore, since the analysis can be carried out in either frequency domain or time domain; to reflect this aspect, the questionnaire was further subgrouped to include these objectives. Four sets of stand alone questionnaires were developed and are designated below:

TABLE I	Questionnaire for Frequency Domain Software Capabilities (based on Morison's Equation)
TABLE II	Questionnaire for Frequency Domain Software Capabilities (based on Diffraction Theory or combination of Diffraction Theory, Strip Theory and Morison's Equation)
TABLE III	Questionnaire for Time Domain Software Capabilities (based on Morison's Equation)
TABLE IV	Questionnaire for Time Domain Software Capabilities (based on Diffraction Theory or combination of Diffraction Theory, Strip Theory and Morison's Equation)

A sample blank questionnaire is included in this report for reference. Also a definition of some of the terms included in the questionnaire was sent to the participants to facilitate understanding of the questions. This addendum to the questionnaire is also included in this report.

2.3.1 Elements of the Questionnaire

The sets of questionnaires were developed with the following considerations:

1. Environmental Forces
2. Equations of Motion (for Motion Response Calculation)
3. Environmental Description
4. Solution Techniques
5. Output
6. Mooring System Analysis
7. Stability (for floating platform) Analysis
8. Structural Analysis
9. Riser Analysis
10. Software Verifications
11. Hardware System
12. Programming Language
13. Documentation
14. Support, Maintenance and Training
15. Accessibility and Business Terms

Items 1 and 3 indicated the capabilities in the following areas:

- current profile and current force
- wind profile, wind spectra, and wind (static and dynamic) force
- wave statistics, theories, and sea spectra
- first and second order wave forces
- effect of orientation, geometries, and interaction with the wave forces

Item 2 demonstrated the capabilities related to calculation of added mass, damping coefficient, and stiffness in both frequency domain and time domain analysis. Item 4 summarized information related to rigid bodies degrees of freedom, coupled degrees of freedom, method of linearization, method of integration (Houbolt, Wilson-â, Newmark-β,..), method of handling transient, and type of matrix solver. A software suite should always have the important calculations printed out in an easy-to-read format. Thus in this work, output (Item 5) was considered to be an important element related to software capability. This element should be considered for each independent analysis. In the prepared questionnaire, the element of "output" appeared only for motion response and mooring analysis; it is being left out for structural analysis since most of the structural packages have a similar and standard output.

Mooring system analysis (Item 6) capabilities cover the assumptions and considerations of hydrodynamic and structural modelling for specific mooring patterns. The questions related to stability analysis (Item 7) are meant for floating and tethered platforms. These questions will indicate whether the software suite can analyze intact and damaged stability of the platform. Structural analysis (Item 8) includes the capabilities related to loading and analysis. The structural analysis suite usually performs both the space frame analysis and the finite element method. The other capabilities may include spectral analysis, modal analysis, and fatigue life analysis. The questions related to riser analysis (Item 9) include hydrodynamic and structural modelling.

It is desirable to use a computer suite which is verified. The verification may be done by model testing, full scale testing, checking against other established computer programs, comparing against technical literature, hand calculations, etc. Thus it was decided to include questions related to software verifications (Item 10) at the end of questions related to motion response, mooring, and riser analyses. The hardware system (Item 11) compatible to a particular software may govern the selection of the software suite for a specific task. The same thing can be said about the programming language. It is a fact that it is very hard to use a computer program without proper documentation. To use a new software package, a training process always helps the user to apply it effectively and efficiently. Also during the period of use, users often encounter bugs and need help. Furthermore, a software package should always be updated to be in line with development of the state-of-the-art, to make it more user friendly, and to meet the changing requirements of users. During development of the sets of questionnaire, due attention was given to include questions related to hardware system (Item 11), programming language (Item 12), documentation (Item 13), support, maintenance, and training (Item 14).

Finally, persons who are in charge of making purchasing or leasing decisions with respect to a particular software package should be familiar with the price and accessibility of the package. To accomplish this, Item 14, "Accessibility and Business Terms" was also included at the end of each set of questionnaires.

2.4 Organizations Selected for Questionnaire Survey

Based on the responses to the first request for information, it was felt that some of the organizations either do not have the software capabilities or do not desire to participate in the survey. Organizations such as Doris (France), and Mitsubishi (Japan) belong to the group who may not have the capabilities. Global Marine, McDermott, and Santa Fe did not seem eager to respond. The letter from Prof. C.H. Kim of Stevens Institute of Technology indicated that they have bits and pieces of software capabilities to determine the motion response of semisubmersibles, but they cannot be readily used. Lloyds and Yard of UK make their capabilities available only on a consulting basis. Texas A&M, Massachusetts Institute of Technology (MIT), Frank Chou and Associates (FCA), and Swan Wooster Engineers (SWE) did not respond at all.

All of the above organizations except for the last three, MIT, FCA and SWE were not selected for the second questionnaire survey and accordingly the questionnaire was not sent to them.

TABLE 2.1
Name and Addresses of the Organizations Contacted

AMERICAN BUREAU OF SHIPPING
Sixty-five Broadway
New York, N.Y. 10006
Attn: Mr. Donald Liu

ATTKINS RESEARCH AND DEVELOPMENT
Woodcote Grove Ashley Road
Epsom Surrey KT18 5BW England
Attn: Mr. Izatt

BATTELLE PETROLEUM TECHNOLOGY CENTER
1100 Rankin Road
Houston, Texas 77073
Attn: Dr. Olson

BROWN & ROOT, INC.
Marine Division
P.O. Box 4302
Houston, Texas 77210
Attn: Dr. A. Mangiavacchi

FRANK CHOU & ASSOCIATES
2825 Wilcrest Drive #172
Houston, Texas 77084
Attn: Dr. F.C. Chou

PROF. C. CHRYSSOSTOMIDIS
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, Maryland 02139
Attn: Prof. C. Chryssostomidis

PROF. JIN S. CHUNG
Colorado School of Mines
Golden, Colorado 80401
Attn: Prof. Jin S. Chung

DANISH HYDRAULIC INSTITUTE
Agern Alle' 5
DK-2970 Horsholm
Copenhagen Denmark
Attn: Dr. Lundgren

DEPARTMENT OF CIVIL AND OCEAN ENGINEERING
Stevens Institute of Technology
Castle Point
Hoboken, New Jersey 07030
Attn: Prof. C.H. Kim

DORIS
France

EARL AND WRIGHT
One Market Plaza
Spear Street Tower
San Fransisco, California 94103
Attn: Dr. Bennett

FLUOR SUBSEA SERVICES, INC.
3333 Michelson Drive
Irvine, California 92730
Attn: Mr. J. Lien

FRIEDE AND GOLDMAN, LTD.
935 Gravier Street
Suite 2100
New Orleans, Louisiana 70112

C.J. GARRISON & ASSOCIATES
3088 Hacienda Drive
Pebble Beach, California 93953
Attn: Dr. C. J. Garrison

GLOBAL MARINE DEVELOPMENT, INC.
P.O. Box 3010
Newport Beach, California 92663
Attn: Dr. N. Daoud

JOHN HALKYARD
Ocean Engineering Consultant
2949 Epaulette
San Diago, California 92123
Attn: Mr. J. Halkyard

MR. RICHARD J. HARTMAN
Ocean Engineering
530 North Midway Drive
Escondido, California 92027
Attn: Mr. R. J. Hartman

PROF. ROBERT T. HUDSPETH
Oregon State University
Department of Civil Engineering
Corvallis, Oregon 97331-2302
Attn: Prof. Robert T. Hudspeth

LLOYD's REGISTER OF SHIPPING
71 Fenchurch Street
London, EC3M 4B5
Attn: Mr. S.H. Atkinson

LOCKHEED OFFSHORE SYSTEMS
AND SERVICES
1214 Oakmead Parkway
Sunnyvale, California 94086
Attn: Mr. Nikkel

LONDON CENTRE FOR MARINE TECHNOLOGY
Imperial College of Science and
Technology
Department of Civil Engineering
Imperial College Road
London SW7 2BU
England
Attn: Dr. M. Patel

McDERMOTT MARINE CONSTRUCTION
Research and Development
1010 Cannon Street
P.O. Box 60035
New Orleans, Louisiana 70160
Attn: Mr. L.A. Boston

McDONNEL DOUGLAS AUTOMATION COMPANY
Box 516
Saint Louis, Missouri 63166
Attn: Mr. Kappus

MITSUBISHI HEAVY INDUSTRIES AMERICA, INC.
2 Houston Center, Suite 3800
Houston, Texas 77010-1072
Attn: Mr. S. Sasago

NETHERLANDS SHIP MODEL BASIN
Wageningen Laboratories: 2, Haagsteeg
P.O. Box 28, 6700 AA
Wageningen, Netherlands
Attn: Mr. Ir Tan Seng Gie

NMI LTD
Hydrodynamics Division
Feltham, Middlesex TW140LQ
England
Attn: Mr. Bowden

NORWEGIAN HYDRODYNAMIC LABORATORY
Hakon Hakonsons gt 34
N-7001 Trondheim Norway
Attn: Prof. Torum

J. RANDOLPH PAULLING, INC.
P. O. Box 278
Point Richmond, California 94807
Attn: Dr. J. R. Paulling

PMB SYSTEMS ENGINEERING INC.
500 Sansome Street, Suite 400
San Fransisco, California 94111
Attn: Dr. Litton

SANTA FE ENGINEERING SERVICES
505 South Main Street
P.O. Box 1401
Orange, California 92668
Attn: Dr. Bob Chou

TABLE 2.1 (Continued)

SCIENCE APPLICATIONS, INC.
134 Holiday Court
Suite 318
Annapolis, Maryland 21401
Attn: Dr. Salvesen

SHELL DEVELOPMENT COMPANY
Bellaire Research Center
P.O. Box 481
Houston, Texas 77001
Attn: Mr. Boye

SWAN WOOSTER ENGINEERING
1525 Rodson
British Columbia, Canada U6G-ICS

TECNOMARE S.P.A.
2091 San Marco
30124 Venice Italy
Attn: Dr. Di Tella

TEXAS A&M UNIVERSITY
Department of Civil Engineering
College Station, Texas 77843
Attn: Prof. James R. Morgan

ULTRAMARINE ENGINEERING
4657 Briarpark
Suite 105
Houston, Texas 77042
Attn: Mr. Nachlinger

VERITAS TECHNICAL SERVICES
1325 South Dairy Ashford
Suite 300
Houston, Texas 77077
Attn: Mr. R. Borresen

VO OFFSHORE LIMITED
197 Knightsbridge
London SW 1RB England
Attn: Mr. Perrett

BRIAN WATT ASSOCIATES, INC.
2350 E. North Belt Drive
Suite 450
Houston, Texas 77032
Attn: Mr. Ay

YARD LTD.
Charing Cross Tower
Glasgow, G24PP
Scotland, U.K.
Attn: Mr. C. Edmonds

2.5 Response From Organizations

Fifteen (16) out of the thirty-one (31) organizations who received the questionnaire replied in time to be included in compiled form in this report. Except for Danish Hydraulic Institute, every one of them filled in the questionnaire. Danish Hydraulic Institute found that the questionnaire format was not relevant for describing their software capabilities. The reason being that their programs were developed for more general use and exist as individual modules. These modules are often pieced together into a package for analyzing specific problems.

Most of the organizations have the capabilities of using both Morison's equation and diffraction theory to calculate the wave forces. Only three organizations, Battelle, Vicker's Offshore, and P.M.B. Systems Engineering, Inc. have capabilities limited to using Morison's equation. National Maritime Institute (NMI) of UK, Netherlands Ship Model Basin (NSMB), and Brown & Root, Inc. have their present capability restricted to use of diffraction theory. Science Applications, Inc. uses a hybrid finite element method (HFEM) in their package. The remaining organizations, Tecnomare, J.R. Paulling, Inc., Det norske Veritas, W.S. Atkins, University College of London, and Ultramarine and R. T. Hudspeth of Oregon State University have capabilities to use Morison's equation and/or diffraction theory.

3.0 SOFTWARE PACKAGES CAPABILITIES

Software packages of the participants in the survey perform various tasks to analyze semisubmersibles and tension leg platforms. These tasks are broadly classified as a) Wind and Current Forces, b) Wave Forces and Motion Responses, c) Mooring Analysis, d) Riser Analysis, and e) Structural Analysis. Various computer programs are grouped according to these tasks and are summarized in Table 3-1.

3.1 Software Packages of Respondents

The software packages of sixteen respondents are purposely identifed only by numerical numbers (1-16) and are briefly reviewed in the following sections.

3.1.1 Synopsis of Response No. 1

This organization has software capabilities based on both Morison's equation and diffraction theory. The Morison's formulation includes relative velocity and current. The diffraction theory is based on 3-D source-sink distribution and as such interaction effects among members are taken into consideration. Second order forces and responses are taken into account in diffraction formulation only.

The program package includes both time and frequency domain capabilities. The linearization of Morison's equation is based on an energy balance in one cycle of oscillation (Krylov and Bugoliov).

The software package includes also mooring, riser, and structural analysis capabilities. Some of the modules in the package have been verified against experimental data (1/55 scale).

The software suite is available based on lease/consultancy basis.

3.1.2 Synopsis of Response No. 2

The capability of this respondent is limited to time domain analysis and their software suite is called INTRA-WACS 2. It uses Morison's equation which has the relative velocity of structure, current and wave particles in the drag term. The calculation of drift force in this suite however, does not account for low frequency second order waves. For the time domain solution, it uses the Newmark-β technique for integration. It can analyze spread catenary mooring, catenary mooring with lumped weight and vertical taut mooring and has the capability of taking into account the mass of the mooring system in the structural model. The riser system can be modelled as a mooring system for analysis. In their suite, the structural analysis package includes the capability of space frame analysis and also finite element analysis. The library of finite elements include beam, plate, truss, strut, cable, and soil element. This suite is well documented, provides support and training, and is compatible to IBM, CDC and CRAY system. It is available for purchase at a price of 55,000.00 dollars.

3.1.3 Synopsis of Response No. 3

The suite offered by this respondent has the capability of using both Morison's equation and diffraction theory and is comprised of computer programs EUREKA, CATMO, HYDRO3, SPLASHD, TDSIM6, STRAN, and MLTPIP.

In the wave force calculation, the form of Morison's equation with relative velocity of structure, current, and wave particle is used in the analysis. For the suite with the Morison's formulation, the second order wave forces are not accounted for. This suite uses Runge Kutta fourth order techniques for integration in the time domain solution and the transient is handled by a cosine ramp function. Mooring pattern of spread catenary, vertical taut, and slanted taut can be analyzed with this suite. The riser analysis capability is limited only to frequency domain. The structural analysis capability includes space frame analysis and finite element analysis. The finite elements available in this package are beam, plate, and stiffened plate.

This suite of program is well documented, supported, and is compatible with IBM, CDC, Prime, and VAX. Some of the programs are also suited for micro computer with CP/M system. It is available for lease, purchase, and on a consulting basis.

3.1.4 Synopsis of Response No. 4

The respondent has software capabilities which are limited to perform motion response calculations in time domain and mooring analysis. Their computer program suite does not have the capabilities of performing a) stability analysis of semisubmersibles and tension leg platforms, b) riser analysis, and c) structural analysis.

The motion response suite is based on a hybrid finite element method. It takes into account the second order wave forces and the various spectral formulations that are built in the program. This program was compared with model tests and other published material. The mooring analysis package is capable of analyzing either a spread catenary mooring or vertical taut mooring with mass of the mooring duly taken into account in the mooring model. This program was verified by model test and by comparison with results obtained by other softwares. This suite, as such, does not have any special package for riser analysis.

This computer program suite is well documented, supported, and a training program to get acquainted with the package is available. It can be used in the IBM, CDC and VAX hardware system and is available for lease, purchase, and on a consulting basis.

3.1.5 Synopsis of Response No. 5

This particular respondent has the capability of using both Morison's equation and diffraction theory and the suite of program is comprised of SESTRA, WAMLOS, and POSTFRAME. The suite SESAM80 is used for frequency domain analysis. FENRIS and WAJFAC along with WAMLOS perform the time domain analysis for motion response. The program NV223 performs the stability analysis of semisubmersibles and tension leg platforms. It uses Morison's equation with relative velocity of structure and wave particles; while the diffraction theory capability is based on 3D theory due to Faltinsen and Michelsen. It does not take into account the low frequency second order wave forces. The programs to perform motion response analysis in frequency domain were verified by model tests, other software, and published technical literature.

According to the responses received from this particular organization, this suite does not have the capability to perform either mooring analysis or riser analysis.

SESAM80 is capable of performing space frame analysis and finite element analysis. Its library of finite elements include beam, shell, plate, cable, truss, bar, solid, and axisym.

All of the software are well documented, maintained, supported, and training program for the users can be arranged. The frequency domain programs can be used in IBM, VAX and UNIVAC system; while the time domain programs can presently be used only in VAX and UNIVAC.

3.1.6 Synopsis of Response No. 6

The software suite of this respondent is known as AQWA suite. It is capable of performing a) motion response calculation, b) mooring analysis, c) riser analysis, d) stability analysis, and e) structural analysis. The response from this participant indicates that they do not have the capability of using Morison's equation at present to calculate wave forces; but this capability is being developed right now and will be available in 1984-85. This particular program, when developed, will use the Morison's equation formulation with relative velocity of structure, current, and wave particles. The code based on diffraction theory uses a three-dimensional source-sink distribution method. It does not take into account the second order low frequency waves and uses a two stage predictor-corrector technique for integration in the time domain solution . It is verified against model test with a scale of 1:40, compared with other software, and published results in technical literature.

The mooring analysis capability includes modelling of spread catenary lines, catenary with lumped weight, vertical taut line, and hawser system. This module for mooring analysis was also verified against model tests with a scale of 1:40 and 1:200, compared with other software, and results published in technical literatures. AQWA-suites do possess the capability of analyzing risers in frequency domain.

The respondent is in the process of developing a structural analysis package which will be able to perform space frame analysis and finite element analysis. This package is expected to be available some time in 1985.

The user's guide for all the programs are already developed and some theoretical manuals are available. All the programs are supported, maintained and training programs for users is available. These software can be used in IBM, CDC, prime computer, VAX, and ICL system. Some of the programs can also be used in the IBM personal computer. This suite of programs is available for lease, purchase, and on consulting basis.

3.1.7 Synopsis of Response No. 7

The capabilities of this suite are limited to motion response calculation, mooring analysis, riser analysis, and stability analysis. It does not have any structural analysis package. This suite can use either Morison's equation or diffraction theory for first order wave force calculation. The questionnaire for time domain capability based on diffraction theory was not returned by the respondent and it is assumed here that such capability does not exist in their software package. The form of Morison's equation with relative velocity of structure and current is being used in the package. Presently, this suite is not capable of taking into account the second order low frequency wave forces. This capability is in the process of being developed and is expected to be operational by July 1984. This motion response analyisis package has been verified by model test of scale 1:32, 1:64, 1:78, and 1:100, compared with other software, and published data in the technical literature.

The mooring analysis package is capable of modelling spread catenary lines and vertical taut lines with their mass being taken into account. This suite also possess riser analysis capability in frequency domain as well as in time domain.

This suite of programs are well documented with a user's guide and some theoretical manuals. These programs can be used in IBM, CDC, prime computer, VAX, PDP11, and GEC 4190 and are available for lease, purchase, and on consulting basis.

3.1.8 Synopsis of Response No. 8

The suite described by this respondent consists of NMISPM and NMIWAVE and their capability is restricted to only motion response calculation and mooring analysis. The wave force calculations are based on a three dimensional source-sink distribution method and it takes into account low frequency second order wave forces. The mooring analysis program can model spread catenary mooring and vertical taut mooring lines and is capable of accounting for the mass of the mooring line. Both the packages for motion response analysis and mooring analysis were verified by model tests with a scale of 1:50, compared with other software, and published material.

The frequency domain analysis package is well documented with user's guides and theoretical manuals the documentation for the time domain analysis package is still lacking. This suite is well supported, maintained, and training programs are scheduled for new users. The packages of programs can be used in IBM, SEL (GOULD) and UNIVAC) system and are accessible through the SIA bureau. It is available for lease, purchase, and on consulting basis.

3.1.9 Synopsis of Response No. 9

This suite of program performs a) motion response calculation, b) mooring analysis, c) riser analysis, and d) stability analysis. This suite is known as OSCAR and does not have structural analysis capabilities on its own. It is capable of applying Morison's equation as well as diffraction theory to calculate the wave forces. The code for Morison's equation uses a form with relative velocity of structure and current; while the diffraction theory capability is based on two-dimensional strip theory and three-dimensional diffraction theory. It takes into account low frequency second order wave forces. The mooring analysis package is capable of modelling spread catenary mooring, catenary mooring with lumped weight, vertical taut mooring, and combination taut-buoy-catenary lines. Both the motion response and mooring analyses packages are verified by model test data, other software results, and published material. This suite has riser analysis capability in both frequency and time domain.

The programs belonging to the suite OSCAR are all well documented with user's guides, the theoretical manuals being proprietory. The pripprietor of this suite maintains, supports, and provides a training program to the new users. OSCAR can be used in IBM, CDC, prime computer, VAX, UNIVAC, and Data General system and are available for lease, purchase and/or consulting basis.

3.1.10 Synopsis of Response No. 10

This suite consists of DWVSL and DWRSR. It is a very simple program and was not developed to be a vessel design program. It was only intended to generate reasonable RAOs (Response Amplitude Operators) for semisubmersibles and tension leg platforms. Their capability is limited to motion response calculation, mooring, and riser analysis in frequency domain. It is verified by model test results of scale 1:64 for tension leg platforms and was also compared with other software. It can model a spread catenary line and a vertical taut mooring line.

All the programs are supported, maintained, and training can be arranged for new users. User's guide for each program can be obtained, but theoretical manuals are not available. These programs can be used in IBM, CDC, and VAX system. It can be purchased and the respondant offers consultancy service.

3.1.11 Synopsis of Response No. 11

This suite is comprised of VODAS, VODYN, VORIS, VOCAS, VOPROC, VOFRAME, VOHYDR, VORAN, VOSPEC, MAP, CABDYN, RANTIM, and LASS. It is capable of performing a) motion response calculation, b) mooring analysis, c) riser analysis, d) stability analysis, and e) structural analysis. In the motion response calculation, it is capable of using the form of Morison's equation with relative velocity of structure, current, and wave particles. It does not take into account the low frequency second order wave forces. This program is verified by 1:64 scaled model test data. The mooring analysis package can model spread catenary mooring, catenary with lumped weight, and vertical taut mooring line. It can also analyze a riser both in frequency and time domain. The mooring and riser analysis packages were checked against other software.

The structural analysis package is capable of performing space frame analysis and finite element analysis. The finite elements available in this package are beam, plate, shell, and stiffened plate. It also possesses a sub-structuring capability.

The programs belonging to this suite lack documentation, but are supported and maintained. Training programs are arranged for new users of this suite. This suite can be used in IBM, CDC, HP, and Apple systems and are available for lease and on consultancy basis.

3.1.12 Synopsis of Response No. 12

This organization has software capabilities based on diffraction theory both in time and frequency domain. Program DFFRAC is used to evaluate first order wave loads and motions in regular waves. The program is based on a three-dimensional source distribution technique to solve the linearized velocity potential problem.

The mean and low frequency second order wave excited forces and moments are evaulated by programs DBDRIFT and DRIFTP based on the results generated by the DIFFRAC program. Adaptions to the DRIFTP allow the calculation of high frequency second order wave excited forces/ moments as well.

Programs IMPRES1 and IMPRES2 are used to compute time domain records of first and second order wave loads for an arbitrary wave train. The time domain simulation for computation of a structure's instantaneous motions and mooring forces due to irregular wave and other environmental loads such as wind and current forces is performed by program MOORSIM. The output of this program consists of time series of forces, platform motions, and mooring forces, including effects due to mean and slowly varying wave drift forces.

The program package is used exclusively by the organization. However, upon request, a lump sum quotation for calculation of a certain design will be provided.

The programs DIFFRAC, DBDRIFT, and IMPRES1 will become available to the offshore industry in the course of years 84-85 through the Dutch Computer Centre ENR, PETTEN. An investigation is underway to make these programs also available through a Computer Bureau in the USA.

This organization is equipped with a CDC CYBER 170-175 computer. Purchase of a CRAY-1-S is also being considered.

The theoretical background and user's instructions are fully documented. Some of the programs in the package are verified against experimental data.

3.1.13 Synopsis of Response No. 13

On the basis of the questionnaire filled in by the respondent number 13, it is found that their capabilities are limited to motion response calculatiuon, mooring analysis, and stability analysis to some extent. The suite consists of frequency domain computer programs MOSAS/TLP and time domain software MOPOP.

In the wave force calculation, it uses basic Morison's equation and their response did not answer the questions related to program verification. It calculates the platform response RAOs, response time history, and the mooring line load RAOs, but the time history of mooring line loads is not an output.

It does not have the capabilities of riser analysis and structural analysis. As far as the stability analysis capability is concerned, it does not perform the damaged stability analysis. User's guides are available but the theoretical manuals are lacking.

This suite is supported but offers no training program for new users and it can be used only in the UNIVAC system. The questions related to accessibility arrangement for leasing, purchasing, consulting, etc., were not answered by the respondent.

3.1.14 Synopsis of Response No. 14

Only Table IV of the questionnaire set was returned by the respondent and that too was incomplete. The names of the suite or the programs were not supplied. Their capability appears to be very limited and restricted to motion response calculation and mooring analysis. It uses a simplified McCamy Fuchs model for columns and does not use diffraction for pontoons and/or bracings. From the questionnaire, returned by this respondent, it is very hard to list the output quantities. This suite, probably, consists of many modules for use in micro computers with a CP/M or MSDOS (IBM PC) system. Presently the programs are used on a consultancy basis and it will be available for purchase by the end of 1984.

3.1.15 Synopsis of Response No. 15

The suite offered by this respondent consists of WIND, WINDSPEC, CURRENT, TENMOT, TENMOR, TENLOAD, DAMS, DAMSFE, FDRISER, and DWRSR. It is capable of performing a) motion response calculation, b) mooring analysis, c) riser analysis, d) stability analysis, and e) structural analysis. It uses diffraction theory (2D and 3D) for wave forces and takes into account low frequency second order wave forces. The mooring and riser analysis can be performed by this suite in both frequency and time domain. The package related to motion response and mooring analysis was verified with 1:40 scaled model tests results. The riser analysis was checked against the published material in API RP 2J.

The stability analysis package can analyze a free floating as well as a tethered platform. The suite offers full capability for structural analysis which includes space frame analysis and finite element analysis. Various finite elements available for use are beam, shell, plate, stiffened plate, and solid. The software packages are all well documented with user's guides and theoretical manuals, and are also supported and maintained on a regular basis. These programs can all be used in an IBM and CDC system; some of the packages can be used in VAX as well. All the computer programs of this suite are available for lease, purchase, and on consultancy basis.

3.1.16 Synopsis of Response No. 16

The respondent has software capabilities which are limited to perform motion response calculations of tension leg platforms and semisubmersible. The software suite is capable of using Morison's equation to calcuate the hydrodynamic loading for both the frequency domain and time domain analysis for motion response. It is also capable of using the diffraction theory in the frequency domain analysis. This program suite is not capable to perform a) floating stability analysis, b) riser analysis and c) structural analysis. Furthermore, it's mooring analysis capabilities are limited to vertical taut mooring lines.

This suite of computer programs are provided with user's guide and theoretical manuals, but it is not well maintained and no training program to get acquainted with the package is available.

3.2 Software Packages Of Three Non-Respondents

Three software packages developed by three non-respondent organizations, which were considered to have the capabilities of analyzing semisubmersible and tension leg platforms, are also reviewed in this work. It may be cautioned here that the reviews are based on somewhat limited informations. The three organizations who developed these softwares are McDonnel Douglas, C. J. Garrison & Associates and Texas A&M University. These packages are identified respectively by alphabets A, B and C.

3.2.1 Synopsis of Software Package A

This software package uses Morison's equation to calculate the wave forces and is capable of calculating motion responses in both frequency and time domain. It can also perform mooring analysis and structural analysis, but probably, it is not capable of analyzing riser and stability of floating vessel. It is well documented and supported, can be used in IBM and VAX hardware system and is available for lease, purchase and on a consulting basis.

3.2.2 Synopsis of Software Package B

This package uses diffraction theory and it is comprised of HYDRAL, FREDA, NONTID, DRIFT and sometimes it is referred to as "MORA". The materials, which were used to review this package, does not indicate any capability based on Morison's equation. It is primarily a package to perform motion response analysis in frequency and time domain. It does not indicate any capability related to riser analysis, floating stability analysis and structural analysis. It is available thru Boeing Computer Services and can also be purchased.

3.2.3 Synopsis of Software Package C

This package was developed as a thesis work and is based on Morison's equation. The package does not seem to be well documented and is expected not to be user friendly. It is not supported and no training program is available to users and is also not verified with other softwares or model test data. The material, which was used to review the package, is in a Ph.D. dissertation form. It does not indicate any capability related to riser, structural and floating stability analysis.

4.0 SUMMARY OF SOFTWARE CAPABILITIES

Based on the responses received from the organizations who were requested to fill in the prepared set of questionnaires, a set of summary tables showing the capabilities of various software suites were prepared and are presented in Tables (I-IV). The names of the organizations, who are the proprieters of the software suites were not shown purposely in these tables and were identified only by numerical numbers (1-16).

Three software packages developed by three non-respondent organizations, are reviewed in Section 3 and a separate summary tables showing their capabilities are presented in Tables (IA - IVA).

The completed questionnaires, received from the sixteen respondent organizations are included in the Appendix I and are identified by the assigned numerals. The questionnaire was also filled for the three non respondent organizations and are included in the Appendix I and are designated the assigned alphabets A, B and C.

TABLE I

SUMMARY OF FREQUENCY DOMAIN SOFTWARE CAPABILITIES
(BASED ON MORISON'S EQUATION)

NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM
ANALYSIS TECHNIQUES
(SOFTWARE SURVEY)

ROW #	****	****	** ** ** ** ****** ** ** ** **	1		2		3				5		6		7		8	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
1	ENVIR	WIND FORCE CALCULATIONS	CALCULATES STATIC WIND FORCES	DIFAN	Y			EUREKA	Y			SESTRA (SESAM80)	N	AQUALIBRIUM	Y	WINDFORCE	END OF 1984		
2	ENVIR	WIND FORCE CALCULATIONS	CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION	"	JUNE '84			"	N			"	N	AQUA-DRIFT	Y	"	N		
3	ENVIR	WIND FORCE CALCULATIONS	IS THE WIND FORCE AN INPUT TO THE PROGRAM	"	N			SPLASHD	Y			"	Y	AQUALIBRIUM	OPTIONAL	"	N		
4	ENVIR	CURRENT FORCE CALCULATION	IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED	"	Y			"	Y			"	N	"	N	—	—		
5	ENVIR	CURRENT FORCE CALCULATION	CURRENT FORCES CALCULATED INDEPENDENTLY AND ADDED TO WAVE FORCES	"	N			"	N			"	N	AQUA-LINE	1984-85	—	—		
6	ENVIR	CURRENT FORCE CALCULATION	IS THE CURRENT FORCE AN INPUT TO THE PROGRAM	"	N			"	Y			"	Y	"	OPTIONAL (84-85)	—	—		
7	ENVIR	MEMBER ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER	"	Y			"	Y			WAMLOS (SESAM80)	Y	"	1984-85	UCLRIG UCLTBP	Y		
8	ENVIR	MEMBER ORIENTATION	VERTICAL MEMBER	"	Y			"	Y			"	Y	"	1984-85	"	Y		
9	ENVIR	MEMBER ORIENTATION	HORIZ. MEMBER	"	Y			"	Y			"	Y	"	1984-85	"	Y		
10	ENVIR	MEMBER X-SECT	DOES IT USE EQUIVALENT CIRCULAR CROSS SECTION FOR NONCIRCULAR SECTION	"	N			"	EQUIV ELLIPTICAL X-SECT			"	Y	"	N (84-85)	"	N		
11	ENVIR	MEMBER X-SECT	DOES IT USE MODIFIED C_d AND C_m VALUES FOR NON CIRCULAR X-SECTION	"	N			"	Y			"	Y	"	1984-85	"	Y		

ROW #	****	****	** ** ** ** ****** ** ** ** **	9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
1	ENVIR	WIND FORCE CALCULATIONS	CALCULATES STATIC WIND FORCES	OSCAR	Y	DWVSL	N	VODAS	Y			MOSAS/TLP	Y					FVRS	Y
2	ENVIR	WIND FORCE CALCULATIONS	CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION	"	N	"	N	RANTIM	OCT 1985			"	N					"	N
3	ENVIR	WIND FORCE CALCULATIONS	IS THE WIND FORCE AN INPUT TO THE PROGRAM	"	Y	"	N					"	N					"	N
4	ENVIR	CURRENT FORCE CALCULATION	IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED	"	N	"	N	VODAS	Y			"	N					"	N
5	ENVIR	CURRENT FORCE CALCULATION	CURRENT FORCES CALCULATED INDEPENDENTLY AND ADDED TO WAVE FORCES	"	Y	"	N					"	Y					"	Y
6	ENVIR	CURRENT FORCE CALCULATION	IS THE CURRENT FORCE AN INPUT TO THE PROGRAM	"	Y	"	N					"	N					"	N
7	ENVIR	MEMBER ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER	"	Y	"	N	VODAS / VODYN	Y / N			"	Y					"	Y
8	ENVIR	MEMBER ORIENTATION	VERTICAL MEMBER	"	Y	"	Y	"	Y			"	Y					"	Y
9	ENVIR	MEMBER ORIENTATION	HORIZ. MEMBER	"	Y	"	Y	"	Y			"	Y					"	Y
10	ENVIR	MEMBER X-SECT	DOES IT USE EQUIVALENT CIRCULAR CROSS SECTION FOR NONCIRCULAR SECTION	"	Y	"	N	"	Y			"	N					"	N
11	ENVIR	MEMBER X-SECT	DOES IT USE MODIFIED C_d AND C_m VALUES FOR NON CIRCULAR X-SECTION	"	N	"	Y	"	Y			"	Y					"	Y

NOTE: NUMBERS AT THE TOP OF THE COLUMNS REFER TO DETAILED RESPONSES TO THE BARDI QUESTIONAIRE FROM VARIOUS PARTICIPANTS. ALL RESPONSES ARE COMPILED IN APPENDIX I.

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
					PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
12	O N	W	: ION	OTHER METHODS, IF ANY, TO CALCULATE WAVE FORCE ON NON CIRCULAR X-SECTION	DIFAN	N			SPLASHD	2D/3D SOURCE PROG			WAMLOS (SESAM 83)	N	AQUA LINE	N	-	-			OSCAR	2D/3D DIFF.	DWVSL	N	VODAS VODYN	N			MOSAS/TLP	N					FVRS	N
13	M			IS THE FORCE CALCULATED AT THE LONGL AXIS OF THE MEMBER	"	Y			"	Y			"	N	"	1984-85	UCLRIG UCLTBP	Y			"	Y	"	N	"	Y			"	Y					"	Y
14	E N	A V		ANY METHOD TO CALC PRESS DISTRIBUTION ON SURFACE IF YES, PLEASE SPECIFY	"	N			"	N			"	Y	"	N	"	LINEAR WAVE PRESS			"	2D-STRIP 3D-DIFF	"	N	"	Y N			"	Y					"	Y
15	T	E		IS THE INTERACTION BET MEMBERS CONSIDERED : COLUMN AND COLUMN	"	N			"	2D/3D SOURCE PROG			"	Y	"	1984-85	"	N			"	N	"	N	"	Y N			"	N					"	[illegible]
16	A		MEMBER INTER-ACTION	COLUMN AND PONTOON	"	N			"	"			"	Y	"	'84-85	"	N			"	N	"	N	"	Y N			"	N					"	
17	L			PONTOON AND PONTOON	"	N			"	"			"	Y	"	'84-85	"	N			"	N	"	N	"	Y			"	N					"	[illegible]
18		F	FIRST	IS THE PROGRAM BASED ON BASIC MORISON'S EQUATION	"	N			"	N			"	N	"	'84-85	"	Y			"	N	"	Y	"	Y			"	Y					"	[illegible]
19		O		IS THE PROGRAM BASED ON MORISON'S EQN FORMULATION W/ REL VELOCITY	"	N			"	Y			"	Y	"	'84-85	"	Y			"	Y	"	N	"	Y			"	N					"	Y
20		R	ORDER	IS THE PROGRAM BASED ON MORISON'S EQN W/ REL VELOCITY AND CURRENT	"	Y			"	Y			"	N	"	1984-85	"	N			"	N	"	N	"	Y N			"	N					"	[illegible]
21	F	C		IS THE PROGRAM BASED ON LINEARIZED FORM OF MORISON'S EQUATION	"	Y			"	N			"	Y	"	N	"	Y			"	N	"	N	"	Y N			"	N					"	Y
22	O	E	DRIFT	DOES IT CONSIDER THE WAVE ELEVATION	"	N			"	N			"	N	"	N	"	N			"	Y	"	N	"	N			"	N					"	N
23	R C	S		DOES THE PROGRAM ACCOUNT REFLECTION OF 1ST ORDER WAVES FROM THE BODY	"	N			"	N			"	Y	"	'84-85	"	N			"	Y	"	N	"	N			"	N					"	N
24	E			DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO DISPLACEMENT OF BODY	"	N			"	N			"	Y	"	N	"	N			"	Y	"	N	"	N			"	N					"	Y
25	S	:	SE FORCES	DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO ROTATION OF BODY	"	N			"	N			"	Y	"	N	"	N			"	Y	"	N	"	N			"	N					"	Y
26	*	:	CO	DOES IT ACCOUNT FORCE ON A FIXED BODY BY LOW FREQUENCY 2ND ORDER WAVES	"	N			"	N			"	N	"	N	"	N			"	Y	"	N	"	N			"	N					"	N

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
27	*******	ORDER	VISCOUS FORCES	DOES THE PROGRAM CONSIDER NON-LINEAR WAVE DRAG	DIFAN	N			SPLASHD	N			WAMLOS (SESAM80)	N	AQWA-LINE	'84-85	UCLRIG UCLTBP	N		
28				IF DRAG FORCE CALCULATION CONSIDER MEAN CURRENT & WAVE PARTICLE VELOCITY	"	Y			"	N			"	N	"	'84-85	"	N		
29				IS CURRENT & WAVE FRICTION CONSIDERED IN RESULTANT FRICTIONAL DRIFT	"	Y			"	Y			"	N	"	N	"	N		
30				IS ITERATION OF RESPONSE USED FOR CONVERGENCE	"	Y			"	Y			"	N	"	-	"	Y		
31				DOES IT USE PREVIOUS TIME STEP RESULTS IN PRESENT STEP CALCULATION	"	N			"	Y			"	-	"	-	"	Y		
32				IS THE CONVERGENCE TOLERANCE BUILT IN THE PROGRAM	"	N			"	Y (DEFAULT)			"	-	"	-	"	Y		
33				DOES THE USER SPECIFY THE CONVERGENCE TOLERANCE	"	Y			"	Y			"	-	"	-	"	N		
34	**** EQUATION OF MOT	FREQUENCY DO	ADD MASS	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	"	Y			"	X			"	N	"	OPTIONAL ('84-19	"	N		
35				CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	3D			"	2D			"	Y	"	'84-85	"	2D		
36			DAMPING COEFFICIEN	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	N			"	Y			"	Y	"	'84-55	"	Y		
37				IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	N			"	Y			"	N	"	N	"	N		
38				IS THE CURRENT DRAG DAMPING CONSIDERED	"	N			"	Y			"	N	"	'84-85	"	N		
39				IS THE CURRENT FRICTION DAMPING CONSIDERED	"	N			"	Y			"	N	"	N	"	N		
40				IS THE RADIATION DAMPING CONSIDERED	"	Y			"	Y			"	N	"	'84-85	"	N		
41				IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	N			SESTRA (SESAM80)	Y	"	N	"	N		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
27	OSCAR	Y	DWVSL	N	VODAS VODYN	N			MOSAS/TLP	N					FVRS	N
28	"	Y	"	N	"	Y			"	N					.	N
29	"	N	"	N	"	N			"	N					"	N
30	"	Y	"	N	"	Y			"	N					"	N
31	"	Y	"	N	"	Y			"	N					"	N
32	"	Y	"	N	"	N			"	N					"	N
33	"	OPTION-AL	"	N	"	N			"	N					"	N
34	"	N	"	N	"	N			"	Y					"	N
35	"	2D	"	-	"	3D			"	N					"	N
36	"	Y	"	N	"	Y			"	N					"	N
37	"	N	"	N	"	-			"	N					"	N
38	"	N	"	N	"	-			"	N					"	N
39	"	N	"	N	"	-			"	N					"	N
40	"	Y	"	N	"	-			"	N					"	Y
41	"	N	"	N	"	-			"	N					"	N

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
42	ON ****	MAIN	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	DIFAN	N			SPLASHD	N			WAMLDS (SESAME)	N	AQWA-LINE	OPTION-AL	ULLRIG ULLTBP	N			OSCAR	N	DWVSL	N					MOSAS/TLP	Y					FVRS	N
43			STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	"	Y			"	N			"	Y	"	-DO-	"	N			"	N	"	N					"	N					"	Y
44				IS THE STIFFNESS MATRIX COMPUTED	"	N			"	Y			"	N	"	-DO-	"	Y			"	Y	"	Y					"	Y					"	Y
45	*** ENVIRONMENTAL	** WIND **	STATIC WIND	IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT	"	Y			EUREKA	Y			-	-	AQWA-FER	Y	WINDFORCE	Y			"	Y	"	N	RANTIM	OCT 1985			"	Y					"	N
46			DYNAMIC WIND	IS THERE PROVISION TO USE FOLLOWING SPECTRA : HARRIS	"	JUNE '84			"	N			-	-	"	N	"	N			"	N	"	N					"	N					"	N
47				DAVENPORT	"	JUNE '84			"	N			-	-	"	N	"	N			"	N	"	N					"	N					"	N
48				SIMIU	"	N			"	N			-	-	"	N	"	N			"	N	"	N					"	N					"	N
49				OTHERS (SPECIFY)	"	N			"	N			-	-	"	N	"	N			"	N	"	N					"	N					"	N
50		CURRENT		IS IT BASED ON UNIFORM CURRENT VELOCITY PROFILE	"	N			SPLASHD	Y			-	-	AQWA-LINE	N	DRIFT	Y			"	N	"	N					"	Y					"	N
51				IS IT CAPABLE OF USING NON-UNIFORM CURRENT PROFILE	"	Y			"	N			-	-	"	1984-85	"	Y			"	Y	"	N					"	N					"	N
52		******	STATISTICS	SIGNIFICANT WAVE HEIGHT	"	N			"	Y			POSTFRAME (SESAME)	Y	AQWA-FER	-DO-	"	N			"	Y	"	N	VOPROC	Y			"	N					"	N
53				MEAN SPECTRAL PERIOD	"	N			"	Y			"	Y	"	-DO-	"	N			"	Y	"	N	"	Y			"	N					"	N
54				WAVE SCATTER DIAGRAM	"	N			"	N			"	Y	"	N	"	N			"	N	"	N	"	Y			"	N					"	N
55			...	LINEAR WAVE	"	Y			"	Y			"	Y	"	1984-85	"	Y			"	Y	"	Y	"	Y			"	Y					"	Y
56				STRETCH LINEAR	"	N			"	N			"	N	"	N	"	N			"	N	"	N	"	N			"	N					"	N

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
					PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
57			W A V E	STOKE'S 2ND, 3RD OR 5TH ORDER .... PLEASE CIRCLE ...	DIFAN	N			SPLASHD	N			POSTFRAME (SESAM80)	N	AQWA-FER-LING	N		N			OSCAR	N	DWVSL	N	VOPROC	2nd 3rd 5th			MISAS/TLP	N					FVRS	N
58				STREAM FUNCTION USING THE FORM GIVEN BY .... DEAN		N			"	N			"	N	"	N		N			"	Y	"	N	"	N			"	N					"	N
59			T	STREAM FUNCTION : THE FORM GIVEN BY .... VON SCHWIND		N			"	N			"	N	"	N		N			"	N	"	N	"	N			"	N					"	N
60		W	H E O R	STREAM FUNCTION : THE FORM GIVEN BY .... HUDSPETH		N			"	N			"	N	"	N		N			"	N	"	N	"	N			"	N					"	N
61		A	I E S	STREAM FUNCTION : OR ANY OTHER FORM .... PLEASE SPECIFY		N			"	N			"	N	"	N		N			"	N	"	N	"	N			"	N					"	N
62		V	. .	EXTENDED VELOCITY POTENTIAL		N			"	N			"	N	"	N		N			"	N	"	N	"	N			"	N					"	N
63		E	. .	CNOIDAL WAVE THEORY		N			"	N			"	N	"	N		N			"	N	"	N	"	N			"	N					"	N
64		S	S	IS THERE PROVISION TO USE FOLLOWING SPECTRA : PIERSON-MOSKOWITZ		N			"	Y			POSTFRAME (SESAM80)	Y	AQWA-FER	Y	JONSWP	Y			"	Y	"	N	"	Y			"	N					"	N
65	D		E	ISSC		N			"	Y			"	N	"	Y	"	Y			"	Y	"	N	"	N			"	N					"	N
66	E S C		A	JONSWAP		N			"	Y			"	Y	"	Y	"	Y			"	Y	"	N	"	Y			"	N					"	N
67	R I		S	BRETSCHNEIDER		N			"	Y			"	N	"	N	"	N			"	N	"	N	"	N			"	N					"	N
68	P T		P E	SCOTT		N			"	Y			"	N	"	N		N			"	N	"	N	"	Y			"	N					"	N
69	I O	* *	C	OCHI (SIX PARAMETER)		N			"	Y			"	N	"	N		N			"	N	"	N	"	N			"	N					"	N
70	N	* *	T	INPUT SPECTRA		N			"	Y			"	N	"	Y		N			"	Y	"	N	"	N			"	N					"	N
71	*	*	R	OTHERS		N			"	N			"	N	"	N		N			"	N	"	N	"	CLIENT'S SPEC.			"	N					"	N

ROW #		**** **** * A	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
72	*****	*	DIRECTIONAL SPECTRA	DIFAN	N			SPLASHD	Y			POSTFRAME (SESAM80)	Y	AQWA-FER	N		N		
73		OTHERS	DOES IT CONSIDER EARTH QUAKE SPECTRA	"	N			"	N			"	N	"	N		N		
74			DOES IT CONSIDER CHANGE IN WATER LEVEL DUE TO TIDE	"	N			"	N			"	N	"	N		N		
75	SOLUTION	STATICS	NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	"	SIX (6)			"	SIX			WAMLAS (SESAM80)	SIX	AQWA-FER LINE	SIX		-		
76			WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	"	?			"	SIX COUPLED DOF			"	ALL SIX COUPLED	"	ALL SIX		-		
77			IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	"	N			"	?			SESTRA (SESAM80)	UNLIMITED	"	N		-		
78	TECHNIQUE	DYNAMICS FREQUENCY DOMAIN	HOW MANY DEGREES OF FREEDOM INCLUDED IN THE SOLUTION .... SPECIFY	"	SIX (6)			"	SIX			"	SIX	"	SIX	UCLRIG UCLTBP	SIX +		
79			WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	"	?			"	SIX COUPLED			"	ALL SIX	"	ALL SIX	"	ALL SIX		
80			WHAT METHOD OF LINEARIZATION USED .... SPECIFY	"	ENERGY BALANCE			"	LEAST SQUARE ERROR MIN.			"	-	"	-	"	LINEARIZED DAMPING		
81			MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION	"	N			"	N			"	Y	"	Y	"	Y		
82			OTHERS .... SPECIFY	"	PIVOT METHOD			"	GAUSS JORDAN RED.			"	CHOLE-SKYS	"	X	"	N		
83	PLATFORM RESPONSE OUTPUT	* *** ***** *******	MEAN OFFSET OF THE PLATFORM	"	Y			"	Y			"	N	AQWA-LIBRIUM	Y	"	N		
84			MOTION RAO(S) OF THE PLATFORM, FOR PLOT CAPABILITY ENTER 'P'	"	Y			"	Y			WAMLOS	Y	AQWA-SUITE	P	UCLRIG UCLTBP CURV	Y (P)		
85			PLATFORM MOTION RESPONSE SPECTRA	"	N			"	Y			"	N	AQWA-FER	Y	JONSWP	Y (P)		
86			RESPONSE STATISTICS .. MEAN VALUE	"	N			"	Y			POSTFRAME	Y	"	Y	"	N		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
72	OSCAR	N	DWVSL	N	VOPROC	Y			MOSAS/TLP	N					[illegible]	N
73	"	N	"	N	?	N			"	N						N
74	"	N	"	N	?	Y			"	N						N
75	"	SIX	"	NO STATIC SOLN	VODAS VODYN VOFRAME VOHYDR	SIX			"	SIX						SIX
76	"	ALL SIX	"	-DO-	"	ALL SIX			"	ROLL COUPLING						ALL SIX
77	"	N	"	-DO-	"	N			"	-						N
78	"	SIX	"	THREE SURGE HEAVE PITCH	"	SIX			"	SIX						SIX
79	"	ALL SIX	"	ALL THREE	"	ALL COUPLED			"	ROLL COUPLING						[illegible]
80	"	-	"	NO DRAG CONSIDERED	"	STRT LINEARIZATION			"	-						[illegible]
81	"	PROPRIETARY	"	N	"	N			"	N						
82	"	N	"	MATRIX INVERSION	VOFRAME	CHOLES-KY			"	GAUSS-JORDAN W/PIVOT						GAUSS [illegible]
83	"	Y	"	N	VODYN	Y			"	N						Y
84	"	P	"	Y	"	P			"	Y						[illegible]
85	"	Y	"	N	VOPROC	Y			"	N						N
86	"	Y	"	N	"	N			"	N						[illegible]

* MOORING ANALYSIS FOR TIME DOMAIN ONLY

ROW #				1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
87	******* ***** *** *		RESPONSE STATISTICS .. R.M.S. VALUE	DIFAN	N			SPLASHD	N			POTFRAME	Y	AQUA-FER	Y	UCLRIG UCLTBP	N			OSCAR	Y	DWVSL	N	VOPROC	Y			MOSAS/TLP	N					FVRS	
88			RESPONSE STATISTICS .. (SIGNIFICANT)1/3	″	N			″	Y			″	Y	″	Y	″	N			″	Y	″	N	″	Y			″	N					″	
89			RESPONSE STATISTICS .. OTHERS; SPECIFY	″	N			″	N			″	N	″	Y	″	N			″	1/10 1/100	″	N	″	Hz Tz			″	N					″	
90			EIGEN VALUES (SYSTEM NATURAL PERIODS)	NASTA	Y			″	Y			SESTRA	Y	″	Y	″	Y			″	N	″	Y	VODYN VODAS	Y			″	Y					″	
91	** ****		MODEL TEST - INDICATE SCALE	DIFAN	Y (55)			″	Y			SESAM80	Y	″	Y	UCLRIG	78,100 32&64			″	Y	″	Y	″	64			″	N					″	
92	PROGRAM		OTHER AVAILABLE SOFTWARE - LIST PROGRAMS	″	Y			″	N			″	Y	″	Y	″	NMIWAVE			″	N	″	Y	″	N			″	N						
93	VERIFICATION		OTHER.PUBLISHED MATERIAL - SPECIFY	″	N			″	N			″	Y	″	Y	″	TO BE PUBLISHED 17th ITTC OCEAN ENGG. COMMITTEE			″	NOBLE DENTON REPORT	″	Y	″	N			″	N					″	✓
94	**** **		OTHERS (SPECIFY)	″	N			″	N			″	N	″	Y	″				″	N	″	N	″	N			″	N					″	
95	******	DESCRIPTION	SPREAD MOORING (CATENARY)	ANCOR3 ANCOR4	Y			″	Y			″	-	″	Y	MOOR	Y			″	Y	″	Y	MAP	Y			″	N						
96			SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT	″	Y			″	N			″	-	″	Y	″	N			″	Y	″	N	″	Y			″	N						N
97			VERTICAL (TAUT) MOORING	″	Y			″	Y			″	-	″	Y	MOOR UCLTBP	Y			″	Y	″	Y	″	Y			″	Y						
98			HYBRID/OTHER COMBINATION .... SPECIFY	″	Y			″	SLANTED TAUT			″	-	″	Y	″	N			″	TAUT-BUOY-CATENARY LIKE	″	N	″	N			″	N					″	
99			SYNTHETIC ROPE - SUCH AS NYLON KEVLAR	″	Y			″	N			″	-	″	Y	MOOR	Y			″	Y	″	N	″	Y			″	N						N
100	M	MATERIA	CHAIN (STEEL)	″	Y			″	Y			″	-	″	Y		Y			″	Y	″	N	″	Y			″	N						
101	O		WIRE ROPE (STEEL)	″	Y			″	Y			″	-	″	Y		Y			″	Y	″	N	″	Y			″	N						

ROW #		**** ****	L	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
102	O R			COMBINATIONS SUCH AS CHAIN/WIRE ROPE OTHERS, SPECIFY	ANCORS ANCOR4	Y			SPLASHD	N			SESAM80	-	AQUA-FER	Y	MOOR	Y		
103	I	ANALYSES	STATICS	USER SPECIFIED LOAD DISPLACEMENT TABLE	"	Y			"	N			"	Y	"	Y	"	N		
104	N			IS IT BASED ON CATENARY EQUATION	"	Y			"	Y			"	-	"	Y	"	Y		
105	G			IS IT BASED ON FINITE EL-EMENT METHOD W/ OR W/O BENDING STFFNSS, CIRCLE	"	N			"	N			"	-	"	N	"	N		
106				OTHERS (SPECIFY)	"	N			"	N			"	-	"	N	"	N		
107			DYNAMICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	N			"	N			"	Y	"	Y	"	N		
108		****	. . .	IS THE MASS OF THE MOORING CONSIDERED	DIFAN	N			"	N			"	-	"	N	UCLTBP	Y		
109			. . .	IS THE MOORING SYSTEM MODELLED AS A LINEAR SPRING	"	Y			"	Y			"	-	"	Y	"	Y		
110			. . .	IS THE MOORING SYSTEM MODELLED AS A NON-LINEAR SPRING	"	N			"	N			"	-	"	Y	"	N		
111	S	VERTICAL		IS GEOMETRIC NON LINEA-RITY CONSIDERED	"	N			"	N			"	-	"	Y	"	N		
112	Y			IS MATERIAL NON LINEA-RITY CONSIDERED	"	N			"	N			"	-	"	Y	"	N		
113	S T			IS THE HYDRODYNAMIC DAMPING CONSIDERED	"	N			"	N			"	-	"	N	"	Y		
114	E		MOOR	IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	N			"	-	"	N	"	N		
115	M			IS THE MOORING SYSTEM COUPLED WITH PLATFORM	"	N			"	N			"	-	"	Y	"	Y		
116				IS IT BASED ON FINITE EL-EMENT METHOD,W/ OR W/O BENDING STFFNSS, CIRCLE	"	N			"	N			"	-	"	N	"	Y (w/)		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
102	OSCAR	CHAIN-WIRE-NYLON	DWVSL	N	MAP	Y			MOSAS/JLP	BAR					FVRS	
103	"	N	"	N	"	N			"	N					"	
104	"	Y	"	N	"	Y			"	N					"	
105	"	N	"	N	"	Y			"	N					"	
106	"	N	"	N	"	N			"	N					"	
107	"	Y	"	Y	"	Y			"	N					"	
108	"	N	"	N	VORIS	N			"	N					"	
109	"	Y	"	Y	"	Y			"	Y					"	
110	"	FOR STATICS	"	N	VODAS	N			"	Y					"	
111	"	Y	"	N	"	Y			"	N					"	
112	"	Y	"	N	"	N			"	N					"	
113	"	N	"	N	VORIS	N			"	N					"	
114	"	N	"	N	"	N			"	N					"	
115	"	Y	"	Y	"	Y			"	Y					"	
116	"	N	"	N	CABDYN	N			"	N					"	

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
117			ING MODEL	IS IT BASED ON FINITE DIFFERENCE METHOD	DIFAN	N			SPASHD	N			SESAM80	–	AQUA-FER	N	UCLTBP	N			OSCAR	N	DWVSL	N	MAP CABDYN	N Y			MOSAS/TLP	N					FIR	
118			HYDRODYNAMIC MODEL	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	"	N			"	BASIC			"	–	"	N	"	BASIC			"	N	"	N	"	N Y			"	N					"	
119				IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	"	N			"	N			"	–	"	N	"	N			"	N	"	N	"	N Y			"	N					"	
120				IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING	"	N			"	N			"	–	"	N	"	N			"	N	"	N	"	N			"	N					"	
121				IS THE MOORING HYDRODYNAMIC MODEL 2D	"	N			"	Y			"	–	"	N	"	Y			"	N	"	N	"	Y N			"	N					"	
122				IS THE MOORING HYDRODYNAMIC MODEL 3D	"	N			"	N			"	–	"	Y	"	N			"	N	"	N	"	N Y			"	N					"	
123	CAPABILITIES	MOORING		IS THE MOORING MODEL TWO DIMENSIONAL (STRUCT'L)	"	Y			"	Y			"	–	"	N	"	Y			"	N	"	N	"	Y N			"	N					"	
124				IS THE MOORING MODEL THREE DIMENSIONAL (STRUCT'L)	"	N			"	Y			"	–	"	Y	"	N			"	N	"	Y	"	N Y			"	Y					"	N
125				IS THE MOORING END AT FOUNDATION MODELED BY A LINEAR AXIAL SPRING	"	N			"	Y			"	–	"	N	"	N			"	N	"	N	"	N			"	N					"	N
126				IS MOORING END AT FOUNDATION MODELED BY A LINEAR & ROTATIONAL SPRING	"	N			"	N			"	–	"	N	"	N			"	N	"	N	"	N			"	N					"	N
127				IS IT POSSIBLE TO MODEL AN ARRAY OF INTERCONNECTED MOORING LINES	"	N			"	N			"	–	"	Y	"	N			"	N	"	Y	"	Y N			"	N					"	N
128				IS THE PROGRAM CAPABLE OF FATIGUE LIFE ANALYSIS	"	N			"	N			"	–	"	N	"	N			"	N	"	N	"	N			"	N					"	N
129			DYNAMICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	N			"	N			"	–	"	Y	"	Y			"	N	"	Y	"	N			"	Y					"	N
130		***	INSTALLATION ANALYS	IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING	"	N			"	N			"	–	"	Y	"	N			"	Y	"	N	VORIS	Y			"	N					"	
131		** ****		MEAN LOAD OF THE MOORING LINE	"	N			"	Y			"	–	"	Y	UCLTBP MOOR	Y			"	Y	"	N	MAP CABDYN	Y			"	N						N

* RISER ANALYSIS IN THE TIME DOMAIN ONLY

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
132		OUTPUT FOR THE MOORING SYSTEM	MOORING LINE LOAD RAO(S)	DIFAN	N			SPLASHD	Y			SESAM80	-	AQUA-FER	Y	UCLTBP MOOR	Y			OSCAR	Y	DWVSL	N	VOS PEG	Y			MOSAS/TLP	Y					FVRS	
133		**** **	MOORING LINE LOAD STATISTICS .. R.M.S. VALUE	"	N			"	N			"	-	"	Y		N			"	Y	"	N	"	Y			"	N					"	
134			MOORING LINE LOAD STATISTICS .. (SIGNIFICANT)1/3	"	N			"	Y			"	-	"	Y		N			"	Y	"	N	"	Y			"	N					"	
135			MOORING LINE LOAD STATISTICS .. OTHERS; SPECIFY	"	N			"	N			"	-	"	Y		N			"	Y	"	N	"	N			"	N					"	
136	*	* ***	WITH MODEL TESTS - INDICATE SCALE	"	N			"	N			"	-	"	40-100	UCLTBP	60			"	Y	"	N	"	N			"	N						
137	* * *	PROGRAM VERIFICATN	WITH OTHER SOFTWARE - LIST PROGRAMS	"	N			"	N			"	-	"	NMI DnV	UCLTBP MOOR	UCLRIG NHL			"	Y	"	N	"	Y			"	N						
138	* * *	*** *	WITH OTHER PUBLISHED MATERIAL .... SPECIFY	"	N			"	N			"	-	"	PINKSTER ETC	"	NHL			"	Y	"	N	"	N			"	N						
139	* *		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES	DWRSR	SEPT '84			"	N			"	N	AQUA-RISER	Y	UCLRISER	Y			"	Y	DWRSR	Y	VORIS	Y			"	N						
140	* * * *	* *	IS THE RISER MODEL TWO DIMENSIONAL	"	Y			MLTPIP	N			"	-	"	Y	"	Y			"	N	"	Y	"	Y										
141		S T R	IS THE RISER MODEL THREE DIMENSIONAL	"	N			"	Y			"	-	"	N	"	N			"	Y	"	Y	"	N									"	N
142		U C T U	DOES THE PROGRAM USE FINITE ELEMENT METHOD	"	Y			"	Y			"	-	"	Y	"	Y			"	N	"	Y	"	Y										
143	R	R A L	DOES THE PROGRAM USE FINITE DIFFERENCE METHOD	"	N			"	N			"	-	"	N	"	N			"	N	"	N	"	N										
144	I S	M O D E L	DOES THE PROGRAM USE SMALL DEFLECTION THEORY	"	Y			"	Y			"	-	"	Y	"	Y			"	N	"	Y	"	Y										
145	E	* *	IS THE PROGRAM CAPABLE OF USING LARGE DEFLECT-ION THEORY	"	N			"	N			"	-	"	N	"	Y			"	N	"	Y	"	N										
146	R	* * *	IS IT BASED ON MORISON'S EQUATION. SPECIFY THE FORM	"	SEE ITEM #20			"	Y			"	-	"	Y	"	Y			"	Y	"	w/ REL VEL & CURRENT	"	Y										N

ROW #		**** **** *	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
147	SYSTEM	HYDRODYNAMIC	IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	DWRSR	Y			MLTPIP	Y			SESAM80	-	AQWA-RISER	Y	UCLRISER	Y			OSCAR	Y	DWRSR	Y	VORIS	Y										
148			IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING	"	N			"	Y			"	-	"	N	"	N			"	N	"	N		N										
149			IS THE RISER HYDRODYNAMIC MODEL 2D	"	Y			"	N			"	-	"	Y	"	Y			"	N	"	N		Y										
150			IS THE RISER HYDRODYNAMIC MODEL 3D	"	N			"	Y			"	-	"	N	"	N			"	Y	"	Y		N										
151		** SOLUTION MODE	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM	"	Y			"	Y			"	-	"	Y	"	Y			"	Y	"	Y		N										
152		**	IS THE PROGRAM PERFORM FREQUENCY DOMAIN ANALYSIS	"	Y			"	Y			"	-	"	Y	"	Y			"	Y	"	N		N										
153		* ***	IS IT CAPABLE OF CLEARANCE ANALYSIS BETWEEN RISERS	"	Y			"	Y			"	-	"	N	"	N			"	N	"	Y		N										
154		SPECIAL ANALYSIS	IS IT CAPABLE OF INSTALLATION ANALYSIS W/ RISER BOTTOM AS FREE END	"	N			"	Y			"	-	"	Y	"	Y			"	Y	"	Y		Y										
155		*** *	IS IT CAPABLE OF INSTALLATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE	"	N			"	Y			"	-	"	Y	"	Y			"	Y	"	Y		Y										
156		PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE	"	N			"	Y			"	-	"	Y	"	Y			"	N	"	N		N										
157	*****		WITH OTHER SOFTWARE - LIST PROGRAMS	"	N			"	Y			"	-	"	BATTELLE	"	Y			"	N	"	Y		Y										
158	*		WITH OTHER PUBLISHED MATERIAL .... SPECIFY	"	N			"	Y			"	-	"	Y	"	Y			"	N	"	Y		Y										
159	* *** STABILITY ANALYSIS	INTACT	INTACT FREE FLOATING	FLOSTA NASTA	Y			EUREKA	Y			NV223	Y	AQWA-LIBRIUM	Y	ARCHIMEDES	Y			"	Y	DWVSL	N	VODYN VODAS	Y			MOSAS/TLP	Y						
160			INTACT WITH VERTICAL TAUT TENDONS	"	Y			"	N			"	Y	"	Y	"	N			"	Y	"	N	"	Y			"	Y						
161		DAM	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED	"	Y			"	Y			"	Y	"	Y	"	Y			"	Y	"	N	LASS	Y			"	N						

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
162	*** *	A G E D	DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING	FLOSTA NASTA	Y			EUREKA	N			NV 223	N	AQWA LIBRIUM	Y	ARCHIMEDES	N			OSCAR	Y	DWVSL	N	LASS	N			MOSAS/TLP	Y					FVRS	Y
163	**** STRUCTURAL ANALYSIS ****	LOADING	HYDRODYNAMIC LOADING CONSIDERED	DIFAN	Y			SPLASH STRAN	Y			SESTRA (SESAM 80)	Y	AQWA-LINK	Y					"	Y	"	N	VOHYDE VODAS	Y									"	Y
164			IS INERTIA LOADING CONSIDERED	"	Y			"	Y			"	Y	"	Y					"	Y	"	N	"	Y									"	Y
165			IS DYNAMIC LOADING CONSIDERED	"	Y			"	Y			"	Y	"	Y					"	Y	"	N	"	Y									"	Y
166		SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS	"	Y			"	Y			"	Y	"	N					"	N	"	N	"	N Y									"	N
167			THREE DIMENSIONAL SPACE FRAME ANALYSIS	"	Y			"	Y			"	Y	"	N					"	N	"	N	"	Y									"	N
168		* *** FINITE ELEMENT ANALYSIS *** *	BEAM ELEMENT	SAPS NASTRAN	Y			"	Y			"	Y	"	N					"	N	"	N	"	Y									"	N
169			SHELL ELEMENT	"	Y			"	N			"	Y	"	8,4,6 & 3 NODES					"	N	"	N	"	Y N									"	N
170			PLATE ELEMENT	"	Y			"	Y			"	Y	"	Y					"	N	"	N	"	Y N									"	N
171			STIFFENED PLATE ELEMENT	"	N			"	Y			"	N	"	Y					"	N	"	N	"	Y N									"	N
172			OTHERS .... SPECIFY	"	N			"	N			"	CABLE TRUSS BAR SOLID AXISYM	"	N					"	N	"	N	"	N SUBSTRUCTURE									"	N
173			NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM	"	?			"	?			"	UNLIMITED	"	?					"	N	"	N	"	?									"	N
174		OTHER ANALYTICAL CAPABILITY	SPECTRAL ANALYSIS	"	Y			"	Y			"	Y	ASAS	Y					"	N	"	N	"	Y									"	N
175			MODAL ANALYSIS	"	Y			"	N			"	Y	ASAS DYNAMICS	Y					"	N	"	N	"	Y									"	N
176			FATIGUE LIFE ANALYSIS	FASTAN	Y			"	Y			"	Y	FAT JACK	Y					"	N	"	N	"	Y										N

ROW #	**** ****	** ** **. ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
			PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
177	PRE-PROCESSING AND POST-PROCESSING CAPABILITIES	VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)	PLOTZ PROSP MENTAT	Y				?			SESAM80	Y	AQWA ASAS	Y	ALL PROGRAM	Y			OSCAR	Y	DWVSL	N	VODAS VODYN VOPROC VORIS	N									[illegible]	
178		RESTART CAPABILITIES (LIST ALL THE PROGRAMS)	NASTRAN	Y				?			"	Y	"	Y	"	Y			"	Y	"	N	"	N										
179		PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)	PLOTZ PROSP MENTAT NASTRAN	Y				?			"	Y	ASDLS C-GUL AQWA ASAS	Y	"	Y			"	Y	"	N	VOPROC VOHYDR VOFRAME	Y										N
180		CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)	NAISC3 NAISC4 PUNSHE DNV77	Y				?			"	Y	ASAS-BEAMST	Y	"	Y			"	N	"	N												N
181	PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON	PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION		FORTRAN 77 (ASCII)			EUREKA SPLASH MLTPIP STRAN	FORT IV			"	FORT 77	AQWA ASAS	FORT 66	"	FORT IV + 77			"	Y	"	Y	VODAS VORAN VOSPEC	FORT IV			MOSAS TLP	IV						Y
182		.... BASIC		N			"	N			"	N	"	N	"	N			"	N	"	N	VOFRAME VOHYDR	Y			"	N						N
183		.... PASCAL		N			"	N			"	N	"	N	"	N			"	N	"	N	"	N			"	N						N
184		.... OTHERS; SPECIFY		N			"	N			"	N	"	N	"	N			"	N	"	N	"	N			"	N						N
185		COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU		?			"	(10-20)			"	?	"	?	"	?			"	?	"	2.3sec CDC Cyber 74	"	?			"	?						–
186	DOCUMENTATION	IS USERS' GUIDE AVAILABLE	ALL THE PROGRAMS MENTIONED	Y			"	Y			"	Y	"	Y	"	Y			"	Y	"	Y	ALL THE PROGRAMS	SOME			"	Y						Y
187		IS THEORETICAL MANUAL AVAILABLE	"	Y			"	Y			"	Y	AQWA-SUITE (some)	Y	"	Y (some)			"	PROPRIETORY	"	N	"	N			"	N						
188	SUPPORT MAINTENANCE AND TRAINING	ARE THE PROGRAMS SUPPORTED AND MAINTAINED	"	Y			"	Y			"	Y	AQWA-ASAS	Y	"	N			"	Y	"	Y	"	Y			"	Y						
189		IS ANY TRAINING OFFERED	"	Y			"	(CONSULTING BASIS)			"	Y	"	Y	"	N			"	Y	"	Y	"	Y			"	N						
190	** ****	IBM	"	N			"	Y			"	Y	"	Y	"	Y			"	Y	"	Y	VODAS VORIS	Y			"	N						
191		CDC	"	N			"	Y			"	LATER	"	Y	"	Y			"	Y	"	Y	"	Y			"	N						

ROW #	**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
			PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
192	HARDWARE SYSTEM	PRIME COMPUTER	ALL THE PROGRAMS MENTIONED	N			SPLASHD	Y			SESAM80	LATER	AQWA ASAS	Y	ALL PROGRAMS	Y			OSCAR	Y	DWVSL	N	ALL THE PROGRAMS	N			MOSAS/TLP	N						
193		VAX	"	N			"	Y			"	Y	"	Y	"	Y			"	Y	"	Y	"	N			"	N						
194		MICRO .. SPECIFY	"	N			EUREKA	CP/M			"	N	AQWA	IBM P.C.	"	N			"	N	"	N	"	HP APPLE			"	N						
195	**** **	OTHERS .... SPECIFY	"	SPERRY O.S. EXEC8			SPLASHD EUREKA	HONEY WELL UNIVAC			"	UNIVAC	"	ICL	"	PDP11 GEC 4190			"	UNIVAC DATA GEN	"	UNIVAC PERKIN-ELMER	"	N			"	UNIVAC						
196	** ****	LEASE (PRICE $ .00)	"	Y (EXCEPT MASTERING)			SPLASHD	X			"	Y	AQWA ASAS	Y	"	Y			"	Y	"	N	"	Y			"	?						
197	ACCESSIBILITY	PURCHASE (PRICE $ .00)	"	N			"	$ 25000			"	Y	"	Y	"	Y			"	Y	DWVSL DWRSR	$8000. 40000	"	?			"	?						
198	ARRANGEMENT	CONSULTANCY BASIS	"	Y			"	X			"	Y	"	Y	"	Y			"	Y	"	Y	"	Y			"	?						
199	**** **	OTHERS .... SPECIFY	"	N			"	?			"	—	"	?	"	?			"	N	"	?	"	?			"	?						
200											ALL PROGRAMS EXCEPT NV223 BELONG TO																							
201	REMARKS AND NOTES										SESAM80																							
202																																		

TABLE I(A) SUMMARY OF FREQUENCY DOMAIN SOFTWARE CAPABILITIES
(BASED ON MORISON'S EQUATION)
NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM ANALYSIS TECHNIQUES
(SOFTWARE SURVEY)

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
1	* *	WIND FORCE CALCULATIONS	CALCULATES STATIC WIND FORCES	SELOS	Y			?	N		
2	* *	WIND FORCE CALCULATIONS	CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION	"	?			"	N		
3	* *	WIND FORCE CALCULATIONS	IS THE WIND FORCE AN INPUT TO THE PROGRAM	"	N			"	N		
4	* *	CURRENT FORCE CALCULATION	IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED	"	Y			"	N		
5		CURRENT FORCE CALCULATION	CURRENT FORCES CALCULATED INDEPENDENTLY AND ADDED TO WAVE FORCES	"	N			"	?		
6		CURRENT FORCE CALCULATION	IS THE CURRENT FORCE AN INPUT TO THE PROGRAM	"	N			"	?		
7	*	MEMBER ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER	"	Y			"	Y		
8	E N	MEMBER ORIENTATION	VERTICAL MEMBER	"	Y			"	Y		
9	V	MEMBER ORIENTATION	HORIZ. MEMBER	"	Y			"	Y		
10	I	MEMBER X-SECTI	DOES IT USE EQUIVALENT CIRCULAR CROSS SECTION FOR NONCIRCULAR SECTION	"	N			"	?		
11	R O	MEMBER X-SECTI	DOES IT USE MODIFIED C AND C VALUES FOR NON CIRCULAR X-SECTION	"	N			"	?		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****			** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
12	N	W	:	ON	OTHER METHODS, IF ANY, TO CALCULATE WAVE FORCE ON NON CIRCULAR X-SECTION	SELOS	?			?	N		
13	M				IS THE FORCE CALCULATED AT THE LONGL AXIS OF THE MEMBER	"	Y			"	Y		
14	E N	A V			ANY METHOD TO CALC PRESS DISTRIBUTION ON SURFACE IF YES, PLEASE SPECIFY	"	?			"	?		
15	T	E	MEMBER INTER-ACTION		IS THE INTERACTION BET MEMBERS CONSIDERED : COLUMN AND COLUMN	"	N			"	N		
16	A				COLUMN AND PONTOON	"	N			"	N		
17	L				PONTOON AND PONTOON	"	N			"	N		
18		F	FIRST		IS THE PROGRAM BASED ON BASIC MORISON'S EQUATION	"	N			"	N		
19		O			IS THE PROGRAM BASED ON MORISON'S EQN FORMULATI-ON W/ REL VELOCITY	"	N			"	Y		
20		R	ORDER		IS THE PROGRAM BASED ON MORISON'S EQN W/ REL VELOCITY AND CURRENT	"	Y			"	N		
21	F	C			IS THE PROGRAM BASED ON LINEARIZED FORM OF MORISON'S EQUATION	"	N			"	N		
22	O	E		DRIFT	DOES IT CONSIDER THE WAVE ELEVATION	"	Y			"	Y		
23	R				DOES THE PROGRAM ACCOUNT REFLECTION OF 1ST ORDER WAVES FROM THE BODY	"	N			"	N		
24	C E	S			DOES IT ACCOUNT FOR ADD-ITIONAL PRESSURE DUE TO DISPLACEMENT OF BODY	"	N			"	N		
25	S	:	SE	FORCES	DOES IT ACCOUNT FOR ADD-ITIONAL PRESSURE DUE TO ROTATION OF BODY	"	N			"	N		
26	*	:	CO		DOES IT ACCOUNT FORCE ON A FIXED BODY BY LOW FRE-QUENCY 2ND ORDER WAVES	"	N			"	Y		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****			** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
27	* *	:	N D		DOES THE PROGRAM CONSIDER NON-LINEAR WAVE DRAG	SELOS	Y			?	N		
28	* *	: :		V I S C	DO DRAG FORCE CALCULATION CONSIDER MEAN CURRENT & WAVE PARTICLE VELOCITY	"	Y			"	N		
29	*	: :		O U S	IS CURRENT AND WAVE FRICTION CONSIDERED IN RESULTANT FRICTIONAL DRIFT	"	N			"	N		
30		: :	O R		IS ITERATION OF RESPONSE USED FOR CONVERGENCE	"	?			"	Y		
31		: :	D E	F	DOES IT USE PREVIOUS TIME STEP RESULTS IN PRESENT STEP SOLUTION	"	?			"	Y		
32		: :	R .	O R C E	IS THE CONVERGENCE TOLERANCE BUILT IN THE PROGRAM	"	?			"	Y		
33		: :	. . . .	S	DOES THE USER SPECIFY THE CONVERGENCE TOLERANCE	"	?			"	?		
34	* * *	F		A D D M	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	"	N			"	?		
35	*	R E		A S S	CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	2D			"	2D		
36	E Q U	Q U		D	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	Y			"	?		
37	A T I O N	E N		A M P I N	IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	N			"	?		
38		C Y		G	IS THE CURRENT DRAG DAMPING CONSIDERED	"	?			"	?		
39	O F			C O	IS THE CURRENT FRICTION DAMPING CONSIDERED	"	N			"	?		
40				E F F I	IS THE RADIATION DAMPING CONSIDERED	"	N			"	?		
41	M O T I	D O		C I E N T	IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	Y		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
42	ON ****	MAIN	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	SELOS	N			?	?		
43			STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	"	N			"	N		
44				IS THE STIFFNESS MATRIX COMPUTED	"	Y			"	Y		
45	**** ENVIRONMENTAL	** WIND **	STATIC WIND	IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT	"	Y			"	?		
46			DYNAMIC WIND	IS THERE PROVISION TO USE FOLLOWING SPECTRA : HARRIS	"	N			"	N		
47				DAVENPORT	"	N			"	N		
48				SIMIU	"	N			"	N		
49				OTHERS (SPECIFY)	"	N			"	N		
50		CURRENT		IS IT BASED ON UNIFORM CURRENT VELOCITY PROFILE	"	N			"	N		
51				IS IT CAPABLE OF USING NON-UNIFORM CURRENT PROFILE	"	Y			"	N		
52		*******	STATISTICS	SIGNIFICANT WAVE HEIGHT	"	Y			"	Y		
53				MEAN SPECTRAL PERIOD	"	Y			"	Y		
54				WAVE SCATTER DIAGRAM	DANOS	Y			"	N		
55			... W	LINEAR WAVE	SELOS	Y			"	Y		
56				STRETCH LINEAR	"	N			"	N		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A		B		C		D	
					PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO
57			AVE	STOKE'S 2ND, 3RD OR 5TH ORDER .... PLEASE CIRCLE ...	SELOS	Y			?	N		
58				STREAM FUNCTION USING THE FORM GIVEN BY .... DEAN	〃	Y			〃	N		
59		WAVES	THEORIES	STREAM FUNCTION : THE FORM GIVEN BY .... VON SCHWIND	〃	N			〃	N		
60				STREAM FUNCTION : THE FORM GIVEN BY .... HUDSPETH	〃	N			〃	N		
61				STREAM FUNCTION : OR ANY OTHER FORM .... PLEASE SPECIFY	〃	N			〃	N		
62			......	EXTENDED VELOCITY POTENTIAL	〃	Y			〃	N		
63				CNOIDAL WAVE THEORY	〃	Y			〃	N		
64			SEA SPECTRA	IS THERE PROVISION TO USE FOLLOWING SPECTRA : PIERSON-MOSKOWITZ	SELOS DANOS	Y			〃	Y		
65	DESCRIPTION *			ISSC	SELOS	N			〃	N		
66				JONSWAP	〃	N			〃	Y		
67				BRETSCHNEIDER	〃	Y			〃	N		
68				SCOTT	〃	N			〃	N		
69		******		OCHI (SIX PARAMETER)	〃	N			〃	N		
70				INPUT SPECTRA	〃	?			〃	N		
71				OTHERS	〃	?			〃	N		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
72	* *	*	DIRECTIONAL SPECTRA	SELOS	Y			?	N		
73	* *	OTHERS	DOES IT CONSIDER EARTH QUAKE SPECTRA	DYNAL	?			〃	Y		
74	* *		DOES IT CONSIDER CHANGE IN WATER LEVEL DUE TO TIDE	-	-			〃	?		
75	SOLUTION	STATICS	NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	DANOS (STRUDL)	SIX			〃	SIX		
76			WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	〃	?			〃	ALL SIX (?)		
77			IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	〃	?			〃	?		
78	TECHNIQUE	DYNAMICS FREQUENCY DOMAIN	HOW MANY DEGREES OF FREEDOM INCLUDED IN THE SOLUTION .... SPECIFY	〃	SIX			〃	SIX		
79			WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	〃	?			〃	ALL SIX (?)		
80			WHAT METHOD OF LINEARIZATION USED .... SPECIFY	〃	?			〃	?		
81			MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION	〃	?			〃	?		
82			OTHERS .... SPECIFY	〃	?			〃	N		
83	* *** ***** ******* PLATFORM RESPONSE OUTPUT		MEAN OFFSET OF THE PLATFORM	〃	Y			〃	N		
84			MOTION RAO(S) OF THE PLATFORM, FOR PLOT CAPABILITY ENTER 'P'	SELOS	Y			〃	Y		
85			PLATFORM MOTION RESPONSE SPECTRA	〃	?			〃	?		
86			RESPONSE STATISTICS .. MEAN VALUE	〃	?			〃	?		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
87	******* ***** *** *		RESPONSE STATISTICS .. R.M.S. VALUE	SELOS	?			?	?		
88			RESPONSE STATISTICS .. (SIGNIFICANT)1/3	"	Y			"	?		
89			RESPONSE STATISTICS .. OTHERS; SPECIFY	"	?			"	?		
90			EIGEN VALUES (SYSTEM NATURAL PERIODS)	"	?			"	?		
91	** ****		MODEL TEST - INDICATE SCALE	"	?			"	N		
92	PROGRAM		OTHER AVAILABLE SOFTWARE - LIST PROGRAMS	"	?			"	N		
93	VERIFICATION		OTHER PUBLISHED MATERIAL - SPECIFY	"	?			"	N		
94	**** **		OTHERS (SPECIFY)	"	?			"	N		
95	******	DESCRIPTION	SPREAD MOORING (CATENARY)	"	Y			"	N		
96			SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT	"	N			"	N		
97			VERTICAL (TAUT) MOORING	"	Y			"	Y		
98			HYBRID/OTHER COMBINATION .... SPECIFY	"	N			"	N		
99		MATERIAL	SYNTHETIC ROPE - SUCH AS NYLON KEVLAR	"	N			"	N		
100	M		CHAIN (STEEL)	"	Y			"	Y		
101	O O		WIRE ROPE (STEEL)	"	Y			"	Y		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG -RAM	A YES /NO	B PROG -RAM	B YES /NO	C PROG -RAM	C YES /NO	D PROG -RAM	D YES /NO
102	RING			COMBINATIONS SUCH AS CHAIN/WIRE ROPE OTHERS, SPECIFY	SELOS	N			?	N		
103		ANALYSES	STATICS	USER SPECIFIED LOAD DISPLACEMENT TABLE	DANOS	N			〃	N		
104				IS IT BASED ON CATENARY EQUATION	〃	?			〃	N		
105				IS IT BASED ON FINITE EL -EMENT METHOD W/ OR W/O BENDING STFFNSS, CIRCLE	〃	?			〃	N		
106				OTHERS (SPECIFY)	〃	?			〃	N		
107			DYNA-MICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	〃	?			〃	N		
108		****	....	IS THE MASS OF THE MOORING CONSIDERED	〃	N			〃	N		
109				IS THE MOORING SYSTEM MODELLED AS A LINEAR SPRING	〃	?			〃	Y		
110				IS THE MOORING SYSTEM MODELLED AS A NON-LINEAR SPRING	〃	?			〃	N		
111	SYSTEM	VERTICAL		IS GEOMETRIC NON LINEA-RITY CONSIDERED	〃	?			〃	N		
112				IS MATERIAL NON LINEA-RITY CONSIDERED	〃	?			〃	N		
113				IS THE HYDRODYNAMIC DAMPING CONSIDERED	〃	N			〃	N		
114			MOOR	IS THE STRUCTURAL DAMPING CONSIDERED	〃	N			〃	N		
115				IS THE MOORING SYSTEM COUPLED WITH PLATFORM	〃	N			〃	N		
116				IS IT BASED ON FINITE EL -EMENT METHOD,W/ OR W/O BENDING STFFNSS, CIRCLE	〃	?			〃	N		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****			** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
117	CAPABILITIES	MOORING	MODELING	HYDRODYNAMIC MODEL	IS IT BASED ON FINITE DIFFERENCE METHOD	SELOS DANDS	?			?	N		
118					IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	"	?			"	-		
119					IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	"	?			"	-		
120					IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING	"	N			"	-		
121					IS THE MOORING HYDRODYNAMIC MODEL 2D	"	Y			"	-		
122					IS THE MOORING HYDRODYNAMIC MODEL 3D	"	?			"	-		
123					IS THE MOORING MODEL TWO DIMENSIONAL	"	Y			"	Y		
124					IS THE MOORING MODEL THREE DIMENSIONAL	"	Y			"	N		
125					IS THE MOORING END AT FOUNDATION MODELED BY A LINEAR AXIAL SPRING	"	?			"	-		
126					IS MOORING END AT FOUNDATION MODELED BY A LINEAR & ROTATIONAL SPRING	"	?			"	-		
127					IS IT POSSIBLE TO MODEL AN ARRAY OF INTERCONNECTED MOORING LINES	"	N			"	N		
128					IS THE PROGRAM CAPABLE OF FATIGUE LIFE ANALYSIS	"	Y			"	N		
129			DYNAMICS		IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	?			"	N		
130		***	INSTALLATION ANALYS		IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING	"	N			"	N		
131		** **** OUTPUT			MEAN LOAD OF THE MOORING LINE	"	Y			"	N		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
132		FOR THE MOORING SYSTEM **** **	MOORING LINE LOAD RAO(S)	SELOS DANAS	Y			?	?		
133			MOORING LINE LOAD STATISTICS .. R.M.S. VALUE	"	?			"	?		
134			MOORING LINE LOAD STATISTICS .. (SIGNIFICANT)1/3	"	Y			"	?		
135			MOORING LINE LOAD STATISTICS .. OTHERS; SPECIFY	"	?			"	?		
136	********	* *** PROGRAM VERIFICATN *** *	WITH MODEL TESTS - INDICATE SCALE	"	?			"	N		
137			WITH OTHER SOFTWARE - LIST PROGRAMS	"	?			"	N		
138			WITH OTHER PUBLISHED MATERIAL .... SPECIFY	"	?			"	N		
139	******		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES	"	N			"	N		
140		* * STRUCTURAL MODEL * *	IS THE RISER MODEL TWO DIMENSIONAL								
141			IS THE RISER MODEL THREE DIMENSIONAL								
142			DOES THE PROGRAM USE FINITE ELEMENT METHOD								
143	R I		DOES THE PROGRAM USE FINITE DIFFERENCE METHOD								
144	S		DOES THE PROGRAM USE SMALL DEFLECTION THEORY								
145	E		IS THE PROGRAM CAPABLE OF USING LARGE DEFLECTION THEORY								
146	R	* * * *	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM								

TABLE I(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
147	SYSTEM	HYDRODYNAMIC	IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER								
148			IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING								
149			IS THE RISER HYDRODYNAMIC MODEL 2D								
150			IS THE RISER HYDRODYNAMIC MODEL 3D								
151		** SOLUTION MODE **	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM								
152			IS THE PROGRAM PERFORM FREQUENCY DOMAIN ANALYSIS								
153		* *** SPECIAL ANALYSIS *** *	IS IT CAPABLE OF CLEARANCE ANALYSIS BETWEEN RISERS								
154			IS IT CAPABLE OF INSTALLATION ANALYSIS W/ RISER BOTTOM AS FREE END								
155			IS IT CAPABLE OF INSTALLATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE								
156	******	PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE								
157			WITH OTHER SOFTWARE - LIST PROGRAMS								
158			WITH OTHER PUBLISHED MATERIAL .... SPECIFY								
159	* *** STABILITY ANALYSIS	INTACT	INTACT FREE FLOATING	SELOS	?			?	N		
160			INTACT WITH VERTICAL TAUT TENDONS	〃	?			〃	N		
161		DAMA	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED	〃	?			〃	N		

TABLE I(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
162	*** *	G E D	DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING	SELOS	?			?	N		
163	**** STRUCTURAL ANALYSIS ****	LOADING	HYDRODYNAMIC LOADING CONSIDERED	SELOS DANOS	Y			"	N		
164			IS INERTIA LOADING CONSIDERED	"	Y			"	N		
165			IS DYNAMIC LOADING CONSIDERED	"	Y			"	N		
166		SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS	"	Y			"	N		
167			THREE DIMENSIONAL SPACE FRAME ANALYSIS	"	Y			"	N		
168		* *** FINITE ELEMENT ANALYSIS *** *	BEAM ELEMENT	"	Y			"	N		
169			SHELL ELEMENT	"	Y			"	N		
170			PLATE ELEMENT	"	Y			"	N		
171			STIFFENED PLATE ELEMENT	"	N			"	N		
172			OTHERS .... SPECIFY	"	N			"	N		
173			NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM	"	?			"	N		
174		OTHER ANALYTICAL CAPABILITY	SPECTRAL ANALYSIS	"	Y			"	N		
175			MODAL ANALYSIS	DANOS DYNAL	Y			"	N		
176			FATIGUE LIFE ANALYSIS	"	Y			"	N		

TABLE I(A) [CONTINUED]

ROW #	**** ** ****	** ** ** ** ****** ** ** ** **	A		B		C		D	
			PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO
177	PRE-PROCESSING AND POST-PROCESSING CAPABILITIES	VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)	.				?	N.		
178		RESTART CAPABILITIES (LIST ALL THE PROGRAMS)					〃	N		
179		PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)	SELOS DANAS	Y			〃	?		
180		CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)	〃	Y (API)			〃	?		
181	PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON	PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION	〃	Y (IV)			〃	Y (IV)		
182		.... BASIC	〃	N			〃	N		
183		.... PASCAL	〃	N			〃	N		
184		.... OTHERS; SPECIFY	〃	N			〃	N		
185		COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU	〃	?			〃	?		
186	DOCUMENTATION	IS USERS' GUIDE AVAILABLE	〃	Y			〃	N		
187		IS THEORETICAL MANUAL AVAILABLE	〃	Y			〃	Y		
188	SUPPORT MAINTENANCE AND TRAINING	ARE THE PROGRAMS SUPP-ORTED AND MAINTAINED	〃	Y			〃	N		
189		IS ANY TRAINING OFFERED	〃	?			〃	N		
190	** ****	IBM	〃	Y			〃	?		
191		CDC	〃	N			〃	?		

TABLE I(A) [CONTINUED]

ROW #	**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
192	HARDWARE SYSTEM	PRIME COMPUTER	SELOS DANOS	N			?	?		
193		VAX	〃	Y			〃	?		
194		MICRO .. SPECIFY	〃	N			〃	?		
195	**** **	OTHERS .... SPECIFY	〃	N			〃	?		
196	** ****	LEASE (PRICE $ .00)	〃	Y			〃	?		
197	ACCESSIBILITY	PURCHASE (PRICE $ .00)	〃	Y			〃	?		
198	ARRANGEMENT	CONSULTANCY BASIS	〃	Y			〃	?		
199	**** **	OTHERS .... SPECIFY	〃	?			〃	?		
200										
201	REMARKS AND NOTES									
202										

TABLE II

SUMMARY OF FREQUENCY DOMAIN SOFTWARE CAPABILITIES
(BASED ON DIFFRACTION THEORY OR COMBINATION OF
DIFFRACTION THEORY, STRIP THEORY, AND MORISON'S EQUATION)

NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM
ANALYSIS TECHNIQUES
(SOFTWARE SURVEY)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
1	*	WIND FORCE CALCULATIONS	CALCULATES STATIC WIND FORCES	DINDIF	N			EUREKA	Y	SAI-HFEM	N	SESTRA (SESAM80)	N	AQUA-LIBRIUM	Y	DYNANA	N	NMISPM	LATE 1984
2	* *		CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION	"	N			"	N	"	N	"	N	AQUA-DRIFT	Y	"	N	"	-Do-
3	* *		IS THE WIND FORCE AN INPUT TO THE PROGRAM	"	N			SPLASHD	Y	"	N	"	Y	AQUA-LIBRIUM	OPTION-AL	"	N	"	N
4	* *		IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED	"	N			"	Y	"	N	"	N	AQUA-SUITE	N	"	N	"	N
5	*	CURRENT FORCE CALCULATION	CURRENT FORCES CALCULATED INDEPENDENTLY AND ADDED TO WAVE FORCES	"	N			"	N	"	N	"	N	AQUA-DRIFT-LIBRIUM	Y	"	N	"	Y
6			IS THE CURRENT FORCE AN INPUT TO THE PROGRAM	"	N			"	Y	"	N	"	Y	"	OPTION-AL	"	N	"	N
7		MEMBER ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER	"	N			CATMO HYDRO3 SPLASHD	Y	"	Y	WAMLOS (SESAM80)	Y	AQUA-LINE	Y	"	Y	NMIWAVE	Y
8	E		VERTICAL MEMBER	"	N			"	Y	"	Y	"	Y	"	Y	"	Y		Y
9	N		HORIZ. MEMBER	"	N			"	Y	"	Y	"	Y	"	Y	"	Y		Y
10	I	MEMBER X-SECT	IS THE PROGRAM CAPABLE OF HANDLING NONCIRCULAR CROSS SECTION	"	N			CATMO HYDRO3	Y	"	Y	"	Y	"	Y	"	Y		Y
11	R		DOES IT USE EQUIVALENT CIRCULAR X-SECTION	"	N			"	N	"	N	"	N	"	N	"	N		N

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
1	OSCAR	Y					WWC FORCE	Y					WIND	Y	FVRS	Y
2	"	N						N					WINDSPEC	Y	"	N
3		Y						N					"	N	"	N
4		N						N					"	N	"	N
5		Y						Y					CURRENT	Y	"	N
6		Y						Y					"	Y	"	N
7		Y					DIFFRAC SEMI-SUB	Y					TENMOT	Y	"	Y
8		Y					"	Y					"	Y	"	Y
9		Y					"	Y					"	Y	"	Y
10		Y					"	Y					"	Y	"	N
11		N					"	Y					"	N	"	N

NOTE: NUMBERS AT THE TOP OF THE COLUMNS REFER TO DETAILED RESPONSES TO THE BARDI QUESTIONAIRE FROM VARIOUS PARTICIPANTS. ALL RESPONSES ARE COMPILED IN APPENDIX I.

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
					PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
12	O N		: : ION	IS IT POSSIBLE TO DEFINE ARBITRARY GEOMETRY	DINDIF	Y			CATMO HYDRO3	Y	SAT-HFEM	Y	WAMLOS (SESAM)	Y	AQUA-LINE	Y	DYHANA	Y	NMIWAVE	Y	OSCAR	Y					DIFFRAC	Y					TENMOT	Y	FVRS	N
13	M	W		IS THE FORCE CALCULATED AT THE LONGL AXIS OF THE MEMBER	DINDIF DIFPOS	Y			SPLASHD HYDRO3 CATMO	Y	"	Y		Y	"	Y	"	N	"	Y	"	Y					"	Y					"	Y		N
14	E N	A		ANY METHOD TO CALC PRESS DISTRIBUTION ON SURFACE; IF YES, PLEASE SPECIFY	DINDIF	Y			"	Y	"	Y		FALTINSEN MICHELSEN (75)	"	Y	"	Y	"	POTENTIAL THEORY	"	Y					"	Y					"	Y		Y
15	T	V		IS THE INTERACTION BET MEMBERS CONSIDERED : COLUMN AND COLUMN	"	Y			HYDRO3	Y	"	Y		Y	"	Y	"	Y	"	Y	"	Y					"	Y					"	Y		N
16	A	E	MEMBER INTER-ACTION	COLUMN AND PONTOON	"	Y			"	Y	"	Y		Y	"	Y	"	Y	"	Y	"	Y					"	Y					"	Y		N
17	L			PONTOON AND PONTOON	"	Y			"	Y	"	Y		Y	"	Y	"	Y	"	Y	"	Y					"	Y					"	Y		N
18			FIRST ORDER	IS THE PROGRAM BASED ON DIFFRACTION THEORY, SPECIFY THE TYPE	"	Y			"	Y	"	Y		FALTINSEN MICHELSEN (75)	"	SINGULARITY DISTRIBUTION	"	1ST ORDER DIFF& RADIATION	"	SOURCE /SINK	"	2D STRIP 3D DIFF					"	Y					"	Y		Y
19				IS THE PROGRAM BASED ON HYBRID ELEMENT METHOD : DIFFRACTION & MORISON	DINDIF DRAGON	Y			"	N	"	Y		Y	"	Y	"	N	"	Y	"	Y						N					"	N		Y
20				DIFFRACTION & FLUID FINITE ELEMENT	DINDIF	N			"	N	"	N		N	"	N	"	N	"	N	"	N						N					"	N		N
21		F		OR ANY OTHER COMBINATION, PLEASE SPECIFY	"	N			SPLASHD + HYDRO3 CATMO	DIFF + MORISON	"	N		N	"	N	"	FE + BE	"	N	"	N						N					"	N		N
22	F	O		DOES IT CONSIDER THE WAVE ELEVATION	"	Y			HYDRO3 CATMO	Y	"	Y		N	"	N	"	Y	"	Y	"	Y					DRIFT P DB DRIFT	Y					"	N		N
23	O R	R	SECOND DRIFT FORCES	DOES THE PROGRAM ACCOUNT REFLECTION OF 1ST ORDER WAVES FROM THE BODY	"	Y			"	Y	"	Y		Y	"	Y	"	Y	"	Y	"	Y					"	Y					"	Y		Y
24	C	C		DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO DISPLACEMENT OF BODY	"	Y			"	Y	"	Y		Y	"	N	"	Y	"	Y	"	Y					"	Y					"	Y		Y
25	E	E		DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO ROTATION OF BODY	"	Y			"	Y	"	Y		Y	"	N	"	Y	"	Y	"	Y					"	Y					"	Y		Y
26	S	S		DOES IT ACCOUNT FORCE ON A FIXED BODY BY LOW FREQUENCY 2ND ORDER WAVES	DINDIF + UTILITY ROUTINE	Y			"	Y	"	Y		N	"	N	"	JULY 1984	"	Y	"	Y					"	Y					"	Y		N

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
27			VISCOUS — DOES THE PROGRAM CONSIDER NON-LINEAR WAVE DRAG	DINDIF	N			CATHI HYDRO SPLASH	N	SAI-HFEM	Y	WAMLOS (SESAM?)	N	AQUA-LINE	N	DYHANA	N	NMIWAVE	Y	OSCAR	Y						N					TENMOTI?	N	FVRS	N
28		ORDER	IF DRAG FORCE CALCULATION CONSIDER MEAN CURRENT & WAVE PARTICLE VELOCITY	"	N			"	N	"	N	"	N	"	N	"	N	"	Y	"	Y						N					"	N	"	N
29	* * * * * * * * *		IS CURRENT & WAVE FRICTION CONSIDERED IN RESULTANT FRICTIONAL DRIFT	"	N			"	Y	"	N	"	N	"	N	"	N	"	N	"	N						N					"	N	"	N
30			IS ITERATION OF RESPONSE USED FOR CONVERGENCE	"	N			"	Y	"	N	"	N	"	N	"	N	"	N	"	Y						N					"	N	"	N
31			FORCES — DOES IT USE PREVIOUS TIME STEP RESULTS IN PRESENT STEP CALCULATION	"	N			"	Y	"	N	"	N	"	N	"	N	"	N	"	Y					MOORSIN SIMOLA	Y					"	N	"	N
32			IS THE CONVERGENCE TOLERANCE BUILT IN THE PROGRAM	"	N			"	BUILT IN DEFAULT	"	N	"	N	"	N	"	N	"	N	"	Y					"	Y					"	N	"	N
33			DOES THE USER SPECIFY THE CONVERGENCE TOLERANCE	"	N			"	CAN SPECIFY	"	N	"	N	"	N	"	N	"	N	"	Y						N					"	N	"	N
34	* * * *	FREQUENCY	ADD MASS — IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	"	N			"	N	"	N	"	N	"	OPTIONAL	"	N	"	OPTIONAL	"	N						N					"	N	"	N
35			CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	3D			"	3D, 2D	"	3D	"	3D	"	3D	"	3D	"	3D	"	2D, 3D					DIFFRAC	3D					"	Y	"	Y
36	EQUATION		DAMPING — IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	N			"	Y	"	Y	"	Y	"	N	"	N	"	Y	"	Y						N					"	Y	"	N
37			IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	N			"	Y	"	N	"	N	"	N	"	N	"	N	"	N						N					"	Y	"	N
38			IS THE CURRENT DRAG DAMPING CONSIDERED	"	N			"	Y	"	N	"	N	"	N	"	N	"	Y	"	N					"	Y					"	N	"	N
39	OF		COEFFICIEN — IS THE CURRENT FRICTION DAMPING CONSIDERED	"	N			"	Y	"	N	"	N	"	N	"	N	"	N	"	N						N					"	N	"	N
40			IS THE RADIATION DAMPING CONSIDERED	"	N			"	Y	"	Y	"	Y	"	Y	"	Y	"	Y	"	Y					"	Y					"	Y	"	Y
41	MOT	DO	IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	N	"	N	SESTRA (SESAM80)	Y	AQUA-LINK	N	"	Y	"	N	"	N						N					"	Y	"	N

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
42	ON	MAIN	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	DINDIF	N			SPLASHD HYDRO2 CATM	N	SAI-HFEM	N	WAMLOS (SESAM80)	N	AQWA-LINE	OPTIO-NAL	DYHANA	N	NMIWAVE	OPTIO-NAL	OSCAR	N					DIFFRAC	N					TENMOT	N	FVRS	N
43	****	MAIN	STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	"	Y			"	N	"	N	"	Y	"	OPTIO-NAL	"	PARTLY	"	N	"	N					"	Y					"	N	"	Y
44		MAIN	STIFFNS	IS THE STIFFNESS MATRIX COMPUTED	"	N			"	Y	"	Y	"	Y	"	Y	"	PARTLY	"	Y	"	Y					"	Y					"	Y	"	Y
45	**** ENVIRONMENTAL	** WIND **	STATIC WIND	IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT	"	N			EUREKA	Y	"	N	SESAM80	N	"	N	"	N	NMISPM	LATE 1984	"	Y						N					"	Y	"	N
46		WIND	DYNAMIC WIND	IS THERE PROVISION TO USE FOLLOWING SPECTRA : HARRIS	"	N			"	N		N	"	N	"	N	"	N	"	-DO-	"	N						N					"	Y	"	N
47		WIND	DYNAMIC WIND	DAVENPORT	"	N			"	N		N	"	N	"	N	"	N	"	-DO-	"	N						N					"	Y	"	N
48		WIND	DYNAMIC WIND	SIMIU	"	N			"	N		N	"	N	"	N	"	N	"	N	"	N						N					"	N	"	N
49		WIND	DYNAMIC WIND	OTHERS (SPECIFY)	"	N			"	N		N	"	N	"	N	"	N	"	ESDU (LATE '84)	"	N						N					"	N	"	N
50		CURRENT		IS IT BASED ON UNIFORM CURRENT VELOCITY PROFILE	"	N			SPLASHD	Y		N	"	N	"	-	"	N	NMIWAVE	N	"	N						N					"	Y	"	N
51		CURRENT		IS IT CAPABLE OF USING NON-UNIFORM CURRENT PROFILE	"	N			"	N		N	"	N	"	1984-85	"	N	"	Y	"	Y						N					"	N	"	N
52		******	STATISTICS	SIGNIFICANT WAVE HEIGHT	"	N			SPLASHD HYDRO3 CATM	Y		Y	POSTFRAME (SESAM80)	Y	AQWA-FER	Y	"	N	"	Y	"	Y						Y					"	Y	"	N
53			STATISTICS	MEAN SPECTRAL PERIOD	"	N			"	Y		Y	"	Y	"	Y	"	N	"	Y	"	Y					"	Y					"	Y	"	N
54			STATISTICS	WAVE SCATTER DIAGRAM	"	N			"	N		Y	"	Y	"	N	"	N	"	N	"	N						N					"	Y	"	N
55			.	LINEAR WAVE	"	Y			"	Y		Y	"	Y	AQWA-LINE	Y	"	Y	"	AIRY w/ AHNU DEPTH	"	Y					"	Y					"	Y	"	Y
56			.	STRETCH LINEAR	"	N			"	N		N	"	N	"	N	"	N	"	N	"	N						N					"	N	"	N

ROW #		****		** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
57	DESCRIPTION *	WAVES	WAVE THEORIES	STOKE'S 2ND, 3RD OR 5TH ORDER .... PLEASE CIRCLE ...	DINDIF	N			SPLASHD HYDRO3 [illegible]	N	SAI-HFEM	N	SESAM80	N	AQUA-LINE	N	DYHANA	N	NMIWAVE	5th	OSCAR	N						N.A.					TENMOT	N	FVRS	N
58				STREAM FUNCTION USING THE FORM GIVEN BY .... DEAN	"	N			"	N	"	N	"	N	"	N	"	N	"	Y	"	Y						N.A.					"	N	"	N
59				STREAM FUNCTION : THE FORM GIVEN BY .... VON SCHWIND	"	N			"	N	"	N	"	N	"	N	"	N	"	N	"	N						N.A.					"	Y	"	N
60				STREAM FUNCTION : THE FORM GIVEN BY .... HUDSPETH	"	N			"	N	"	N	"	N	"	N	"	N	"	N	"	N						N.A.					"	Y	"	N
61				STREAM FUNCTION : OR ANY OTHER FORM .... PLEASE SPECIFY	"	N			"	N	"	N	"	N	"	N	"	N	"	N	"	N						N.A.					"	Y	"	N
62				EXTENDED VELOCITY POTENTIAL	"	N			"	N	"	N	"	N	"	N	"	N	"	N	"	N						N.A.					"	Y	"	N
63				CNOIDAL WAVE THEORY	"	N			"	N	"	N	"	N	"	N	"	N	"	KEULEGAN/PATTERSON	"	N						N.A.					"	N	"	N
64			SEA SPECTR	IS THERE PROVISION TO USE FOLLOWING SPECTRA : PIERSON-MOSKOWITZ	"	N			"	Y	"	Y	POSTFRAME (SESAM80)	Y	AQUA-FER	Y	"	N	"	Y	"	Y					DIFFRAC	Y					"	N	"	N
65				ISSC	"	N			"	Y	"	Y	"	N	"	Y	"	N	"	Y	"	Y						N					"	Y	"	N
66				JONSWAP	"	N			"	Y	"	Y	"	Y	"	Y	"	N	"	Y	"	Y						Y					"	N	"	N
67				BRETSCHNEIDER	"	N			"	Y	"	Y	"	N	"	N	"	N	"	N	"	N						N					"	Y	"	N
68				SCOTT	"	N			"	Y	"	Y	"	N	"	N	"	N	"	N	"	N						N					"	Y	"	N
69		*****		OCHI (SIX PARAMETER)	"	N			"	Y	"	Y	"	N	"	N	"	N	"	N	"	N						N					"	Y	"	N
70				INPUT SPECTRA	"	N			"	Y	"	Y	"	N	"	Y	"	N	"	Y	"	Y					"	Y					"	Y	"	N
71				OTHERS	"	N			"	Y	"	N	"	N	"	N	"	N	"	DERBYSHIRE	"	N						N					"	N	"	N

ROW #		**** **** * A	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
72	* *	*	DIRECTIONAL SPECTRA	DINDIF	N			HYDROS SPLASND LATMO	Y	SAI-HFEM	Y	POSTFRAME (SESAM80)	Y	AQUA-FER	N	DYHANA	N	NMIWAVE	Y
73	* *	OTHERS	DOES IT CONSIDER EARTH QUAKE SPECTRA	"	N			"	N	"	N	"	N	"	N	"	N		N
74	* *	OTHERS	DOES IT CONSIDER CHANGE IN WATER LEVEL DUE TO TIDE	"	N			"	N	"	N	"	N	"	N	"	Y		N
75	SOLUTION	STATICS	NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	"	SIX			"	SIX	"	SIX	"	SIX	AQUA-FER-LINE	Y	"	SIX		N
76	SOLUTION	STATICS	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	"	?			"	SIX COUPLED DOF	"	SIX COUPLED DOF	"	ALL SIX	"	Y	"	ALL SIX		N
77	SOLUTION	STATICS	IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	"	N			"	?	"	SIX	SESTRA (SESAM80)	UNLIMITED	AQUA-LINE-ASAS	Y	"	N		N
78	TECHNIQUE	DYNAMICS FREQUENCY DOMAIN	HOW MANY DEGREES OF FREEDOM INCLUDED IN THE SOLUTION .... SPECIFY	"	SIX			"	SIX	"	SIX	"	SIX	AQUA-LINE-FER	SIX	"	24 RIGID OR DISTORTION MODES		SIX
79	TECHNIQUE	DYNAMICS FREQUENCY DOMAIN	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	"	?			"	SIX COUPLED DOF	"	SIX COUPLED DOF	"	ALL SIX	"	ALL SIX	"	ANY		ALL SIX
80	TECHNIQUE	DYNAMICS FREQUENCY DOMAIN	WHAT METHOD OF LINEARIZATION USED .... SPECIFY	DRAGON	ENERGY BALANCE			"	LEAST SQUARE ERROR MIN.	"	Y	"	—	AQUA-FER	Y	"	NONE		EQUIV ENERGY DISSIPATION
81	TECHNIQUE	DYNAMICS FREQUENCY DOMAIN	MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION	DINDIF	N			"	GAUSS JORDAN	"	Y	"	Y	"	Y	"	N		Y
82	TECHNIQUE	DYNAMICS FREQUENCY DOMAIN	OTHERS .... SPECIFY	"	PIVOT METHOD			"	N	"	N	"	CHOLESKY	"	N	"	MODAL		N
83	PLATFORM RESPONSE OUTPUT		MEAN OFFSET OF THE PLATFORM	"	N			"	Y	"	Y	WAMLOS (SESAM80)	N	AQUA-LIBRIUM	Y	"	N		N
84	PLATFORM RESPONSE OUTPUT		MOTION RAO(S) OF THE PLATFORM, FOR PLOT CAPABILITY ENTER 'P'	"	Y			"	Y	"	Y	"	Y	AQUA-LINE-FER	P	"	P		P
85	PLATFORM RESPONSE OUTPUT		PLATFORM MOTION RESPONSE SPECTRA	"	N			"	Y	"	Y	"	N	AQUA-FER	Y	"	N		Y
86	PLATFORM RESPONSE OUTPUT		RESPONSE STATISTICS .. MEAN VALUE	"	N			"	Y	"	Y	POSTFRAME	Y	"	Y	"	N		Y

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
72	OSCAR	N					DIFFRAC	Y					TENMOT	Y	FVRS	N
73	"	N						N					"	N	"	N
74	"	N						N					"	N	"	N
75	"	SIX					SIX						"	SIX	"	SIX
76	"	ALL SIX					SIX						"	ALL SIX	"	TWO
77	"	N					—						"	—	"	N
78	"	SIX					18	3 INDEPENDENTLY MOVING BODIES					"	SIX	"	SIX
79	"	ALL SIX					18						"	ALL SIX	"	TWO
80	"	—					—						"	ITERATION	"	Y
81	"	PROPRIETORY					DIRECT						"	N	"	Y
82	"	N					—						"	INVERT MATRIX	"	GAUSS JORDAN
83	"	Y					DIFFRAC	Y					"	Y	"	Y
84	"	P					"	Y					"	Y	"	N
85	"	Y					"	Y					"	Y	"	N
86	"	Y					"	Y					"	Y	"	N

* MOORING ANALYSIS IN TIME DOMAIN ONLY

ROW #	**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
87	******* ***** *** *	RESPONSE STATISTICS .. R.M.S. VALUE	DINDIE	N			ATMO HYDROS SPLASHD	N	SAI-HFEM	Y	POSTRAMB	Y	AQWA-FER	Y	DYHANA	N	NMIWAVE	Y	OSCAR	Y					DIFFRAC	Y					TENMOR	Y	FVRS	N
88		RESPONSE STATISTICS .. (SIGNIFICANT)1/3	"	N			"	Y	"	Y	"	Y	"	Y	"	N	"	Y	"	Y					"	Y					"	Y	"	N
89		RESPONSE STATISTICS .. OTHERS; SPECIFY	"	N			"	N	"	Y	"	N	"	Y	"	N	"	EXPECTED MAX	"	1/10 1/100						N					"	Y	"	N
90		EIGEN VALUES (SYSTEM NATURAL PERIODS)	"	N			"	Y	"	Y	SESTRA	Y	"	–	"	Y	"	Y	"	N					"	Y					"	Y	"	N
91	** **** PROGRAM VERIFICATION **** **	MODEL TEST - INDICATE SCALE	"	Y (55)			"	Y	"	Y	SESAMBO	Y	AQWA-LINE-FER	Y	"	36 + 100	"	50	"	Y					"	40 + 80					"	1/40	"	N
92		OTHER AVAILABLE SOFTWARE - LIST PROGRAMS	"	NV459			"	N	"	Y	"	Y	"	Y	"	HYDRA NMIWAVE, AXID	"	GARRISON DnV NSMB	"	Y					SEE BROCH-URE	Y					"	NMI	"	N
93		OTHER PUBLISHED MATERIAL - SPECIFY	"	N			"	N	"	N	"	Y	"	Y	"	GARRISON FALTINSEN OBERTM-ERSEN	"	PAULLING & ANALYTI-CAL SOLNS.	"	Y					"	Y					"	N	"	BLACK DOT
94		OTHERS (SPECIFY)	"	N			"	N	"	N	"	N	"	FULL SCALE MEASU-REMENT	"	ANALYTICAL SOLNS	"	N	"	N					"	Y					"	N	"	N
95	****** DESCRIPTION	SPREAD MOORING (CATENARY)	ANCOR3 ANCOR4	Y			"	Y	"	Y	"	–	AQWA-FER	Y	"	Y	"	Y	"	Y					"	Y					"	N	"	N
96		SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT	"	Y			"	N	"	N	"	–	"	Y	"	Y	"	N	"	Y					"	Y					"	N	"	N
97		VERTICAL (TAUT) MOORING	"	Y			"	Y	"	Y	"	–	"	Y	"	Y	"	Y	"	Y					"	Y					"	Y	"	Y
98		HYBRID/OTHER COMBINATION .... SPECIFY	"	Y			"	SLANTED TAUT	"	N	"	–	"	Y	"	N	"	N	"	TAUT-BUOY-CATENARY					–	–					"	N	"	N
99	M O MATERIA	SYNTHETIC ROPE - SUCH AS NYLON KEVLAR	"	Y			"	N	"	Y	"	–	"	Y	"	Y	"	N	"	Y					"	Y					"	N	"	N
100		CHAIN (STEEL)	"	Y			"	Y	"	Y	"	–	"	Y	"	Y	"	Y	"	Y					"	Y					"	N	"	N
101		WIRE ROPE (STEEL)	"	Y			"	Y	"	Y	"	–	"	Y	"	Y	"	Y	"	Y					"	Y					"	N	"	N

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
102	RING			COMBINATIONS SUCH AS CHAIN/WIRE ROPE OTHERS, SPECIFY	ANCORS ANCORA	Y			CATMO HYDRO3 SPLASHD	N	SAI-HFEM	N	SESAM80	–	AQWA-FER	Y	DYHANA	Y	NMIWAVE	N	OSCAR	CHAIN-WIRE-NYLON					MOORSIM	Y					TENMO	N	FVRS	N
103		ANALYSES	STATICS	USER SPECIFIED LOAD DISPLACEMENT TABLE	"	Y			"	N	"	Y	"	–	"	Y	"	N	"	N	"	N						N					"	Y	"	N
104				IS IT BASED ON CATENARY EQUATION	"	Y			"	Y	"	Y	"	–	"	Y	"	N	"	Y	"	Y					FLEX 3D-FLEX 2D	Y					"	Y	"	N
105				IS IT BASED ON FINITE EL-EMENT METHOD W/ OR W/O BENDING STFFNSS, CIRCLE	"	N			"	N	"	N	"	–	"	1984-85	"	N	"	N	"	N					DYN-LINE	Y					"	Y	"	N
106				OTHERS (SPECIFY)	"	N			"	N	"	N	"	–	"	N	"	LINEAR STIFFNESS	"	N	"	N					–	–					"	N	"	N
107			DYNAMICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	N			"	N	"	Y	"	Y	"	Y	"	N	"	Y	"	Y						Y					"	N	"	N
108		****	....	IS THE MASS OF THE MOORING CONSIDERED	DINDIF	N			"	N	"	Y	"	–	"	N	"	N	"	Y	"	N						N					"	N	"	N
109				IS THE MOORING SYSTEM MODELLED AS A LINEAR SPRING	"	Y			"	Y	"	Y	"	–	"	Y	"	Y	"	Y	"	Y						Y					"	Y	"	Y
110				IS THE MOORING SYSTEM MODELLED AS A NON-LINEAR SPRING	"	N			"	N	"	N	"	–	"	Y	"	N	"	Y	"	FOR STATIC						N					"	N	"	N
111	SYSTEM	VERTICAL		IS GEOMETRIC NON LINEA-RITY CONSIDERED	"	N			"	N	"	Y	"	–	"	Y	"	N	"	Y	"	Y						N					"	N	"	N
112				IS MATERIAL NON LINEA-RITY CONSIDERED	"	N			"	N	"	N	"	–	"	Y	"	N	"	N	"	Y						N					"	N	"	N
113				IS THE HYDRODYNAMIC DAMPING CONSIDERED	"	N			"	N	"	N	"	–	"	N	"	N	"	N	"	N						N					"	N	"	N
114			MOOR	IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	N	"	N	"	–	"	N	"	N	"	N	"	N						N					"	Y	"	N
115				IS THE MOORING SYSTEM COUPLED WITH PLATFORM	"	N			"	N	"	Y	"	–	"	Y	"	N	"	N	"	Y						N					"	N	"	N
116				IS IT BASED ON FINITE EL-EMENT METHOD,W/ OR W/O BENDING STFFNSS, CIRCLE	"	N			"	N	"	Y	"	–	"	N	"	N	"	N	"	N						N					"	N	"	N

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
117	CAPABILITIES	MOORING – ING MODEL – HYDRODYNAMIC MODEL	IS IT BASED ON FINITE DIFFERENCE METHOD	DINDIF	N			HYDROS SPASND	N	SAI-HFEM	N	SESAM80	—	AQWA-FER	N	DYHANA	N	NMIWAVE	N
118			IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	"	N			SPASHD	Y	"	N	"	—	"	N	"	N	"	N
119			IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	"	N			"	N	"	Y	"	-	"	N	"	N	"	N
120			IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING	"	N			"	N	"	N	"	—	"	N	"	N	"	N
121			IS THE MOORING HYDRODYNAMIC MODEL 2D	"	N			"	Y	"	Y	"	-	"	N	"	N	"	N
122			IS THE MOORING HYDRODYNAMIC MODEL 3D	"	N			"	N	"	N	"	-	"	Y	"	N	"	N
123			IS THE MOORING MODEL TWO DIMENSIONAL (STRUCT'L)	"	Y			"	Y	"	Y	"	-	"	N	"	N	"	N
124			IS THE MOORING MODEL THREE DIMENSIONAL (STRUCT'L)	"	N			"	Y	"	Y	"	-	"	Y	"	N	"	Y
125			IS THE MOORING END AT FOUNDATION MODELED BY A LINEAR AXIAL SPRING	"	N			"	Y	"	Y	"	-	"	N	"	N	"	Y
126			IS MOORING END AT FOUNDATION MODELED BY A LINEAR & ROTATIONAL SPRING	"	N			"	N	"	N	"	-	"	N	"	N	"	N
127			IS IT POSSIBLE TO MODEL AN ARRAY OF INTERCONNECTED MOORING LINES	"	N			"	N	"	N	"	—	"	Y	"	BY DIRECT INPUT	"	N
128			IS THE PROGRAM CAPABLE OF FATIGUE LIFE ANALYSIS	"	N			"	N	"	N	"	—	"	N	"	N	"	N
129		DYNAMICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	N			"	N	"	Y	"	—	"	Y	"	N	"	Y
130		*** INSTALLATION ANALYS	IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING	"	Y			"	N	"	Y	"	-	"	Y	"	Y	"	Y
131		** ****	MEAN LOAD OF THE MOORING LINE	"	N			"	Y	"	Y	"	-	"	Y	"	N	"	Y

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
117	OSCAR	N					DYNLINE	N					TENMOT	N	FVRS	N
118	"	N					"	N					"	N	"	Y
119	"	N					"	N					"	N	"	Y
120	"	N					"	N					"	N	"	N
121	"	N					"	Y					"	N	"	N
122	"	N					"	N					"	N	"	N
123	"	N					"	Y					"	N	"	N
124	"	N					"	N					"	N	"	N
125	"	N					"	Y					"	Y	"	N
126	"	N					"	N					"	N	"	N
127	"	N					"	N					"	N	"	N
128	"	N					"	N					"	Y	"	N
129	"	N					"	Y					"	N	"	N
130	"	Y					"	Y					"	Y	"	N
131	"	Y					"	N					"	Y	"	N

* RISER ANALYSIS IN TIME DOMAIN ONLY

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
132		OUTPUT FOR THE MOORING SYSTEM **** **	MOORING LINE LOAD RAO(S)	DINDIF	N			SPLASHD	Y	SAI-HFEM	Y	SESAM80	-	AQWA-FER	Y	DYHANA	Y	NMIWAVE	Y	OSCAR	Y					STATAN	Y					TENMOT	Y	FVRS	N
133			MOORING LINE LOAD STATISTICS .. R.M.S. VALUE	"	N			"	N	"	Y	"	-	"	Y	"	N		Y	"	Y					"	Y					"	Y	"	N
134			MOORING LINE LOAD STATISTICS .. (SIGNIFICANT)1/3	"	N			"	Y	"	Y	"	-	"	Y	"	N		Y	"	Y					"	Y					"	Y	"	N
135			MOORING LINE LOAD STATISTICS .. OTHERS; SPECIFY	"	N			"	N	"	N	"	-	"	Y	"	N		EXPECTED MAX	"	Y					-	-					"	N	"	N
136	*******	PROGRAM VERIFICATN * *** *** *	WITH MODEL TESTS - INDICATE SCALE	"	N			"	N	"	Y	"	-	"	Y	"	N		50	"	Y					"	20 TO 80					"	1/40	"	N
137			WITH OTHER SOFTWARE - LIST PROGRAMS	"	N			"	N	"	Y	"	-	"	Y	"	N		PAULING	"	Y						-					"	NMI	"	N
138			WITH OTHER PUBLISHED MATERIAL .... SPECIFY	"	N			"	N	"	N	"	-	"	Y	"	N		N	"	Y						-					"	N	"	N
139	****** RISER		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES		N			MLTPIP	Y	"	N	"	N	AQWA-RISER	Y	"	N			"	Y						N					FDRISER DWRSR	Y	"	N
140		** STRUCTURAL MODEL ***	IS THE RISER MODEL TWO DIMENSIONAL					"	N	"	N	"	-	"	Y	"	N			"	N						N					"	Y	"	N
141			IS THE RISER MODEL THREE DIMENSIONAL					"	Y	"	N	"	-	"	N	"	N			"	Y						N					DWRSR	Y	"	N
142			DOES THE PROGRAM USE FINITE ELEMENT METHOD					"	Y	"	N	"	-	"	Y	"	N			"	N						N					"	Y	"	N
143			DOES THE PROGRAM USE FINITE DIFFERENCE METHOD					"	N	"	N	"	-	"	N	"	N			"	N						N					FDRISER	Y	"	N
144			DOES THE PROGRAM USE SMALL DEFLECTION THEORY					"	Y	"	N	"	-	"	Y	"	N			"	N						N					FDRISER DWRSR	Y	"	N
145			IS THE PROGRAM CAPABLE OF USING LARGE DEFLECT-ION THEORY					"	N	"	N	"	-	"	N	"	N			"	N						N					DWRSR	Y	"	N
146			IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM					"	Y	"	N	"	-	"	Y	"	N			"	Y						N					"	WITH CURRENT & REL VEL	"	N

ROW #		**** **** *	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
147		HYDRODYNAMIC	IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER					MLTPIP	Y	SAI-HFEM	N	SESAM80	-	AQUA-RISER	Y	DYBANA	N			OSCAR	Y					DIFFRAC	N					FDRISER DWRSR	Y	FVRS	N
148			IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING					"	Y	"	N	"	-	"	N	"	N			"	N					"	N					FDRISER	Y	"	N
149			IS THE RISER HYDRODYNAMIC MODEL 2D					"	N	"	N	"	-	"	Y	"	N			"	N					"	N					FDRISER DWRSR	Y	"	N
150			IS THE RISER HYDRODYNAMIC MODEL 3D					"	Y	"	N	"	-	"	N	"	N			"	Y					"	N					DWRSR	Y	"	N
151	SYSTEM	** SOLUTION MODE **	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM					"	Y	"	N	"	-	"	Y	"	N			"	Y					"	N					"	N	"	N
152			IS THE PROGRAM PERFORM FREQUENCY DOMAIN ANALYSIS					"	Y	"	N	"	-	"	Y	"	N			"	Y					"	N					FDRISER (DWRSR)	Y (12/84)	"	N
153		* *** SPECIAL ANALYSIS *** *	IS IT CAPABLE OF CLEARANCE ANALYSIS BETWEEN RISERS					"	Y	"	N	"	-	"	N	"	N			"	N					"	N					"	Y	"	N
154			IS IT CAPABLE OF INSTALLATION ANALYSIS W/ RISER BOTTOM AS FREE END					"	Y	"	N	"	-	"	Y	"	N			"	Y					"	N					"	Y	"	N
155			IS IT CAPABLE OF INSTALLATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE					"	Y	"	N	"	-	"	Y	"	N			"	Y					"	N					"	Y	"	N
156		PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE					"	Y	"	N	"	-	"	Y	"	N			"	N					"	N					"	N	"	N
157	*****		WITH OTHER SOFTWARE - LIST PROGRAMS					"	Y	"	N	"	-	"	Y	"	N			"	N					"	N					"	N	"	N
158			WITH OTHER PUBLISHED MATERIAL .... SPECIFY					"	Y	"	N	"	-	"	Y	"	N			"	N					"	N					"	API RP2J	"	N
159	* ***	INTACT	INTACT FREE FLOATING	FLOSTA NASTA	Y			EUREKA	Y	"	N	NV223	Y	AQUA-LIBRIUM	Y	ARCHIMEDES	Y	NMIWAVE	N	"	Y					"	N					FLOSTAB BALANCE	Y	"	N
160	STABILITY		INTACT WITH VERTICAL TAUT TENDONS	"	Y			"	N	"	N	"	Y	"	Y	"	N	"	N	"	Y					"	N					"	Y	"	N
161	ANALYSIS	DAM	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED	"	Y			"	Y	"	N	"	Y	"	Y	"	Y	"	N	"	Y					"	N					"	Y	"	N

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
162	*** *	AGED	DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING	FLOSTA NASTA	Y			EUREKA	N	SAI-HFEM	N	NV223	N	AQUA LIBRIUM	Y	ARCHIMEDES	N	NMIWAVE	N
163	**** STRUCTURAL ANALYSIS ****	LOADING	HYDRODYNAMIC LOADING CONSIDERED	DINDIF DIFPOS	Y			SPLASH STRAN	Y	"	N	SESTRA (SEMBO)	Y	AQUA-LINK	Y	DYHANA	Y		
164		LOADING	IS INERTIA LOADING CONSIDERED	"	Y			"	Y	"	N	"	Y	"	Y	"	Y		
165		LOADING	IS DYNAMIC LOADING CONSIDERED	"	Y			"	Y	"	N	"	Y	"	Y	"	Y		
166		SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS	DINDIF DIFPOS DIFCARG	Y			"	Y	"	N	"	Y	"	N	"	JULY 1985		
167		SPACE FRAME ANALYSIS	THREE DIMENSIONAL SPACE FRAME ANALYSIS	"	Y			"	Y	"	N	"	Y	"	N	"	-DO-		
168		* *** FINITE ELEMENT ANALYSIS	BEAM ELEMENT	NASTRAN	Y			"	Y	"	N	"	Y	"	N	"	N		
169		FINITE ELEMENT ANALYSIS	SHELL ELEMENT	"	Y			"	N	"	N	"	Y	"	8,4,6 4,3 NODE	"	N		
170		FINITE ELEMENT ANALYSIS	PLATE ELEMENT	"	Y			"	Y	"	N	"	Y	"	Y	"	N		
171		FINITE ELEMENT ANALYSIS	STIFFENED PLATE ELEMENT	"	?			"	Y	"	N	"	N	"	Y	"	N		
172		*** *	OTHERS .... SPECIFY	"	N			"	N	"	N	"	CABLE TRUSS BAR SOLID AXISYM	"	N	"	N		
173			NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM	"	?			"	?	"	N	"	UNLIMITED	"	Y	"	N		
174		OTHER ANALYTICAL CAPABILITY	SPECTRAL ANALYSIS	"	Y			"	Y	"	N	"	Y	ASAS	Y	"	N		
175		OTHER ANALYTICAL CAPABILITY	MODAL ANALYSIS	"	Y			"	N	"	N	"	Y	ASAS DYNAMICS	Y	"	Y		
176	****	OTHER ANALYTICAL CAPABILITY	FATIGUE LIFE ANALYSIS	SHELFA	Y			"	Y	"	N	"	Y	FAT JACK	Y	"	N		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
162	OSCAR	Y					DIFFRAC	N					FLOSTAB BALANCE	Y	EVRS	N
163	"	Y					DYNFORCE	Y					TENLOAD	Y	"	Y
164	"	Y					"	Y					"	Y	"	Y
165	"	Y					"	Y					"	Y	"	Y
166	"	N					"	Y					DAMS	Y	"	N
167	"	N					"	Y					"	Y	"	N
168	"	N					"	Y					"	Y	"	N
169	"	N					"	Y					DAMSFE	Y	"	N
170	"	N					"	Y					"	Y	"	N
171	"	N						-					"	Y	"	N
172	"	N						-					"	SOLID	"	N
173	"	N						-					"	SIX/NODE	"	N
174	"	N					STATAN	Y					TENLOAD	Y	"	N
175	"	N						N					DAMS	Y	"	N
176	"	N						N					SDFATIGUE DFATIGUE TFATIGUE	Y	"	N

ROW #	**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
			PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
177	PRE-PROCESSING AND POST-PROCESSING CAPABILITIES	VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)	PROSP	Y				?	SAI-HFEM	N	SESAM84	Y	AQWA ASAS	Y	DYHANA	Y	NMIWAVE	Y	OSCAR	Y						Y					ALL	Y	FVRS	N
178		RESTART CAPABILITIES (LIST ALL THE PROGRAMS)	NASTRAN	Y				?	"	N	"	Y	"	Y	"	Y		Y	"	Y						N					TENLOAD TENMOT DAMS	Y	"	Y
179		PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)	PROSP NASTRAN	Y				?	"	N	"	Y	ASDIS C-GUL AQWA PLANE	Y	"	Y		Y	"	Y						Y					ALL	Y	"	N
180		CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)	DNV 77	Y				?	"	N	"	Y	ASAS -BEAMST	Y	"	N		N	"	N						N					DAMS	Y	"	N
181	PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON	PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION	ALL THE PROGRAMS	77			ALL THE PROGR-AMS	FORT IV	"	FORT IV	"	FORT 77	ASAS AQWA	FORT 66	"	Y	ALL PROGRAMS	FORT 77	"	Y					FORT 77						ALL	FORT 77	"	Y
182		.... BASIC	"	N			"	N	"	N	"	N		N	"	N		N	"	N						N					"	N	"	N
183		.... PASCAL	"	N			"	N	"	N	"	N		N	"	N		N	"	N						N					"	N	"	N
184		.... OTHERS; SPECIFY	"	N			"	N	"	N	"	N		N	"	N		N	"	N						N					"	N	"	N
185		COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU	"	?			"	?	"	?	"	?		?	"	?		?	"	N						40:1 10:1					"	?	"	N
186	DOCUMENTATION	IS USERS' GUIDE AVAILABLE	"	Y			"	Y	"	Y	"	Y	AQWA ASAS	Y	"	Y		Y	"	Y						Y					"	Y	"	Y
187		IS THEORETICAL MANUAL AVAILABLE	"	Y			"	Y	"	Y	"	Y	AQWA (some)	Y	"	N		Y	"	PROPRIETARY						Y					"	Y	"	Y
188	SUPPORT MAINTENANCE AND TRAINING	ARE THE PROGRAMS SUPP-ORTED AND MAINTAINED	"	Y			"	Y	"	Y	"	Y	AQWA ASAS	Y	"	N		Y	"	Y						Y					"	Y	"	N
189		IS ANY TRAINING OFFERED	"	Y			"	CONSULTING BASIS	"	Y	"	Y	"	Y	"	N		Y	"	Y						N					"	Y	"	N
190	** ****	IBM	"	N			"	Y	"	Y	"	Y	"	Y	"	N		Y	"	Y						-					"	Y	"	N
191		CDC	"	N			"	Y	"	Y	"	LATER	"	Y	"	Y		N	"	Y						Y					"	N	"	Y

Table (part 1 of 2: columns 1–8)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
192	SYSTEM			ALL THE PROGRAMS	N			SPLASHD	Y	SAL HFEM	N	SESAMBO	LATER	AQWA ASAS	Y	DYHANA	N	NMIWAVE	N
193			VAX	"	N			"	Y	"	Y	"	Y	"	Y	"	N		N
194		**** **	MICRO .. SPECIFY	"	N			EUREKA	CP/M	"	N	"	N	AQWA	IBM P.C	"	N		N
195			OTHERS .... SPECIFY	"	SPERRY O.S. EXEC8			SPLASHD EUREKA	HONEY-WELL UNIVAC	"	N	"	UNIVAC	"	ICL	"	HP9000		SEL(GOULD) UNIVAC
196	ACCESSIBILITY ARRANGEMENT	** ****	LEASE (PRICE $ .00)	"	Y EXCEPT NASTRAN			SPLASHD	Y	"	Y	"	Y	"	Y	"	–		Y
197			PURCHASE (PRICE $ .00)	"	N			"	$25000	"	Y	"	Y	"	Y	"	Y		Y
198			CONSULTANCY BASIS	"	Y			"	CONSULTANCY BASIS	"	Y	"	Y	AQWA ASAS	Y	"	Y		Y
199		**** **	OTHERS .... SPECIFY	"	N			"	?	"	N	"	N	"	?	"	?		SIA BUREAU
200	REMARKS AND NOTES											ALL PROGRAMS EXCEPT NV223 BELONGS TO SESAMBO							
201																			
202																			

Table (part 2 of 2: columns 9–16)

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
192	OSCAR	Y						N					ALL	N	FVKS	N
193		Y						N					WIND TENLOAD BALANCE	Y	"	N
194		N						N					ALL	N	"	N
195		UNIVAC DATA CEN					CRAY						"	N	"	N
196		Y						N					"	Y	"	N
197		Y						N					"	Y	"	N
198		Y						Y					"	Y	"	N
199		N													"	N
200																
201																
202																

TABLE II(A) SUMMARY OF FREQUENCY DOMAIN SOFTWARE CAPABILITIES (BASED ON DIFFRACTION THEORY OR COMBINATION OF DIFFRACTION THEORY, STRIP THEORY AND MORISON'S EQUATION)

NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM ANALYSIS TECHNIQUES (SOFTWARE SURVEY)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	A		B		C		D	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
1	*	WIND FORCE CALCULATIONS	CALCULATES STATIC WIND FORCES			?	?				
2	* * *		CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION			"	?				
3	* * *		IS THE WIND FORCE AN INPUT TO THE PROGRAM			"	?				
4	*	CURRENT FORCE CALCULATION	IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED			"	?				
5			CURRENT FORCES CALCULATED INDEPENDENTLY AND ADDED TO WAVE FORCES			"	?				
6			IS THE CURRENT FORCE AN INPUT TO THE PROGRAM			"	?				
7		. : : MEMBER: ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER			HYDRAL	Y				
8	E N		VERTICAL MEMBER			"	Y				
9	V		HORIZ. MEMBER			"	Y				
10	I	X-SECTI	IS THE PROGRAM CAPABLE OF HANDLING NONCIRCULAR CROSS SECTION			"	N				
11	R O		DOES IT USE EQUIVALENT CIRCULAR X-SECTION			"	N				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
12	N	W	: ON	IS IT POSSIBLE TO DEFINE ARBITRARY GEOMETRY			HYDRAL	Y				
13	M	A		IS THE FORCE CALCULATED AT THE LONGL AXIS OF THE MEMBER			"	Y				
14	E			ANY METHOD TO CALC PRESS DISTRIBUTION ON SURFACE; IF YES, PLEASE SPECIFY			"	Y				
15	N T	V	MEMBER INTER-ACTION	IS THE INTERACTION BET MEMBERS CONSIDERED : COLUMN AND COLUMN			"	?				
16	A	E		COLUMN AND PONTOON			"	?				
17	L			PONTOON AND PONTOON			"	?				
18			FIRST ORDER	IS THE PROGRAM BASED ON DIFFRACTION THEORY, SPECIFY THE TYPE			"	Y				
19				IS THE PROGRAM BASED ON HYBRID ELEMENT METHOD : DIFFRACTION & MORISON			"	N				
20				DIFFRACTION & FLUID FINITE ELEMENT			"	N				
21		F		OR ANY OTHER COMBINATION, PLEASE SPECIFY			"	N				
22	F	O	SECOND DRIFT FORCES	DOES IT CONSIDER THE WAVE ELEVATION			"	Y				
23	O	R		DOES THE PROGRAM ACCOUNT REFLECTION OF 1ST ORDER WAVES FROM THE BODY			"	Y				
24	R C	C		DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO DISPLACEMENT OF BODY			"	Y				
25	E	E		DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO ROTATION OF BODY			"	Y				
26	S	S		DOES IT ACCOUNT FORCE ON A FIXED BODY BY LOW FREQUENCY 2ND ORDER WAVES			"	Y				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
27	*********	.... ORDER	VISCOUS FORCES	DOES THE PROGRAM CONSIDER NON-LINEAR WAVE DRAG			HYDRAL	Y				
28				IF DRAG FORCE CALCULATION CONSIDER MEAN CURRENT & WAVE PARTICLE VELOCITY			〃	?				
29				IS CURRENT & WAVE FRICTION CONSIDERED IN RESULTANT FRICTIONAL DRIFT			〃	?				
30				IS ITERATION OF RESPONSE USED FOR CONVERGENCE			〃	Y				
31				DOES IT USE PREVIOUS TIME STEP RESULTS IN PRESENT STEP CALCULATION			〃	?				
32				IS THE CONVERGENCE TOLERANCE BUILT IN THE PROGRAM			〃	?				
33				DOES THE USER SPECIFY THE CONVERGENCE TOLERANCE			〃	?				
34	**** EQUATION OF MOTI	FREQUENCY DO	ADDMASS	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM			〃	N				
35				CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS			〃	2D & 3D				
36			DAMPING COEFFICIENT	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING			〃	Y				
37				IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED			〃	?				
38				IS THE CURRENT DRAG DAMPING CONSIDERED			〃	?				
39				IS THE CURRENT FRICTION DAMPING CONSIDERED			〃	?				
40				IS THE RADIATION DAMPING CONSIDERED			〃	Y				
41				IS THE STRUCTURAL DAMPING CONSIDERED			〃	Y				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
42	ON	MAIN	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM			HYDRAL	N				
43	****		STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM			"	N				
44				IS THE STIFFNESS MATRIX COMPUTED			"	Y				
45	****	** WIND **	STATIC WIND	IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT			"	?				
46			DYNAMIC WIND	IS THERE PROVISION TO USE FOLLOWING SPECTRA : HARRIS			"	N				
47				DAVENPORT			"	N				
48	ENVIRONMENTAL			SIMIU			"	N				
49				OTHERS (SPECIFY)			"	N				
50		CURRENT		IS IT BASED ON UNIFORM CURRENT VELOCITY PROFILE			"	?				
51				IS IT CAPABLE OF USING NON-UNIFORM CURRENT PROFILE			"	?				
52		******	STATISTICS	SIGNIFICANT WAVE HEIGHT			FREDA	Y				
53				MEAN SPECTRAL PERIOD			"	Y				
54				WAVE SCATTER DIAGRAM			"	N				
55			....W	LINEAR WAVE			"	?				
56				STRETCH LINEAR			"	?				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
57			A V E	STOKE'S 2ND, 3RD OR 5TH ORDER .... PLEASE CIRCLE ...			FREDA	?				
58				STREAM FUNCTION USING THE FORM GIVEN BY .... DEAN			〃	?				
59			T	STREAM FUNCTION : THE FORM GIVEN BY .... VON SCHWIND			〃	?				
60		W	H E O R	STREAM FUNCTION : THE FORM GIVEN BY .... HUDSPETH			〃	?				
61		A	I E S	STREAM FUNCTION : OR ANY OTHER FORM .... PLEASE SPECIFY			〃	?				
62		V	.	EXTENDED VELOCITY POTENTIAL			〃	Y				
63		E	. . .	CNOIDAL WAVE THEORY			〃	?				
64		S	S	IS THERE PROVISION TO USE FOLLOWING SPECTRA : PIERSON-MOSKOWITZ			〃	?				
65	D E		E	ISSC			〃	?				
66	S C		A	JONSWAP			〃	?				
67	R I		S	BRETSCHNEIDER			〃	?				
68	P T		P	SCOTT			〃	?				
69	I O	*	E C	OCHI (SIX PARAMETER)			〃	?				
70	N	* *	T	INPUT SPECTRA			〃	?				
71	*	* * * *	R A	OTHERS			〃	?				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
72	* *	*	DIRECTIONAL SPECTRA			FREDA	?				
73	* *	OTHERS	DOES IT CONSIDER EARTH QUAKE SPECTRA			"	?				
74	* *	OTHERS	DOES IT CONSIDER CHANGE IN WATER LEVEL DUE TO TIDE			"	?				
75	SOLUTION	STATICS	NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY			"	SIX				
76	SOLUTION	STATICS	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY			"	?				
77	SOLUTION	STATICS	IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM			"	?				
78	TECHNIQUE	DYNAMICS / FREQUENCY DOMAIN	HOW MANY DEGREES OF FREEDOM INCLUDED IN THE SOLUTION .... SPECIFY			"	SIX				
79	TECHNIQUE	DYNAMICS / FREQUENCY DOMAIN	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY			"	?				
80	TECHNIQUE	DYNAMICS / FREQUENCY DOMAIN	WHAT METHOD OF LINEARIZATION USED .... SPECIFY			"	?				
81	TECHNIQUE	DYNAMICS / FREQUENCY DOMAIN	MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION			"	?				
82	TECHNIQUE	DYNAMICS / FREQUENCY DOMAIN	OTHERS .... SPECIFY			"	?				
83	* *** ***** ******* PLATFORM RESPONSE OUTPUT		MEAN OFFSET OF THE PLATFORM			"	Y				
84			MOTION RAO(S) OF THE PLATFORM, FOR PLOT CAPABILITY ENTER 'P'			"	P				
85			PLATFORM MOTION RESPONSE SPECTRA			"	Y				
86			RESPONSE STATISTICS .. MEAN VALUE			"	Y				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
87	******* ***** *** *		RESPONSE STATISTICS .. R.M.S. VALUE			FREDA	?				
88			RESPONSE STATISTICS .. (SIGNIFICANT)1/3			〃	Y				
89			RESPONSE STATISTICS .. OTHERS; SPECIFY			〃	?				
90			EIGEN VALUES (SYSTEM NATURAL PERIODS)			〃	?				
91	** ****		MODEL TEST - INDICATE SCALE			〃	Y				
92	PROGRAM		OTHER AVAILABLE SOFTWARE - LIST PROGRAMS			〃	?				
93	VERIFICATION		OTHER PUBLISHED MATERIAL - SPECIFY			〃	?				
94	**** **		OTHERS (SPECIFY)			〃	?				
95	******	DESCRIPTION	SPREAD MOORING (CATENARY)			MORA	Y				
96			SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT			〃	N				
97			VERTICAL (TAUT) MOORING			〃	Y				
98			HYBRID/OTHER COMBINATION .... SPECIFY			〃	N				
99		MATERIAL	SYNTHETIC ROPE - SUCH AS NYLON KEVLAR			〃	N				
100	M		CHAIN (STEEL)			〃	Y				
101	O		WIRE ROPE (STEEL)			〃	Y				
	O										

TABLE II(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG -RAM	A YES /NO	B PROG -RAM	B YES /NO	C PROG -RAM	C YES /NO	D PROG -RAM	D YES /NO
102	RING SYSTEM			COMBINATIONS SUCH AS CHAIN/WIRE ROPE OTHERS, SPECIFY			MORA	Y				
103		ANALYSES	STATICS	USER SPECIFIED LOAD DISPLACEMENT TABLE			"	Y				
104				IS IT BASED ON CATENARY EQUATION			"	Y				
105				IS IT BASED ON FINITE EL -EMENT METHOD W/ OR W/O BENDING STFFNSS, CIRCLE			"	?				
106				OTHERS (SPECIFY)			"	?				
107			DYNAMICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS			"	?				
108		**** VERTICAL	.... MOOR	IS THE MASS OF THE MOORING CONSIDERED			"	N				
109				IS THE MOORING SYSTEM MODELLED AS A LINEAR SPRING			"	Y				
110				IS THE MOORING SYSTEM MODELLED AS A NON-LINEAR SPRING			"	?				
111				IS GEOMETRIC NON LINEA-RITY CONSIDERED			"	?				
112				IS MATERIAL NON LINEA-RITY CONSIDERED			"	?				
113				IS THE HYDRODYNAMIC DAMPING CONSIDERED			"	?				
114				IS THE STRUCTURAL DAMPING CONSIDERED			"	?				
115				IS THE MOORING SYSTEM COUPLED WITH PLATFORM			"	?				
116				IS IT BASED ON FINITE EL -EMENT METHOD,W/ OR W/O BENDING STFFNSS, CIRCLE			"	?				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****			** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
117			ING MODEL		IS IT BASED ON FINITE DIFFERENCE METHOD			MORA	?				
118				HYDRODYNAMIC	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM			"	?				
119					IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER			"	?				
120					IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING			"	?				
121				MODEL	IS THE MOORING HYDRODYNAMIC MODEL 2D			"	N				
122					IS THE MOORING HYDRODYNAMIC MODEL 3D			"	Y				
123	CAPABILITIES	MOORING ***			IS THE MOORING MODEL TWO DIMENSIONAL			"	N				
124					IS THE MOORING MODEL THREE DIMENSIONAL			"	Y				
125					IS THE MOORING END AT FOUNDATION MODELED BY A LINEAR AXIAL SPRING			"	?				
126					IS MOORING END AT FOUNDATION MODELED BY A LINEAR & ROTATIONAL SPRING			"	?				
127					IS IT POSSIBLE TO MODEL AN ARRAY OF INTERCONNECTED MOORING LINES			"	N				
128					IS THE PROGRAM CAPABLE OF FATIGUE LIFE ANALYSIS			"	N				
129			DYNAMICS		IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS			"	?				
130			INSTALLATION ANALYS		IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING			"	N				
131		** **** OUTPUT			MEAN LOAD OF THE MOORING LINE			"	Y				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
132		FOR THE MOORING SYSTEM **** **	MOORING LINE LOAD RAO(S)			MORA	Y				
133			MOORING LINE LOAD STATISTICS .. R.M.S. VALUE			"	?				
134			MOORING LINE LOAD STATISTICS .. (SIGNIFICANT)1/3			"	Y				
135			MOORING LINE LOAD STATISTICS .. OTHERS; SPECIFY			"	?				
136	********	* *** PROGRAM VERIFICATN *** *	WITH MODEL TESTS - INDICATE SCALE			"	N				
137			WITH OTHER SOFTWARE - LIST PROGRAMS			"	N				
138			WITH OTHER PUBLISHED MATERIAL .... SPECIFY			"	N				
139	****** R I S E R		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES			"	N				
140		** STRUCTURAL MODEL **	IS THE RISER MODEL TWO DIMENSIONAL								
141			IS THE RISER MODEL THREE DIMENSIONAL								
142			DOES THE PROGRAM USE FINITE ELEMENT METHOD								
143			DOES THE PROGRAM USE FINITE DIFFERENCE METHOD								
144			DOES THE PROGRAM USE SMALL DEFLECTION THEORY								
145			IS THE PROGRAM CAPABLE OF USING LARGE DEFLECT-ION THEORY								
146		****	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM								

TABLE II(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
147	SYSTEM	HYDRODYNAMIC	IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER								
148	SYSTEM	HYDRODYNAMIC	IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING								
149	SYSTEM	HYDRODYNAMIC	IS THE RISER HYDRODYNAMIC MODEL 2D								
150	SYSTEM	HYDRODYNAMIC	IS THE RISER HYDRODYNAMIC MODEL 3D								
151	SYSTEM	** SOLUTION MODE **	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM								
152	SYSTEM	** SOLUTION MODE **	IS THE PROGRAM PERFORM FREQUENCY DOMAIN ANALYSIS								
153	SYSTEM	* *** SPECIAL ANALYSIS *** *	IS IT CAPABLE OF CLEARANCE ANALYSIS BETWEEN RISERS								
154	SYSTEM	* *** SPECIAL ANALYSIS *** *	IS IT CAPABLE OF INSTALLATION ANALYSIS W/ RISER BOTTOM AS FREE END								
155	SYSTEM	* *** SPECIAL ANALYSIS *** *	IS IT CAPABLE OF INSTALLATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE								
156	SYSTEM *****	PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE								
157	SYSTEM *****	PROGRAM VERIFICATN	WITH OTHER SOFTWARE - LIST PROGRAMS								
158	SYSTEM *****	PROGRAM VERIFICATN	WITH OTHER PUBLISHED MATERIAL .... SPECIFY								
159	* *** STABILITY ANALYSIS	INTACT	INTACT FREE FLOATING				N				
160	* *** STABILITY ANALYSIS	INTACT	INTACT WITH VERTICAL TAUT TENDONS				N				
161	* *** STABILITY ANALYSIS	DAMA	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED				N				

TABLE II(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
162	*** *	G E D	DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING				N				
163	**** STRUCTURAL ANALYSIS ****	LOADING	HYDRODYNAMIC LOADING CONSIDERED								
164			IS INERTIA LOADING CONSIDERED								
165			IS DYNAMIC LOADING CONSIDERED								
166		SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS								
167			THREE DIMENSIONAL SPACE FRAME ANALYSIS								
168		* *** FINITE ELEMENT ANALYSIS *** *	BEAM ELEMENT								
169			SHELL ELEMENT								
170			PLATE ELEMENT								
171			STIFFENED PLATE ELEMENT								
172			OTHERS .... SPECIFY								
173			NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM								
174		OTHER ANALYTICAL CAPABILITY	SPECTRAL ANALYSIS								
175			MODAL ANALYSIS								
176			FATIGUE LIFE ANALYSIS								

TABLE II(A) [CONTINUED]

ROW #	**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
177	PRE-PROCESSING AND POST-PROCESSING CAPABILITIES	VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)								
178		RESTART CAPABILITIES (LIST ALL THE PROGRAMS)			FREDA	?				
179		PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)			〃	Y				
180		CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)								
181	PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON	PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION			HYDCAL FREDA	Y				
182		.... BASIC								
183		.... PASCAL								
184		.... OTHERS; SPECIFY								
185		COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU								
186	DOCUMENTATION	IS USERS' GUIDE AVAILABLE			HYDCAL FREDA	Y				
187		IS THEORETICAL MANUAL AVAILABLE			〃	Y				
188	SUPPORT MAINTENANCE AND TRAINING	ARE THE PROGRAMS SUPPORTED AND MAINTAINED			〃	Y				
189		IS ANY TRAINING OFFERED			〃	Y				
190	** ****	IBM			〃	?				
191		CDC			〃	?				

TABLE II(A) [CONTINUED]

ROW #	**** ** ****	** ** ** ** ****** ** ** ** **	A		B		C		D	
			PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO
192	HARDWARE SYSTEM	PRIME COMPUTER			HYDCAL FREDA	?				
193		VAX			"	?				
194		MICRO .. SPECIFY			"	N				
195	**** **	OTHERS .... SPECIFY			"	N				
196	** ****	LEASE (PRICE $ .00)			MORA	N				
197	ACCESSIBILITY	PURCHASE (PRICE $ .00)			"	$40000				
198	ARRANGEMENT	CONSULTANCY BASIS			"	Y				
199	**** **	OTHERS .... SPECIFY								
200										
201	REMARKS AND NOTES									
202										

TABLE III

SUMMARY OF TIME DOMAIN SOFTWARE CAPABILITIES
(based on Morison's Equation)

NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM
ANALYSIS TECHNIQUES

(SOFTWARE SURVEY)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
1	*	WIND FORCE CALCULAT-IONS	CALCULATES STATIC WIND FORCES	CARGONV DBMARZ	Y	INTRA.WACS	N	EUREKA	Y			FENRIS WAJAC	1984-85	AQUA-BEZIUM	Y	WINDFORCE	Y			OSCAR	Y			VODAS	Y			MOMOP	N					AGAPIP	N
2	* *		CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION	"	JUNE '84	"	N	"	N			"	N	"	N	"	N			"	N			RANTIM	OCT 1985				N					"	N
3	* *		IS THE WIND FORCE AN INPUT TO THE PROGRAM	"	N	"	Y	TDSIM6	Y			"	Y	AQUA-NAUT	Y	"	N			"	Y								Y					"	N
4	* *		IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED	"	Y	"	Y	"	Y			"	N	"	N	-	-			"	N			VODAS	Y				Y					"	N
5	*	CURRENT FORCE CALCULATION	CURRENT FORCES CALCULA-TED INDEPENDENTLY AND ADDED TO WAVE FORCES	"	N	"	N	"	N			"	N	"	Y	-	-			"	Y								N					"	Y
6			IS THE CURRENT FORCE AN INPUT TO THE PROGRAM	"	N	"	N	"	N			"	Y	"	OPTION-AL	-	-			"	Y								N					"	N
7		: : MEMBER ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER	"	Y	"	Y	"	Y			"	Y	"	Y	UCLRIGT UCLTBPT	Y			"	Y			VODAS VODYN	Y N				Y					"	Y
8	E		VERTICAL MEMBER	"	Y	"	Y	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y				Y					"	N
9	N V		HORIZ. MEMBER	"	Y	"	Y	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y				Y					"	Y
10	I	: : MEMBER X-SECT	DOES IT USE EQUIVALENT CIRCULAR CROSS SECTION FOR NONCIRCULAR SECTION	"	N	"	N	"	Y			"	Y	"	N	"	N			"	Y			"	Y				N					"	N
11	R		DOES IT USE MODIFIED C_d AND C_m VALUES FOR NON CIRCULAR X-SECTION	"	N	"	N	"	Y			"	Y	"	Y	"	Y			"	N			"	Y				Y						N

NOTE: NUMBERS AT THE TOP OF THE COLUMNS REFER TO DETAILED RESPONSES TO THE BARDI QUESTIONAIRE FROM VARIOUS PARTICIPANTS. ALL RESPONSES ARE COMPILED IN APPENDIX I.

ROW #	O	**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
12	N		: I O N	OTHER METHODS, IF ANY, TO CALCULATE WAVE FORCE ON NON CIRCULAR X-SECTION	CARGONS DISMARZ	N	INTRA-WACS2	N	TDSIMV	2D/3D SOURCE PROG			FENRIS WAJAC	N	AQUA-NAUT	N	-	-			OSCAR	2D/3D DIFF			VODAS VADYN	N			MOMOP	N					AGATH	[illegible]
13	M			IS THE FORCE CALCULATED AT THE LONGL AXIS OF THE MEMBER	"	Y	"	Y	"	Y			"	Y	"	N	UCLRIGT UCLTBP	Y			"	Y			"	Y			"	Y					"	Y
14	E N	W		ANY METHOD TO CALC PRESS DISTRIBUTION ON SURFACE; IF YES, PLEASE SPECIFY	"	N	"	N	"	N			"	N	"	N	"	Y			"	2DSTRIP 3D DIFF			"	EXT'L DIFF ANALYSIS			"	N					"	N
15	T	A V	MEMBER INTER-ACTION	IS THE INTERACTION BET MEMBERS CONSIDERED : COLUMN AND COLUMN	"	N	"	N	"	N			"	N	"	N	"	N			"	Y			"	Y N			"	N					"	[illegible]
16	A	E		COLUMN AND PONTOON	"	N	"	N	"	N			"	N	"	N	"	N			"	Y			"	Y N			"	N					"	[illegible]
17	L			PONTOON AND PONTOON	"	N	"	N	"	N			"	N	"	N	"	N			"	Y			"	Y N			"	N					"	[illegible]
18			FIRST ORDER	IS THE PROGRAM BASED ON BASIC MORISON'S EQUATION	"	N	"	Y	"	N			"	N	"	Y	"	Y			"	N			"	Y			"	N					"	[illegible]
19				IS THE PROGRAM BASED ON MORISON'S EQUATION FORMULATION W/ REL VELOCITY	"	N	"	Y	"	N			"	N	"	Y	"	Y			"	Y			"	Y			"	N					"	[illegible]
20				IS THE PROGRAM BASED ON MORISON'S EQN W/ REL VELOCITY AND CURRENT	"	Y	"	Y	"	Y			"	Y	"	Y	"	N			"	N			"	Y N			"	Y					"	Y
21	F	F		IS THE PROGRAM BASED ON LINEARIZED FORM OF MORISON'S EQUATION	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	Y			"	N					"	[illegible]
22	O	O	SECON... DRIFT FORCES	DOES IT CONSIDER THE WAVE ELEVATION	"	Y	"	Y	"	Y			"	N	"	Y	"	N			"	Y			"	N			"	N					"	[illegible]
23	R C	R C		DOES THE PROGRAM ACCOUNT REFLECTION OF 1ST ORDER WAVES FROM THE BODY	"	N	"	N	"	N			"	N	"	N	"	N			"	Y			"	N			"	N					"	[illegible]
24	E	E		DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO DISPLACEMENT OF BODY	"	N	"	Y	"	N			"	N	"	Y	"	N			"	Y			"	N			"	N					"	[illegible]
25	S	S		DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO ROTATION OF BODY	"	N	"	Y	"	N			"	N	"	Y	"	N			"	Y			"	N			"	N					"	[illegible]
26				DOES IT ACCOUNT FORCE ON A FIXED BODY BY LOW FREQUENCY 2ND ORDER WAVES	"	N	"	N	"	N			"	N	"	N	"	N			"	Y			"	N			"	N						[illegible]

ROW #		**** ****			** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
27			D	V	DOES THE PROGRAM CONSIDER NON-LINEAR WAVE DRAG	CARGONS DISMAR	Y	INTRA-WACS2	Y	JDSIM6	N			FENRIS WAJAS	Y	AQUA-NAUT	Y	UCLRIGT UCLTOPT	Y		
28				I S C	DO DRAG FORCE CALCULATION CONSIDER MEAN CURRENT & WAVE PARTICLE VEL	"	Y		Y	"	Y			"	Y	"	Y	"	N		
29	*	.		O U S	IS CURRENT AND WAVE FRICTION CONSIDERED IN RESULTANT FRICTIONAL DRIFT	"	N		N	"	Y			"	N	"	N	"	N		
30	* *	. .	O R		IS ITERATION OF RESPONSE USED FOR CONVERGENCE	"	N		Y	"	N			"	N	"	N	"	N		
31	* *	. .	D E	F O R	DOES IT USE PREVIOUS TIME STEP RESULTS IN PRESENT STEP CALCULATION	"	N		Y	"	N			"	N	"	Y	"	Y		
32	* *	. .	R	C E S	IS THE CONVERGENCE TOLERANCE BUILT-IN THE PROGRAM	"	N		N	"	N			"	N	"	N	"	Y		
33	* *	.	. . .		DOES THE USER SPECIFY THE CONVERGENCE TOLERANCE	"	N		Y	"	N			"	N	"	Y	"	N		
34	* * *	* * *	* * *	A D D	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	"	N		Y	"	N			"	N	"	OPTION-AL	"	N		
35	* *	* * *		M A S S	CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	2D		-	"	2D			"	2D	"	3D	"	2D		
36		* *	R E	D	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	Y		N	"	Y			"	Y	"	Y	"	Y		
37			G U	A M P I	IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	N		N	"	N			"	N	"	N	"	N		
38	E	T	L A	N G	IS THE CURRENT DRAG DAMPING CONSIDERED	"	Y		N	"	Y			"	Y	"	Y	"	N		
39	Q U		R	C O	IS THE CURRENT FRICTION DAMPING CONSIDERED	"	N		N	"	N			"	N	"	N	"	N		
40	A	I		E F F I	IS THE RADIATION DAMPING CONSIDERED	"	Y		Y	"	N			"	N	"	Y	"	N		
41	T	M	W A	C I E N	IS THE STRUCTURAL DAMPING CONSIDERED	"	N		Y	"	N			"	Y	"	N	"	N		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
27	OSCAR	Y			VODAS /ODYN	N			MONOP	N					[illegible]	
28	"	Y			"	Y				N						
29	"	N			"	N				N						
30	"	Y			"	Y				N						
31	"	Y			"	Y				N						
32	"	Y			"	N				N						
33	"	OPTION-AL			"	N				N						
34	"	N			"	N				Y						
35	"	2D			"	3D				3D						
36	"	Y			"	Y				N						
37	"	N			"	N				N						
38	"	N			"	N				N						
39	"	N			"	N				N						
40	"	Y			"	Y NOT FOR HEAVE				N						
41	"	N				N				N						

ROW #	I	**** ****	V	T	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
						PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO
42	O	E	E S	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	EARGON3 -DISMAR2	N	INTRA -WACS2	N	TDSING	N			FENRIS WAJAC	N	AQUA -NAUT	OPTIO -NAL	UCLRIGT UCLTBPT	N			OSCAR	N			VODAS VODYN	N			MOMOP	Y					ALAM[illegible]	
43	N			STIFF	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	"	N	"	N	"	N			"	N	"	-DO-	"	N			"	N			"	N			"	N					"	
44			***	NS	IS THE STIFFNESS MATRIX COMPUTED	"	N	"	Y	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y			"	Y					"	
45	O	D	***	ADDM	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	N			"	Y					"	
46	F	O	I	ASS	CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	2D	"	—	"	2D			"	Y	"	3D	"	2D			"	2D			"	3D			"	3D					"	
47		M	R R	DA	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	Y	"	N	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y			"	N					"	
48	M		E G	MPI	IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	N			"	N					"	
49	O	A	U L	NG	IS THE CURRENT DRAG DAMPING CONSIDERED	"	Y	"	N	"	Y			"	Y	"	Y	"	N			"	N			"	N			"	N					"	
50	T I	I	A R	COE	IS THE CURRENT FRICTION DAMPING CONSIDERED	"	N	"	N	"	N			"	N	"	N	"	N			"	N				N			"	N					"	
51	O	N		FFICI	IS THE RADIATION DAMPING CONSIDERED	"	Y	"	Y	"	N			"	N	"	Y	"	N			"	Y				Y NOT FOR HEAVE			"	N					"	
52	N		W A	ENT	IS THE STRUCTURAL DAMPING CONSIDERED	"	N	"	Y	"	N			"	Y	"	N	"	N			"	N			"	N			"	N					"	
53	*		V E	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	"	N	"	N	"	N			"	N	"	OPTION -AL	"	N			"	N			"	N			"	Y					"	
54	****	*	S	STIF	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	"	N	"	N	"	N			"	N	"	-DO-	"	N			"	N			"	N			"	Y					"	
55		***	***	FNS	IS THE STIFFNESS MATRIX COMPUTED	"	N	"	Y	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y			"	Y					"	
56	*	**	STATIC WIND		IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT	"	Y	"	N	EUREKA TDSIMG	N			"	N	"	Y	WINDFORCE	Y			"	Y			RANTIM	OCT 1985			"	Y						

ROW #				1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
57	*****	WIND **	DYNAMIC WIND	IS THERE PROVISION TO USE FOLLOWING SPECTRA : HARRIS	CARGONS DISMARS	JUNE '84	INTRA-WACS2	N	EUREKA TDSIM6	N			FENRIS WAJAS	N	AQWA-NAUT	N	WINDFORCE	N			OSCAR	N			RANTIM	OCT 1985			MOMOP	N					[illegible]	
58				DAVENPORT	"	JUNE '84	"	N	"	N			"	N	"	N	"	N			"	N			"	?			"	N					"	
59				SIMIU	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	?			"	N					"	
60				OTHERS (SPECIFY)	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	?			"	N					"	
61	ENVIRONMENTAL	CURRENT		IS IT BASED ON UNIFORM CURRENT VELOCITY PROFILE	"	N	"	N	SPLASHD	Y			"	N	"	N	DRIFT	Y			"	N							"	Y					"	
62				IS IT CAPABLE OF USING NON-UNIFORM CURRENT PROFILE	"	Y	"	Y	"	N			"	N	"	Y	"	Y			"	Y							"	N					"	
63		********	STATISTICS	SIGNIFICANT WAVE HEIGHT	"	Y	"	N	TDSIM6	Y			"	Y	"	N	"	N			"	Y			VOPROC	Y			"	N					"	
64				MEAN SPECTRAL PERIOD	"	Y	"	N	"	Y			"	Y	"	N	"	N			"	Y			"	Y			"	N					"	
65				WAVE SCATTER DIAGRAM	"	Y	"	N	"	N			"	Y	"	N	"	N			"	N			"	Y			"	N					"	
66			WAVE THEO	LINEAR WAVE	"	Y	"	Y	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y			"	N					"	
67				STRETCH LINEAR	"	N	"	Y	"	Y			"	Y	"	N	"	N			"	N			"	N			"	Y					"	
68				STOKE'S 2ND, 3RD OR 5TH ORDER .... PLEASE CIRCLE ..	"	5th ORDER	"	5th ORDER	"	N			"	5th	"	2nd	"	5th			"	N			"	2nd 3rd 5th			"	5th					"	
69				STREAM FUNCTION USING THE FORM GIVEN BY .... DEAN	"	N	"	N	"	N			"	Y	"	N	"	N			"	Y			"	N			"	N					"	
70				STREAM FUNCTION : THE FORM GIVEN BY .... VON SCHWIND	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	N			"	N					"	
71		W		STREAM FUNCTION : THE FORM GIVEN BY .... HUDSPETH	"	N	"	N	"	N			"	N	"	N	"	N			"	N							"	N						

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
72		A	R- I	STREAM FUNCTION : OR ANY OTHER FORM .... PLEASE SPECIFY	CARGON3 DISMAR2	N	INTRA-WACS2	Y	TDSIM6	N			FENRIS WAJAC	N	AQUA-NAUT	N		N		
73		V	E S	EXTENDED VELOCITY POTENTIAL	"	N	"	N	"	N			"	N	"	N		N		
74		E		CNOIDAL WAVE THEORY	"	N	"	N	"	N			"	Y	"	N		N		
75			S	IS THERE PROVISION TO USE FOLLOWING SPECTRA : PIERSON-MOSKOWITZ	"	Y	"	N	"	RANDOM WAVE TRAIN			"	Y	"	–	JONSWP	Y		
76	D E		E	ISSC	"	N	"	N	"	IS SYNTHESIZED BY			"	N	"	–	"	Y		
77	S C		A	JONSWAP	"	Y	"	N	"	A SERIES OF COMPONENT			"	Y	"	–	"	Y		
78	R I		S	BRETSCHNEIDER	"	N	"	N	"	ELEMENTARY WAVES			"	N	"	–	"	N		
79	P T	* *	P	SCOTT	"	N	"	N	"				"	N	"	–	"	N		
80	I O	* *	E	OCHI (SIX PARAMETER)	"	N	"	N	"				"	N	"	–	"	N		
81	N	* *	C T	INPUT SPECTRA	"	N	"	N	"				"	N	"	–	"	N		
82	*	* *	R	OTHERS	"	N	"	N	"				"	N	"	–	"	N		
83	* *		A	DIRECTIONAL SPECTRA	"	N	"	N	"				"	Y	"	–	"	N		
84	* *	OTHERS		DOES IT CONSIDER EARTH QUAKE SPECTRA	"	N	"	Y	"	N			"	Y	"	N	"	N		
85	* *			DOES IT CONSIDER CHANGE IN WATER LEVEL DUE TO TIDE	"	N	"	Y	"	N			"	N	"	N	"	N		
86		STA		NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	CARGON3	SIX	"	SIX	"	SIX			"	SIX	"	SIX	UCLRIGT UCLTBPY	SIX +		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
72	OSCAR	N			VOPROC	N			MOMOP	N					[illegible]	
73	"	N			"	N			"	N						
74	"	N			"	N			"	N						
75	"	Y			"	Y			"	N						
76	"	Y			"	N			"	N						
77	"	Y			"	Y			"	N						
78	"	N			"	N			"	N						
79	"	N			"	Y			"	N						
80	"	N			"	N			"	N						
81	"	Y			"	N			"	N						
82	"	N			"	CLIENT SPECIFIED			"	N						
83	"	N			"	Y			"	N						
84	"	N			"	N			"	N						
85	"	N			"	Y			"	N						
86	"	SIX			VODAS VODYN VOFRAME VOHYDR	SIX			"	SIX						

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
87	SOLUTION TECHNIQUE	TICS	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	CARGON3	?	INTRA-WACS2	ALL SIX	TDSIM6	SIX COUPLED DOF			FENRIS WAJAC	ALL SIX	AQWA-NAUT	ALL SIX	UCLRGT UCLTRA	ALL		
88	SOLUTION TECHNIQUE	TICS	IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	"	?	"	UNLIMITED	"	?			"	UNLIMI-TED	"	N	"	N		
89	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	DISMAR2	SIX	"	SIX	"	SIX			"	SIX	"	SIX	"	SIX		
90	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	"	?	"	ALL SIX	"	SIX COUPLED DOF			"	ALL SIX	"	ALL SIX	"	ALL SIX		
91	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	"	?	"	UNLIMITED	"	?			"	UNLIMI-TED	"	N	"	N		
92	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	WHAT METHOD OF INTEGRATION USED .... HOUBOLT	"	N	"	N	"	N			"	N	"	N	"	N		
93	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	.... WILSON-θ	"	N	"	N	"	N			"	N	"	N	"	N		
94	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	.... NEWMARK-β	"	N	"	Y	"	N			"	Y	"	N	"	Y		
95	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	OTHERS .... PLEASE SPECIFY	"	STEP-BY-STEP W/PREDICTIVE CORRECTN	"	N	"	RUNGE KUTTA 4th ORDER			"	N	"	2 STAGE PREDICT-CORRECT	"	N		
96	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	HOW THE TRANSIENT IS HANDLED .... RAMP FUNCTION	"	Y	"	–	"	COSINE RAMP			"	N	"	N	"	N		
97	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	.... VARIABLE INTEGRATION TIME	"	N	"	–	"	N			"	Y	"	Y	"	Y		
98	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	OTHERS .... PLEASE SPECIFY	"	N	"	RAMP DAMPING COEFF	"	N			"	N	"	MOTION FILTERING	"	N		
99	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION	"	N	"	Y	"	N			"	N	"	Y	"	Y		
100	SOLUTION TECHNIQUE	DYNAMICS TIME DOMAIN	OTHERS .... PLEASE SPECIFY	"	N	"	N	"	GAUSS JORDAN			"	CHOLE-SKY	"	N	"	N		
101	SOLUTION TECHNIQUE		PLATFORM MOTION TIME HISTORY	"	Y	"	Y	"	Y			"	Y	"	Y	"	Y		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
87	OSCAR	ALL SIX			VODAS VODYN VOFRAME VOHYDR	ALL SIX			MOMOP	ALL SIX					AGA	
88	"	N			–	–			"	–						
89		SIX			"	SIX			"	SIX						
90		ALL SIX				ALL SIX			"	ALL SIX						
91		N				–			"	–						
92		N							"	N						
93		N							"	N						
94		N							"	N						
95		?							"	RUNGE KUTTA 4th ORDER						
96		?							"	Y						
97		?							"	N						
98		?							"	N						
99		PROPRIETORY			"				"	GAUSS JORDAN W/PIVOT						
100		N			VOFRAME	CHOLE-SKY			"	N						
101		Y			VOPROC	Y			"	Y						

ROW #	**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
102	** **** ****** ******** PLATFORM RESPONSE OUTPUT ******** ****** **** **	PLATFORM RESPONSE STATISTICS .... MEAN VALUE	HARMAN	Y	INTRA-WACS2	N	TDSIM6	Y			FENRIS WAJAC	N	AQUA-NAUT	Y	UCLRIG UCLTBP	Y		
103		... R.M.S. VALUE	"	Y	"	N	"	N			"	N		Y	"	Y		
104		... (SIGNIFICANT)1/3	"	Y	"	N	"	N			"	Y		Y	"	Y		
105		... EXPECTED MAXIMUM	"	Y	"	N	"	N			"	Y		Y	"	Y		
106		... OTHERS, SPECIFY	"	Y	"	Y	"	N			"	N		N	"	N		
107		CAN IT PREDCT RESPONSES IN ANY HEADING FROM RES-PONSES IN ORTHO HEADINGS	DISMAR2	N	"	N	"	N			"	N		Y (?)	"	N		
108	** **** PROGRAM VERIFICATION **** **	MODEL TEST - INDICATE SCALE	"	Y (55)	"	N	"	Y			"	–		40, 200	"	60,100, 200		
109		OTHER AVAILABLE SOFTWARE - LIST PROGRAMS	"	N	"	N	"	N			"	–		TRMIR (IFP)	"	N		
110		OTHER PUBLISHED MATERIAL - SPECIFY	"	N	"	Y	"	N			"	–		B. MOLIN	"	N		
111		OTHERS (SPECIFY)	"	N	"	N	"	N			"	–		N	"	N		
112	******* DESCRIPTION	SPREAD MOORING (CATENARY)	ANCOR3 ANCOR4	Y	"	Y	"	Y			"	Y		Y	MOOR	Y		
113		SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT	"	Y	"	Y	"	N			"	Y		Y	"	N		
114		VERTICAL (TAUT) MOORING	"	Y	"	Y	"	Y			"	Y		Y	MOOR UCLTBPT	Y		
115		HYBRID/OTHER COMBINATION .... SPECIFY	"	Y	"	N	"	SLANTED TAUT			"	N		HAUSERS	"	N		
116		SYNTHETIC ROPE - SUCH AS NYLON KEVLAR	"	Y	"	Y	"	N			"	Y		Y	MOOR	Y		

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
102	OSCAR	Y			VJPROC	Y			MOMOP	N					[illegible]	
103	"	Y			"	Y			"	N						
104	"	Y			"	Y			"	N						
105	"	N			"	–			"	N						
106	"	1/10 1/100			"	M_A T_Z			"	N						
107	"	N			"	N			"	N						
108	"	Y			"	[illegible]			"	N						
109	"	Y				N			"	N						
110	"	NOBLE DENTON REPORT				N			"	N						
111	"	N				N			"	N						
112	"	Y			MAP	Y			"	N						
113	"	Y			"	Y			"	N						
114	"	Y			"	Y			"	Y						
115	"	TAUT-BUOY-CATEN-ARY			"	–			"	N						
116	"	Y				Y			"	N						

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
					PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
117		MATERIAL		CHAIN (STEEL)	ANCOR3 ANCOR4	Y	INTRA WACS2	Y	TDSIMG	Y			FENRIS WAJAC	Y	AQUA-NAUT	Y	MOOR	Y			OSCAR	Y			MAP	Y			MOMOP	N					AGA	N
118				WIRE ROPE (STEEL)	"	Y	"	Y	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y			"	N					"	N
119				COMBINATIONS SUCH AS CHAIN/WIRE ROPE OTHERS, SPECIFY	"	Y	"	Y	"	N			"	Y	"	Y	"	Y			"	CHAIN WIRE NYLON			"	Y			"	BAR					"	N
120	MOORING	CATENARY	STATICS	USER SPECIFIED LOAD DISPLACEMENT TABLE	"	Y	"	Y	"	N			"	Y	"	Y	"	N			"	N			"	N			"	N					"	N
121				IS IT BASED ON CATENARY EQUATION	"	Y	"	N	"	Y			"	N	"	Y	"	Y			"	Y				Y			"	N					"	N
122				IS IT BASED ON FINITE ELEMENT METHOD	"	N	"	Y	"	N			"	N	"	N	"	N			"	N				W/O BEND-ING			"	N					"	N
123				OTHERS (SPECIFY)	"	N	"	Y	"	N			"	N	"	N	"	N			"	N				N			"	N					"	N
124			DYNA-MICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	ANCOR3 ANCOR4 DISMAR2	Y	"	Y	"	N			"	Y	"	Y	"	N			"	Y			MAP VORIS	N Y			"	N					"	N
125		******	****	IS THE MASS OF THE MOORING CONSIDERED	DISMAR2	N	"	Y	"	N			"	Y	"	N	UCLTBPT	Y			"	N			"	Y			"	N					"	N
126				IS THE MOORING SYSTEM MODELLED AS A LINEAR SPRING	"	N	"	N	"	Y			"	N	"	Y	"	Y			"	N			"	Y			"	Y					"	N
127			*****	IS THE MOORING SYSTEM MODELLED AS A NON-LINEAR SPRING	"	Y	"	Y	"	N			"	N	"	Y	"	N			"	Y			VODAS (TD)	Y			"	Y					"	N
128		VERTI		IS GEOMETRIC NON LINEA-RITY CONSIDERED	"	Y	"	Y	"	N			"	Y	"	Y	"	N			"	Y			"	Y			"	Y					"	N
129				IS MATERIAL NON LINEA-RITY CONSIDERED	"	Y	"	Y	"	N			"	Y	"	Y	"	N			"	Y			"	N			"	N					"	N
130			MO	IS THE HYDRODYNAMIC DAMPING CONSIDERED	"	N	"	Y	"	N			"	Y	"	N	"	Y			"	N			VODAS VORIS	N Y			"	N					"	N
131				IS THE STRUCTURAL DAMPING CONSIDERED	"	N	"	Y	"	N			"	Y	"	N	"	N			"	N			"	N			"	N						N

ROW #		**** ****			** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
132	SYSTEM	CAL	RING		IS THE MOORING SYSTEM COUPLED WITH PLATFORM	DISMAR2	Y	INTRA-WACSE	Y	TDSING	N			FENRIS WAJAC	Y	AQUA-NAUT	Y	UCLTBPT	N			OSCAR	Y			VODAS VORIS	Y			MOMOP	Y					AEAPIP	N
133					IS IT BASED ON FINITE EL-EMENT METHOD, W/ OR W/O BENDING STFFNSS, CIRCLE	"	N	"	Y	"	N			"	Y	"	N	"	Y			"	N			CABDYN	Y			"	N					"	N
134					IS IT BASED ON FINITE DIFFERENCE METHOD	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	W/O BEND-ING			"	N					"	N
135				HYDRODYNAMIC MODEL	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	"	N	"	Y	"	BASIC			"	Y	"	N	"	REL VEL			"	N			"	Y			"	N					"	N
136					IS IT CAPABLE OF CALCUL-ATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	"	N	"	N	"	N			"	Y	"	N	"	N			"	N			"	Y			"	N					"	N
137		MOORING	MODEL		IS IT CAPABLE OF CONSID-ERING EFFECT OF VORTEX SHEDDING	"	N	"	N	"	N			"	N	"	N	"	N			"	N			"	Y			"	N					"	N
138					IS THE HYDRODYNAMIC MODEL FOR MOORING TWO DIMENSIONAL	"	Y	"	Y	"	Y			"	N	"	N	"	Y			"	N			MAP CABDYN	Y N			"	N					"	N
139					IS THE HYDRODYNAMIC MODEL FOR MOORING THREE DIMENSIONAL	"	N	"	Y	"	Y			"	Y	"	Y	"	N			"	N			"	N Y			"	N					"	N
140					IS THE STRUCTURL MOORING MODEL TWO DIMENSIONAL	"	Y	"	Y	"	Y			"	N	"	N	"	Y			"	N			"	Y N			"	N					"	N
141			*****		IS THE STRUCTURL MOORING MODEL THREE DIMENSIONAL	"	Y	"	Y	"	Y			"	Y	"	Y	"	N			"	N			"	N Y			"	Y					"	N
142					IS THE MOORING END AT FOUNDATION MODELED BY A LINEAR AXIAL SPRING	"	Y	"	Y	"	Y			"	Y	"	N	"	N			"	N			"	N			"	N					"	N
143	CAPABI		****		IS MOORING END AT FOUND-ATION MODELED BY A LINE-AR & ROTATIONAL SPRING	"	N	"	Y	"	N			"	Y	"	N	"	N			"	N			"	N			"	N					"	N
144		*********			IS IT POSSIBLE TO MODEL AN ARRAY OF INTERCONNE-CTED MOORING LINES	"	N	"	Y	"	N			"	Y	"	N	"	N			"	N			"	Y N			"	N					"	N
145					IS THE PROGRAM CAPABLE OF FATIGUE LIFE ANALYSIS	"	SEPT '84	"	Y	STRAN	Y			"	Y	"	N	"	N			"	N			"	N			"	N					"	N
146			DYNA-MICS		IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	Y	"	Y	TDSING	N			"	N	"	Y	"	Y			"	N			"	N			"	Y					"	N

Table part 1 (programs 1–8)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
147	L	** INSTALLATION ANALYS.	IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING	DISMAR2	Y	INTRA-WAGS2	Y	TDSIM6	N			FENRIS WAJAC	Y	AQWA-NAUT	Y	UCLTBPT	N		
148	I	MOORING SYSTEM OUTPUT	MOORING LINE LOAD TIME HISTORY	"	Y	"	Y	"	Y			"	Y	"	Y	"	Y		
149	T I		MOORING LINE LOAD STATISTICS ... ... MEAN VALUE	HARMAN	Y	"	N	"	N			"	N	"	Y	"	Y		
150	E		... R.M.S. VALUE	"	Y	"	N	"	N			"	N	"	Y	"	Y		
151	S		... (SIGNIFICANT)1/3	"	Y	"	N	"	N			"	N	"	Y	"	Y		
152			... EXPECTED MAXIMUM	"	Y	"	N	"	N			"	N	"	Y	"	Y		
153			... OTHERS, SPECIFY	"	Y	"	Y	"	N			"	N	"	N	"	N		
154		PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE	ANCOR3 ANCOR4	Y (100)	"	N	"	Y			"	N	"	40 200	"	60 80 100		
155	*		WITH OTHER SOFTWARE - LIST PROGRAMS	"	N	"	–	"	N			"	N	"	TRITIN (IFP)	"	NHL		
156	* * *		WITH OTHER PUBLISHED MATERIAL .... SPECIFY	"	N	"	HAND CALCS	"	N			"	N	"	FULL SCALE	"	–		
157	* * * *		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES	DINTUB DWRSR	Y	"	Y	"	N			"	Y	AQWA-RISER	Y (FD)	UCLRISERT	Y		
158		** STRUCTURAL	IS THE RISER MODEL TWO DIMENSIONAL	"	Y	"	Y					"	N	"	Y	"	Y		
159	R		IS THE RISER MODEL THREE DIMENSIONAL	"	Y	"	Y					"	Y	"	N	"	N		
160	I		DOES THE PROGRAM USE FINITE ELEMENT METHOD	"	Y	"	Y					"	Y	"	Y	"	Y		
161	S E		DOES THE PROGRAM USE FINITE DIFFERENCE METHOD	"	N	"	N					"	N	"	N	"	N		

Table part 2 (programs 9–16)

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
147	OSCAR	Y			VORIS	Y			MOMOP	N					AGA[illegible]	N
148	"	Y			VODYN VDPROC	Y			"	N					"	N
149	"	Y			"	Y			"	N					"	N
150	"	Y			"	Y			"	N					"	[illegible]
151	"	Y			"	Y			"	N					"	N
152	"	N			"	N			"	N					"	[illegible]
153	"	1/10 1/100			"	N			"	N					"	N
154	"	Y			"	N			"	N					"	N
155	"	Y				Y			"	N					"	[illegible]
156	"	Y			"	N			"	N					"	[illegible]
157	"	Y			VORIS	Y			"	N					"	N
158	"	N			"	Y									"	N
159	"	Y			"	N									"	N
160	"	N			"	Y									"	N
161	"	N			"	N										N

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
162	R	MODEL **	DOES THE PROGRAM USE SMALL DEFLECTION THEORY	DINTUB DWRSR	Y	INTRA-WACSL	Y					FENRIS WAJAC	N	AQWA-RISER	Y	UCLRISER	N			OSCAR	N			VORIS	Y									AGAR	N
163			IS THE PROGRAM CAPABLE OF USING LARGE DEFLECT-ION THEORY	〃	Y	〃	Y					〃	Y	〃	N		Y			〃	N			〃	N									〃	N
164		HYDRODYNAMIC MODEL	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	〃	SEE ITEM #20	〃	Y					〃	Y	〃	Y		REL. VEL			〃	Y			〃	Y									〃	N
165			IS IT CAPABLE OF CALCU-LATING HYDRODYNAMIC FOR-CE FOR VARIABLE DIAMETER	DWRSR	Y	〃	N					〃	Y	〃	Y		N			〃	Y			〃	Y									〃	N
166	S		IS IT CAPABLE OF CONSID-ERING EFFECT OF VORTEX SHEDDING	〃	Y	〃	N					〃	N	〃	N		N			〃	N			〃	N									〃	N
167	Y		IS THE RISER MODELLED AS TWO DIMENSIONAL	DINTUB DWRSR	Y	〃	Y					〃	N	〃	Y		Y			〃	N			〃	Y									〃	N
168	S		IS THE RISER MODELLED AS THREE DIMENSIONAL	〃	N	〃	Y					〃	Y	〃	N		N			〃	Y			〃	N									〃	N
169	T	** SOLUTION MODE **	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM	〃	Y	〃	Y					〃	Y	〃	Y		N			〃	Y			〃	N									〃	N
170	E		IS THE PROGRAM PERFORM TIME DOMAIN ANALYSIS	〃	Y	〃	Y					〃	Y	〃	Y		Y			〃	Y			〃	Y									〃	N
171	M	* *** SPECIAL ANALYSIS *** *	IS IT CAPABLE OF CLEAR-ANCE ANALYSIS BETWEEN RISERS	DWRSR	Y	〃	Y					〃	Y	〃	N		N			〃	N			〃	N									〃	N
172	M		IS IT CAPABLE OF INSTAL-LATION ANALYSIS W/ RISER BOTTOM AS FREE END	〃	?	〃	Y					〃	Y	〃	Y		Y			〃	Y			〃	Y									〃	N
173			IS IT CAPABLE OF INSTAL-LATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE	〃	?	〃	Y					〃	Y	〃	Y		Y			〃	Y			〃	Y									〃	N
174		PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE	DINTUB DWRSR	N	〃	N					〃	N	〃	Y		20, FULL SCALE			〃	N			〃	N									〃	N
175	****		WITH OTHER SOFTWARE - LIST PROGRAMS	〃	N	〃	-					〃	N	〃	BATTELLE		DYNRISER SEARISER			〃	N			〃	Y									〃	N
176			WITH OTHER PUBLISHED MATERIAL .... SPECIFY	〃	API	〃	-					〃	N	〃	Y		API 2J			〃	N			〃	Y									-	N

ROW #	****	****	** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
177	STABILITY ANALYSIS	INTACT	INTACT FREE FLOATING	FLOSTA NASTA	Y	INTRA-WACS2	Y	EUREKA	Y			NV223	Y	AQUA-GRIUM	Y	ARCHIMEDES	Y			OSCAR	Y			VOLYN VOCAS	Y			MOSAS/TLP	Y					AGAT	N
178		INTACT	INTACT WITH VERTICAL TAUT TENDONS	"	Y	"	Y	"	N			"	Y	"	Y	"	N			"	Y			"	Y			"	Y					"	N
179		DAMAGED	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED	"	Y	"	Y	"	Y			"	Y	"	Y	"	Y			"	Y			LASS	Y			"	N					"	N
180		DAMAGED	DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING	"	Y	"	Y	"	N			"	N	"	Y	"	N			"	Y			"	Y			"	Y					"	N
181	STRUCTURAL ANALYSIS	LOADING	HYDRODYNAMIC LOADING CONSIDERED	CARGON3	Y	"	Y	TDSIMS STRAN	Y			FENRIS WAJAC	Y	AQUA-LINE	Y					"	Y			VOHYDR YODAS	Y									"	Y
182		LOADING	IS INERTIA LOADING CONSIDERED	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y			"	Y									"	Y
183		LOADING	IS DYNAMIC LOADING CONSIDERED	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y			"	Y									"	Y
184		SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS	"	Y	"	Y	"	Y			"	Y	"	N					"	N			"	N									"	N
185		SPACE FRAME ANALYSIS	THREE DIMENSIONAL SPACE FRAME ANALYSIS	"	Y	"	Y	"	Y			"	Y	"	N					"	N			"	Y									"	N
186		FINITE ELEMENT ANALYSIS	BEAM ELEMENT	SAPS NASTRAN	Y	"	Y	"	Y			"	Y	"	N					"	N			"	Y									"	Y
187		FINITE ELEMENT ANALYSIS	SHELL ELEMENT	"	Y	"	N	"	N			"	Y	"	8,4,6 & 3 NODES					"	N			"	N Y									"	N
188		FINITE ELEMENT ANALYSIS	PLATE ELEMENT	"	Y	"	Y	"	Y			"	Y	"	Y					"	N			"	N Y									"	N
189		FINITE ELEMENT ANALYSIS	STIFFENED PLATE ELEMENT	"	?	"	N	"	Y			"	N	"	Y					"	N			"	N Y									"	N
190		FINITE ELEMENT ANALYSIS	OTHERS .... SPECIFY	"	N	"	TRUSS STRUT CABLE SOIL	"	N			"	CABLE TRUSS BAR SOLID AXISYM	"	N					"	N			"	SUBSTRUCTURE N									"	N
191		FINITE ELEMENT ANALYSIS	NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM	"	?	"	(6-12) PER EL UNLIMITED FOR TOTAL	"	?			"	UNLIMITED	"	?					"	N			"	?										[illegible]

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
192	S	OTHER ANALYTICAL CAPABILITY	SPECTRAL ANALYSIS	SAPS NASTRAN	Y	INTRA-WACS2	N	SPLASH TDSIM6 STRAN	Y			FENRIS WAJAC	Y	ASAS	Y					OSCAR	N			[illegible]	Y									AGAP	N
193	*		MODAL ANALYSIS	″	Y		Y	″	Y			″	N	ASAS DYNAMICS	Y						N				Y									″	N
194	*		FATIGUE LIFE ANALYSIS	VIFAN3	Y		Y	″	Y			″	Y	FAT JACK	Y						N			″	Y									″	N
195		PRE-PROCESSING AND POST-PROCESSING CAPABILITIES	VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)	PLOTE, PROSP, MENTAT	Y		N	″	–			″	Y	AQWA ASAS	Y	ALL PROGRAMS	Y				Y				N									″	Y
196			RESTART CAPABILITIES (LIST ALL THE PROGRAMS)	NASTRAN	Y		Y	″	–			″	N	″	Y	″	N				Y				N									″	N
197			PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)	PLOTR PROSP MENTAT	Y		Y	″	–			″	Y	ASDIS C-GUL AQWA-PLANE	Y	″	Y				Y				N									″	[illegible]
198			CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)	NAISC5 NAISC4 PUNSHE DNV77	Y	BEING DEVE-LOPED		″	–			″	Y	ASAS-BEAMST	Y	″	N				N				N									″	N
199		PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON	PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION	ALL THE PROGRAMS	77 (ASC II)		FORT IV	ALL THE PROGR-AMS	FORT IV			″	FORT 77	AQWA ASAS	FORT 66	″	FORT IV & 77				Y			VODAS YORAN VOSPEC	FOR- IV			MOMOP	IV					″	Y
200			.... BASIC	″	N		N	″	N			″	N	″	N	″	N				N			VOFFIME [illegible]HYDR	Y				N					″	N
201			.... PASCAL	″	N		N	″	N			″	N	″	N	″	N				N			″	N				N					″	N
202			.... OTHERS SPECIFY	″	N		N	″	N			″	N	″	N	″	N				N			″	N				N					″	N
203			COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU	″	?		?	″	?			″	?	″	?	″	?				?			″	?				N					″	?
204		DOCUMENTATION	IS USERS' GUIDE AVAILABLE	″	Y		Y	″	Y			″	Y	″	Y	″	Y				Y			ALL THE PROGRAMS	LIMITED				Y					″	Y
205			IS THEORETICAL MANUAL AVAILABLE	″	Y		Y	″	Y			″	Y	AQWA (Some)	Y	″	Y			PROPRIETARY				″	N				N					″	Y
206		SUPPORT	ARE THE PROGRAMS SUPP-ORTED AND MAINTAINED	″	Y		Y	″	Y			″	Y	AQWA ASAS	Y	″	N				Y			″	Y				Y						N

ROW #	**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
207	MAINTENANCE AND TRAINING	IS ANY TRAINING OFFERED	ALL THE PROGRAMS	Y	INTRA-WACS2	Y	ALL THE PROGRAMS	Y			FENRIS WAJFAD	Y	AQWA ASAS	Y	ALL PROGRAMS	N			OSCAR	Y			ALL THE PROGRAMS	Y			MOMOP	N					AGAPI	N
208	** ****	IBM	"	N	"	Y	"	Y			"	N	"	Y	"	Y			"	Y			VODAS VORIS	Y			"	N					"	N
209		CDC	"	N	"	Y	"	Y			"	N	"	Y	"	Y			"	Y			"	Y			"	N					"	Y
210	HARDWARE SYSTEM	PRIME COMPUTER	"	N	"	N	SPLASHD	Y			"	N	"	Y	"	Y			"	Y			"	N			"	N					"	N
211		VAX	"	N	"	N	"	Y			"	Y	"	Y	"	Y			"	Y			"	N			"	N					"	N
212	**** **	MICRO .... SPECIFY	"	N	"	N	EUREKA	CP/M			"	N	AQWA	IBM P.C	"	N			"	Y			"	HP APPLE			"	N					"	N
213		OTHERS .... SPECIFY	"	SPERRY O.S. EXEC8	"	CRAY	SPLASHD EUREKA TDSIM6	HONEY-WELL UNIVAC			"	UNIVAC	"	ICL	"	GEC 4190			"	UNIVAC DATA GENL			ALL THE PROGRAMS	N			"	UNIVAC					"	N
214	** ****	LEASE (PRICE $ .00)	"	EXCEPT NASTRAN		N	TDSIM6	Y			"	Y	AQWA ASAS	Y	"	Y			"	Y			"	Y			"	?						
215	ACCESSIBILITY ARRANGEMENT	PURCHASE (PRICE $ .00)	"	N		Y 55K	"	$2000/-			"	Y	"	Y	"	Y			"	Y			"	N			"	?						
216		CONSULTANCY BASIS	"	Y		N	"	Y			"	Y	"	Y	"	Y			"	Y			"	Y			"	?						
217	** ****	OTHERS .... SPECIFY	"	N		N	"	?			"	N	"	?	"	?			"	?			"	N			"	?						
218																																		
219	REMARKS AND NOTES																																	
220																																		

TABLE III(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
27			D ORDER VISCOUS FORCES	DOES THE PROGRAM CONSIDER NON-LINEAR WAVE DRAG	SELOS	Y			?	N		
28				DO DRAG FORCE CALCULATION CONSIDER MEAN CURRENT & WAVE PARTICLE VEL		Y			"	N		
29	*	.		IS CURRENT AND WAVE FRICTION CONSIDERED IN RESULTANT FRICTIONAL DRIFT		N			"	N		
30	*	.		IS ITERATION OF RESPONSE USED FOR CONVERGENCE		?			"	Y		
31	*	.		DOES IT USE PREVIOUS TIME STEP RESULTS IN PRESENT STEP CALCULATION		?			"	Y		
32	*	.		IS THE CONVERGENCE TOLERANCE BUILT-IN THE PROGRAM		?			"	Y		
33	*	.		DOES THE USER SPECIFY THE CONVERGENCE TOLERANCE		?			"	?		
34	*****	******	*** ADDMASS	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM		N			"	?		
35				CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS		2D			"	2D		
36			REGULAR WAV DAMPING COEFFICIENT	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING		Y			"	?		
37				IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED		N			"	?		
38	E			IS THE CURRENT DRAG DAMPING CONSIDERED		?			"	?		
39	Q	T		IS THE CURRENT FRICTION DAMPING CONSIDERED		N			"	?		
40	U A	I		IS THE RADIATION DAMPING CONSIDERED		N			"	?		
41	T I	M		IS THE STRUCTURAL DAMPING CONSIDERED		N			"	Y		

TABLE III (A) SUMMARY OT TIME DOMAIN SOFTWARE CAPABILITIES
(BASED ON MORISON'S EQUATION)

NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM ANALYSIS TECHNIQUES
(SOFTWARE SURVEY)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
1	*	WIND FORCE CALCULATIONS	CALCULATES STATIC WIND FORCES	SELOS	Y			?	N		
2	*		CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION	"	?			"	N		
3	*		IS THE WIND FORCE AN INPUT TO THE PROGRAM	"	N			"	N		
4	*	CURRENT FORCE CALCULATION	IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED	"	Y			"	N		
5	*		CURRENT FORCES CALCULATED INDEPENDENTLY AND ADDED TO WAVE FORCES	"	N			"	?		
6			IS THE CURRENT FORCE AN INPUT TO THE PROGRAM	"	N			"	?		
7		. : ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER	"	Y			"	Y		
8	E	. M	VERTICAL MEMBER	"	Y			"	Y		
9	N V	. E M	HORIZ. MEMBER	"	Y			"	Y		
10	I	. B E X-SECTI	DOES IT USE EQUIVALENT CIRCULAR CROSS SECTION FOR NONCIRCULAR SECTION	"	?			"	?		
11	R O	. R :	DOES IT USE MODIFIED C AND C VALUES FOR NON CIRCULAR X-SECTION	"	?			"	?		

TABLE III(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YE[S/NO]
12	NMENTAL		: ON	OTHER METHODS, IF ANY, TO CALCULATE WAVE FORCE ON NON CIRCULAR X-SECTION	SELOS	?			?	N		
13		WAVE		IS THE FORCE CALCULATED AT THE LONGL AXIS OF THE MEMBER	"	Y			"	Y		
14				ANY METHOD TO CALC PRESS DISTRIBUTION ON SURFACE; IF YES, PLEASE SPECIFY	"	?			"	?		
15			MEMBER INTER-ACTION	IS THE INTERACTION BET MEMBERS CONSIDERED : COLUMN AND COLUMN	"	N			"	N		
16				COLUMN AND PONTOON	"	N			"	N		
17				PONTOON AND PONTOON	"	N			"	N		
18			FIRST ORDER	IS THE PROGRAM BASED ON BASIC MORISON'S EQUATION	"	N			"	N		
19				IS THE PROGRAM BASED ON MORISON'S EQUATION FOR-MULATION W/ REL VELOCITY	"	N			"	Y		
20				IS THE PROGRAM BASED ON MORISON'S EQN W/ REL VELOCITY AND CURRENT	"	Y			"	N		
21	FORCES	FORCES		IS THE PROGRAM BASED ON LINEARIZED FORM OF MORISON'S EQUATION	"	N			"	N		
22			SECOND : DRIFT	DOES IT CONSIDER THE WAVE ELEVATION	"	Y			"	Y		
23				DOES THE PROGRAM ACCOUNT REFLECTION OF 1ST ORDER WAVES FROM THE BODY	"	N			"	N		
24			FORCES	DOES IT ACCOUNT FOR ADD-ITIONAL PRESSURE DUE TO DISPLACEMENT OF BODY	"	N			"	N		
25				DOES IT ACCOUNT FOR ADD-ITIONAL PRESSURE DUE TO ROTATION OF BODY	"	N			"	N		
26				DOES IT ACCOUNT FORCE ON A FIXED BODY BY LOW FRE-QUENCY 2ND ORDER WAVES	"	N			"	Y		

TABLE III(A) [CONTINUED]

ROW #		**** ** ****			** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
42	ON	E	ES ***	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	SELOS	N			?	?		
43				STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	"	N			"	N		
44					IS THE STIFFNESS MATRIX COMPUTED	"	Y			"	Y		
45	OF	DOMAIN	***	ADDMASS	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	"	N			"	?		
46			IRREGULAR		CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	2D			"	?		
47				DAMPING	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	Y			"	?		
48	MOTION				IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	N			"	?		
49					IS THE CURRENT DRAG DAMPING CONSIDERED	"	?			"	?		
50				COEFFICIENTS	IS THE CURRENT FRICTION DAMPING CONSIDERED	"	N			"	?		
51					IS THE RADIATION DAMPING CONSIDERED	"	N			"	?		
52			WAVES		IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	Y		
53	*****				IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	"	N			"	?		
54		****		STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	"	N			"	N		
55			***		IS THE STIFFNESS MATRIX COMPUTED	"	Y			"	Y		
56	**	**	STATIC WIND		IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT	"	Y			"	N		

TABLE III(A) [CONTINUED]

ROW #		**** ** ****		** ** ** ** ****** ** ** ** **	A		B		C		D	
					PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO
87		I C S		WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	DYNAL	?			?	ALL SIX (?)		
88	S O			IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	〃	?			〃	–		
89	L U			NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	〃	SIX			〃	SIX		
90	T I			WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	〃	?			〃	ALL SIX (?)		
91	O N		T	IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	〃	?			〃	–		
92		D Y	I M	WHAT METHOD OF INTEGRATION USED .... HOUBOLT	〃	N			〃	N		
93		N	E	.... WILSON-θ	〃	N			〃	N		
94		A		.... NEWMARK-β	〃	Y			〃	Y		
95	T E	M I	D	OTHERS .... PLEASE SPECIFY	〃	Y			〃	N		
96	C H	C	O M	HOW THE TRANSIENT IS HANDLED .... RAMP FUNCTION	〃	Y			〃	?		
97	N I	S	A I	.... VARIABLE INTEGRATION TIME	〃	?			〃	?		
98	Q U		N	OTHERS .... PLEASE SPECIFY	〃	?			〃	N		
99	E			MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION	〃	?			〃	?		
100				OTHERS .... PLEASE SPECIFY	〃	?			〃	N		
101				PLATFORM MOTION TIME HISTORY	〃	Y			〃	Y		

TABLE III(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
102	** **** ****** ******** PLATFORM RESPONSE OUTPUT ******** ****** **** **		PLATFORM RESPONSE STATISTICS .... MEAN VALUE	SELOS DANOS DYNAV	?			?	N		
103			... R.M.S. VALUE	"	?			"	N		
104			... (SIGNIFICANT)1/3	"	?			"	N		
105			... EXPECTED MAXIMUM	"	?			"	N		
106			... OTHERS, SPECIFY	"	?			"	N		
107			CAN IT PREDCT RESPONSES IN ANY HEADING FROM RESPONSES IN ORTHO HEADINGS	"	N			"	N		
108	** **** PROGRAM VERIFICATION **** **		MODEL TEST - INDICATE SCALE	"	N			"	N		
109			OTHER AVAILABLE SOFTWARE - LIST PROGRAMS	"	N			"	N		
110			OTHER PUBLISHED MATERIAL - SPECIFY	"	N			"	N		
111			OTHERS (SPECIFY)	"	N			"	N		
112	********	DESCRIPTION	SPREAD MOORING (CATENARY)	DANOS	Y			"	N		
113			SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT	"	N			"	N		
114			VERTICAL (TAUT) MOORING	"	Y			"	Y		
115			HYBRID/OTHER COMBINATION .... SPECIFY	"	N			"	N		
116			SYNTHETIC ROPE - SUCH AS NYLON KEVLAR	"	N			"	N		

TABLE III(A) [CONTINUED]

ROW #				**** ** ****	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
117		MATERIAL		CHAIN (STEEL)	DANOS	Y			?	Y		
118				WIRE ROPE (STEEL)	"	Y			"	Y		
119				COMBINATIONS SUCH AS CHAIN/WIRE ROPE OTHERS, SPECIFY	"	N			"	N		
120	MOORING	CATENARY	STATICS	USER SPECIFIED LOAD DISPLACEMENT TABLE	"	?			"	N		
121				IS IT BASED ON CATENARY EQUATION	"	?			"	N		
122				IS IT BASED ON FINITE ELEMENT METHOD	"	?			"	N		
123				OTHERS (SPECIFY)	"	?			"	N		
124			DYNA-MICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	?			"	N		
125		VERTI	MOO	IS THE MASS OF THE MOORING CONSIDERED	"	N			"	N		
126				IS THE MOORING SYSTEM MODELLED AS A LINEAR SPRING	"	?			"	Y		
127				IS THE MOORING SYSTEM MODELLED AS A NON-LINEAR SPRING	"	?			"	N		
128				IS GEOMETRIC NON LINEARITY CONSIDERED	"	?			"	N		
129				IS MATERIAL NON LINEARITY CONSIDERED	"	?			"	N		
130				IS THE HYDRODYNAMIC DAMPING CONSIDERED	"	N			"	N		
131				IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	N		

TABLE III(A) [CONTINUED]

ROW #		**** ** ****			** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
132	S	C A	R		IS THE MOORING SYSTEM COUPLED WITH PLATFORM	DANOS	N			?	N		
133	Y	L	I N		IS IT BASED ON FINITE EL-EMENT METHOD, W/ OR W/O BENDING STFFNSS, CIRCLE	"	?			"	N		
134	S T		G		IS IT BASED ON FINITE DIFFERENCE METHOD	"	?			"	N		
135	E			HYDR	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	"	?			"			
136	M		M	ODYN	IS IT CAPABLE OF CALCUL-ATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	"	?			"			
137		M	O	AMIC	IS IT CAPABLE OF CONSID-ERING EFFECT OF VORTEX SHEDDING	"	N			"			
138		O	D	M	IS THE HYDRODYNAMIC MODEL FOR MOORING TWO DIMENSIONAL	"	Y			"			
139		O R	E L	ODEL	IS THE HYDRODYNAMIC MODEL FOR MOORING THREE DIMENSIONAL	"	?			"			
140		I			IS THE STRUCTURL MOORING MODEL TWO DIMENSIONAL	"	Y			"	Y		
141		N G	*****		IS THE STRUCTURL MOORING MODEL THREE DIMENSIONAL	"	Y			"	N		
142					IS THE MOORING END AT FOUNDATION MODELED BY A LINEAR AXIAL SPRING	"	?			"			
143	C A		****		IS MOORING END AT FOUND-ATION MODELED BY A LINE-AR & ROTATIONAL SPRING	"	?			"			
144	P	*****			IS IT POSSIBLE TO MODEL AN ARRAY OF INTERCONNE-CTED MOORING LINES	"	N			"	N		
145	A B	*****			IS THE PROGRAM CAPABLE OF FATIGUE LIFE ANALYSIS	"	Y			"	N		
146	I	****	DYNA-MICS		IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	?			"	N		

TABLE III(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
147	L	* * INSTAL-LATION ANALYS	IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING	DANOS	N			?	N		
148	I		MOORING LINE LOAD TIME HISTORY	DANOS DYNAL	Y			"	?		
149	T I		MOORING LINE LOAD STATISTICS ... ... MEAN VALUE	"	Y			"	?		
150	E		... R.M.S. VALUE	"	?			"	?		
151	S	MOORING SYSTEM OUTPUT	... (SIGNIFICANT)1/3	"	Y			"	?		
152			... EXPECTED MAXIMUM	"	?			"	?		
153			... OTHERS, SPECIFY	"	?			"	?		
154			WITH MODEL TESTS - INDICATE SCALE	"	?			"	N		
155	*	PROGRAM VERIFICATN	WITH OTHER SOFTWARE - LIST PROGRAMS	"	?			"	N		
156	* * *		WITH OTHER PUBLISHED MATERIAL .... SPECIFY	"	?			"	N		
157	* *		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES	"	N			"	N		
158	* *	* *	IS THE RISER MODEL TWO DIMENSIONAL								
159	R	S T R U	IS THE RISER MODEL THREE DIMENSIONAL								
160	I	C T U R	DOES THE PROGRAM USE FINITE ELEMENT METHOD								
161	S E	A L M	DOES THE PROGRAM USE FINITE DIFFERENCE METHOD								

TABLE III(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A		B		C		D	
				PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO
162	R	O D E L	DOES THE PROGRAM USE SMALL DEFLECTION THEORY								
163		* *	IS THE PROGRAM CAPABLE OF USING LARGE DEFLECTION THEORY								
164		H Y D R	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM								
165		O D Y	IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER								
166	S Y	N A M I C	IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING								
167	S	M	IS THE RISER MODELLED AS TWO DIMENSIONAL								
168	T	O D E L	IS THE RISER MODELLED AS THREE DIMENSIONAL								
169	E M	** SOLUTION	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM								
170	M	MODE **	IS THE PROGRAM PERFORM TIME DOMAIN ANALYSIS								
171		* ***	IS IT CAPABLE OF CLEARANCE ANALYSIS BETWEEN RISERS								
172		SPECIAL ANALYSIS	IS IT CAPABLE OF INSTALLATION ANALYSIS W/ RISER BOTTOM AS FREE END								
173		*** *	IS IT CAPABLE OF INSTALLATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE								
174			WITH MODEL TESTS - INDICATE SCALE								
175	*	PROGRAM VERIFICATN	WITH OTHER SOFTWARE - LIST PROGRAMS								
176	* * *		WITH OTHER PUBLISHED MATERIAL .... SPECIFY								

TABLE III(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG -RAM	A YES /NO	B PROG -RAM	B YES /NO	C PROG -RAM	C YES /NO	D PROG -RAM	D YES /NO
177	STABILITY ANALYSIS	INTACT	INTACT FREE FLOATING	SELOS	N			?	N		
178	STABILITY ANALYSIS	INTACT	INTACT WITH VERTICAL TAUT TENDONS	"	N			"	N		
179	STABILITY ANALYSIS	DAMAGED	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED	"	N			"	N		
180	STABILITY ANALYSIS	DAMAGED	DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING	"	N			"	N		
181	STRUCTURAL ANALYSIS	LOADING	HYDRODYNAMIC LOADING CONSIDERED	SELOS DANOS	Y						
182	STRUCTURAL ANALYSIS	LOADING	IS INERTIA LOADING CONSIDERED	"	Y						
183	STRUCTURAL ANALYSIS	LOADING	IS DYNAMIC LOADING CONSIDERED	"	Y						
184	STRUCTURAL ANALYSIS	SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS	"	Y						
185	STRUCTURAL ANALYSIS	SPACE FRAME ANALYSIS	THREE DIMENSIONAL SPACE FRAME ANALYSIS	"	Y						
186	STRUCTURAL ANALYSIS	FINITE ELEMENT ANALYSIS	BEAM ELEMENT	"	Y						
187	STRUCTURAL ANALYSIS	FINITE ELEMENT ANALYSIS	SHELL ELEMENT	"	Y						
188	STRUCTURAL ANALYSIS	FINITE ELEMENT ANALYSIS	PLATE ELEMENT	"	Y						
189	STRUCTURAL ANALYSIS	FINITE ELEMENT ANALYSIS	STIFFENED PLATE ELEMENT	"	?						
190	STRUCTURAL ANALYSIS	FINITE ELEMENT ANALYSIS	OTHERS .... SPECIFY	"	?						
191	STRUCTURAL ANALYSIS	FINITE ELEMENT ANALYSIS	NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM	"	?						

TABLE III(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
192	S	OTHER ANALYTICAL CAPABILITY	SPECTRAL ANALYSIS	DANOS DYNAL	Y						
193	*		MODAL ANALYSIS	〃	Y						
194	* * * *		FATIGUE LIFE ANALYSIS	〃	Y						
195	PRE-PROCESSING AND POST-PROCESSING CAPABILITIES		VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)	〃	?						
196			RESTART CAPABILITIES (LIST ALL THE PROGRAMS)	〃	?						
197			PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)	〃	Y						
198			CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)	〃	Y (API)						
199	PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON		PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION	〃	Y			?	Y (?)		
200			.... BASIC	〃	N			〃	N		
201			.... PASCAL	〃	N			〃	N		
202			.... OTHERS SPECIFY	〃	N			〃	N		
203			COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU	〃	?			〃	?		
204	DOCUMENTATION		IS USERS' GUIDE AVAILABLE	〃	Y			〃	N		
205			IS THEORETICAL MANUAL AVAILABLE	〃	Y			〃	Y		
206	SUPPORT MAINTENANCE		ARE THE PROGRAMS SUPPORTED AND MAINTAINED	〃	Y			〃	N		

TABLE III(A) [CONTINUED]

ROW #	**** ** ****	** ** ** ** ****** ** ** ** **	A PROG -RAM	A YES /NO	B PROG -RAM	B YES /NO	C PROG -RAM	C YES /NO	D PROG -RAM	D YES /NO
207	AND TRAINING	IS ANY TRAINING OFFERED	SELOS DANOS	?			?	N		
208	** ****	IBM	〃	Y			〃	Y(?)		
209		CDC	〃	N			〃	?		
210	HARDWARE SYSTEM	PRIME COMPUTER	〃	N			〃			
211		VAX	〃	Y			〃			
212	**** **	MICRO .... SPECIFY	〃	N			〃			
213		OTHERS .... SPECIFY	〃	IBM 4341 MINI			〃			
214	** ****	LEASE (PRICE $ .00)	〃	Y			〃	?		
215	ACCESSIBILITY	PURCHASE (PRICE $ .00)	〃	Y			〃	?		
216	ARRANGEMENT	CONSULTANCY BASIS	〃	Y			〃	?		
217	** ****	OTHERS .... SPECIFY	〃	?			〃	?		
218										
219	REMARKS AND NOTES									
220										

TABLE IV

SUMMARY OF TIME COMAIN SOFTWARE CAPABILITIES
(based on diffraction theory or combination of diffraction theory, strip theory, and Morison's Equation)

NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM ANALYSIS TECHNIQUES

(SOFTWARE SURVEY)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
1	*	WIND FORCE CALCULAT-IONS	CALCULATES STATIC WIND FORCES	DIFCARG DISMAR3 SEAOFF	Y			EUREKA	Y	SAI-HFEM	Y	FENRIS WAMLOS	1984-85	AQUA-LIBRIUM	Y			NMISPM	LATE 1984
2	*		CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION	DISMAR3 SEAOFF	Y			"	N	"	Y	"	N	AQUA-DRIFT	Y			"	-DO-
3	*		IS THE WIND FORCE AN INPUT TO THE PROGRAM	DIFCARG DISMAR3 SEAOFF	N			TDSIM6	Y	"	Y	"	Y	AQUA-LIBRIUM	OPTION-AL			"	N
4	*	CURRENT FORCE CALCULATION	IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED	DIFCARG DISMAR3	Y			"	Y	"	Y	"	N	AQUA-SUITE	N			"	N
5	*		CURRENT FORCES CALCULA-TED INDEPENDENTLY AND ADDED TO WAVE FORCES	SEAOFF	Y			"	N	"	Y	"	N	"	Y			"	Y
6	*		IS THE CURRENT FORCE AN INPUT TO THE PROGRAM	DIFCARG DISMAR3 SEAOFF	N			"	N	"	Y	"	Y	"	N			"	N
7	ENVIR	MEMBER ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER	DIFCARG DISMAR3	Y			CATMO HYDRO3 SPLASHD	Y	"	Y	"	Y	AQUA-LINE-DRIFT	Y			NMIWAVE	Y
8			VERTICAL MEMBER	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y
9			HORIZ. MEMBER	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y
10		MEMBER X-SECT	IS THE PROGRAM CAPABLE OF HANDLING NONCIRCULAR CROSS SECTION	"	N			CATMO HYDRO3	Y	"	N	"	Y	"	N			"	Y
11			DOES IT USE EQUIVALENT CIRCULAR X-SECTION	"	N			"	N	"	Y	"	Y	"	N			"	N

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
1	OSCAR	Y					WWC FORCE	Y			??	N	WIND	Y		
2	"	N					"	N				N	WINDSPEC	Y		
3	"	Y					"	N				SEPT 1984	"	Y		
4	"	N					"	N				Y				
5	"	Y					"	Y				N	CURRENT	Y		
6	"	Y					"	Y				N	"	Y		
7	"	Y					DIFFRAC	Y				SEPT 1984	TENMOR	Y		
8	"	Y					"	Y				Y	"	Y		
9	"	Y					"	Y				Y	"	Y		
10	"	Y					"	N				Y	"	Y		
11	"	N					"	N				Y	"	N		

NOTE: NUMBERS AT THE TOP OF THE COLUMNS REFER TO DETAILED RESPONSES TO THE BARDI QUESTIONAIRE FROM VARIOUS PARTICIPANTS. ALL RESPONSES ARE COMPILED IN APPENDIX I.

ROW #			**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
12	ONMENTAL FORCES	WAVE FORCES	: ION	OTHER METHODS, IF ANY, TO CALCULATE WAVE FORCE ON NON CIRCULAR X-SECTION	DIFCARG DISMAR3	N			CATMO HYDRO3	N	SAI-HFEM	Y	FENRIS WAMUS	N	AQWA SOITE	N			NMIWAVE	Y	OSCAR	2D, 3D DIFFRACTION					SEMI SUB & DIFFRAC	Y			??	N	TENMOR	Y		
13				IS THE FORCE CALCULATED AT THE LONGL AXIS OF THE MEMBER		Y			"	Y	"	Y	"	N	"	N			"	Y	"	Y					"	Y				Y	"	Y		
14				ANY METHOD TO CALC PRESS DISTRIBUTION ON SURFACE; IF YES, PLEASE SPECIFY	DIFCARG DISMAR3 SEAOFF	Y			"	Y	"	Y	"	FALTINSEN & MICHEL-SEN	"	NOT IN TIME DOMAIN			"	POTENTIAL THEORY	"	2D-STRIP 3D-DIFF.					"	Y				N	"	Y		
15				IS THE INTERACTION BET MEMBERS CONSIDERED : COLUMN AND COLUMN	"	Y			HYDRO3	Y	"	Y	"	Y	AQWA-LINE-DRIFT	Y			"	Y	"	Y					"	Y				N	"	Y		
16			MEMBER INTER-ACTION	COLUMN AND PONTOON	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y				N	"	Y		
17				PONTOON AND PONTOON	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y				N	"	Y		
18			FIRST ORDER	IS THE PROGRAM BASED ON DIFFRACTION THEORY, SPECIFY THE TYPE	"	Y			CATMO HYDRO3	STRIP 3D SOURCE	"	Y	"	FALTINSEN & MICHELSEN	AQWA-LINE	Y			"	SOURCE /SINK	"	Y					"	Y				McCAMY FUCHS ONLY	"	Y		
19				IS IT BASED ON HYBRID ELEMENT W/COMBINATION OF DIFFRACTION & MORISON	"	Y			"	N	"	Y	"	Y	AQWA-DRIFT	Y			"	Y	"	Y					"	N				Y	"	Y		
20				DIFFRACTION AND FLUID FINITE ELEMENT	"	N			"	N	"	N	"	N	"	N			"	N	"	N					"	N				N	"	N		
21				OR ANY OTHER COMBINATION	"	N			"	N	"	N	"	N	"	N			"	N	"	N					"	N				N	"	N		
22			SECOND DRIFT FORCES	DOES IT CONSIDER THE WAVE ELEVATION	DISMAR3 SEAOFF	Y			"	Y	"	Y	"	N	AQWA-NAUT	REGU-LAR WAVES			"	Y	"	Y					DB-DRIFT/ DRIFT P/ IMPRES/ L2	Y				Y	"	Y		
23				DOES THE PROGRAM ACCOUNT REFLECTION OF 1ST ORDER WAVES FROM THE BODY	"	Y			"	Y	"	Y	"	Y	AQWA-LINE	Y			"	Y	"	Y					"	Y				Y	"	Y		
24				DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO DISPLACEMENT OF BODY	"	Y			"	Y	"	Y	"	Y	"	N			"	Y	"	Y					"	Y				Y	"	Y		
25				DOES IT ACCOUNT FOR ADDITIONAL PRESSURE DUE TO ROTATION OF BODY	"	Y			"	Y	"	Y	"	Y	"	N			"	Y	"	Y					"	Y				Y	"	Y		
26				DOES IT ACCOUNT FORCE ON A FIXED BODY BY LOW FREQUENCY 2ND ORDER WAVES	"	Y			"	Y	"	Y	"	N	"	N			"	Y	"	Y					"	Y				N	"	Y		

ROW #		**** ****			** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
						PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
27			D		DOES THE PROGRAM CONSIDER NON-LINEAR WAVE DRAG	DIFCARG DISMAR3 SEAOFF	Y			CATMO HYDRO3	N	SAI-HFEM	Y	FENRIS WAMLOS	Y	AQUA-DRIFT-NAUT	Y			NMIWAVE	N	OSCAR	Y						N			??	Y	TENMOR	Y		
28				V I	DO DRAG FORCE CALCULATION CONSIDER MEAN CURRENT & WAVE PARTICLE VEL	"	Y			"	N	"	Y	"	N	"	Y			"	N	"	Y					–					SEPT 1984	"	N		
29	*	.		S C O U S	IS CURRENT AND WAVE FRICTION CONSIDERED IN RESULTANT FRICTIONAL DRIFT	SEAOFF	Y			"	Y	"	Y	"	N	"	N			"	N	"	N					–	SEE NOTES ON DETAILED TABLES				Y	"	Y		
30	* * *	.	O		IS ITERATION OF RESPONSE USED FOR CONVERGENCE	DIFCARG DISMAR3 SEAOFF	N			CATMO HYDRO3 TDSING	Y	"	Y	"	N	"	N			"	N	"	N					–					N	"	N		
31	* *	.	R D	F	DOES IT USE PREVIOUS TIME STEP RESULTS IN PRESENT STEP CALCULATION	"	N			"	Y	"	Y	"	N	"	Y			"	N	"	N					–					N	"	Y		
32	* *	.	E R	O R C E S	IS THE CONVERGENCE TOLERANCE BUILT-IN THE PROGRAM	"	N			"	BUILT IN DEFAULT	"	Y	"	N	"	Y			"	N	"	N					–					N	"	N		
33	* *	.	. . .		DOES THE USER SPECIFY THE CONVERGENCE TOLERANCE	"	N			"	CAN SPECIFY	"	Y	"	N	"	Y			"	N	"	N					–					N	"	N		
34	* *	* *	* * *	A D D	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	"	Y			"	N	"	N	"	N	AQWA-NAUT	OPTION-AL			"	OPTION-AL	"	N					MOORSIM	N				N	"	N		
35	* * *	* * *		M A S S	CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	3D			"	2D, 3D	"	3D	"	3D	"	Y			"	3D	"	2D, 3D					"	3D				2D	"	Y (2D,3D)		
36		* * *	R		IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	N				Y	"	Y		
37			E G	D A M P	IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	?			"	Y	"	Y	"	N	"	N			"	N	"	N					"	N				Y	"	Y		
38	E	T	U L A	I N G	IS THE CURRENT DRAG DAMPING CONSIDERED	"	Y			"	Y	"	Y	"	N	"	Y			"	Y	"	N					"	Y				Y	"	Y		
39	Q U		R	C O	IS THE CURRENT FRICTION DAMPING CONSIDERED	"	?			"	Y	"	Y	"	N	"	Y			"	N	"	N					"	N				N	"	Y		
40	A	I		E F F I	IS THE RADIATION DAMPING CONSIDERED	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y				SEPT 1984	"	Y		
41	T	M	W H A	C I E N	IS THE STRUCTURAL DAMPING CONSIDERED	SEAOFF	Y			"	N	"	N	"	Y	ASAS	Y			"	N	"	N					"	N				N	"	Y		

ROW #		****			** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
	I	****	V	T		PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO	PROG -RAM	YES /NO
42	O	E	E	S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	DIFCARG DISMAR3 SEAOFF	Y			CATMO HYDRO3 TDSMG	N	SAI-HFEM	N	FENRIS WAMOS	N	AQWA-NAUT	OPTIO-NAL			NMISPM	Y	OSCAR	N						N			??	N	TENMOR	N		
43	N		S	STIFF	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	SEAOFF	Y			"	N	"	N	"	N	"	Y			"	N	"	N						Y				N	"	N		
44			***	NS	IS THE STIFFNESS MATRIX COMPUTED	DIFCARG DISMAR3	N			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y						Y				Y	"	Y		
45	O	D	***	ADDM	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM	DIFCARG DISMAR3 SEAOFF	Y			"	N	"	N	"	N	AQWA-DRIFT	Y			"	Y	"	N					MOORSIM	Y				SET UP FOR REG. WAVES	"	N		
46	F	O	I	ASS	CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE); OTHERS	"	3D			"	2D, 3D	"	3D	"	3D	"	Y			"	Y	"	2D 3D					"	Y				"	"	Y		
47		M	R	D	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	N				"	"	Y		
48	M		R E G	AMP	IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED	"	?			"	Y	"	Y	"	N	"	N			"	N	"	N					"	N				"	"	Y		
49	O	A	U L	ING	IS THE CURRENT DRAG DAMPING CONSIDERED	"	Y			"	Y	"	Y	"	N	"	Y			"	N	"	N					"	Y				"	"	Y		
50	T I	I	A R	C	IS THE CURRENT FRICTION DAMPING CONSIDERED	"	?			"	Y	"	Y	"	N	"	Y			"	N	"	N					"	N				"	"	Y		
51	O	N		OEFF	IS THE RADIATION DAMPING CONSIDERED	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y				"	"	Y		
52	N		W	ICIE	IS THE STRUCTURAL DAMPING CONSIDERED	SEAOFF	Y			"	N	"	N	"	Y	"	N			"	N	"	N					"	N				"	"	Y		
53	*		A V E	NTS	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM	DIFCARG DISMAR3 SEAOFF	Y			"	N	"	N	"	N	"	OPTION-AL			"	Y	"	N					"	Y				"	"	N		
54	****	**	S	STIFF	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM	SEAOFF	Y			"	N	"	N	"	N	"	-Do-			"	N	"	N					"	Y				"	"	N		
55		*	***	NS	IS THE STIFFNESS MATRIX COMPUTED	DIFCARG DISMAR3	N			"	Y	"	Y	"	Y	"	-Do-			"	Y	"	Y					"	Y				"	"	Y		
56	*	*		STATIC WIND	IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT	DIFCARG DISMAR3 SEAOFF	Y			EUREKA	N	"	N	"	–	"	Y			"	N	"	Y					"	N				N	"	Y		

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
57	*	WIND / DYNAMIC WIND	IS THERE PROVISION TO USE FOLLOWING SPECTRA : HARRIS	DIFCARS DISHARS SEACAR	Y			EUREKA	N	SAI-HFEM	Y	FENRIS WAMLOS	–	AQWA-DRIFT	Y			NMISPM	Y	OSCAR	N					MOORSIM	N			??	N	TENMOR	Y		
58	*		DAVENPORT	"	Y			"	N	"	N	"	–	"	Y			"	Y	"	N					"	N				N	"	Y		
59	*		SIMIU	"	N			"	N	"	N	"	–	"	Y			"	N	"	N					"	N				N	"	N		
60			OTHERS (SPECIFY)	"	N			"	N	"	N	"	–	"	ESDO			"	ESDU	"	N					"	N				N	"	N		
61	ENVIRONMENTAL	CURRENT	IS IT BASED ON UNIFORM CURRENT VELOCITY PROFILE	"	N			TDSIM6	Y	"	Y	"	–	"	N			"	Y	"	N					"	Y				N	"	Y		
62			IS IT CAPABLE OF USING NON-UNIFORM CURRENT PROFILE	"	Y			"	N	"	Y	"	–	"	Y			"	N	"	Y					"	N				N	"	N		
63		WAVE STATISTICS	SIGNIFICANT WAVE HEIGHT	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y				N	"	Y		
64			MEAN SPECTRAL PERIOD	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y					"	Y				N	"	Y		
65			WAVE SCATTER DIAGRAM	"	Y			"	N	"	Y	"	Y	"	N			"	N	"	N					"	Y				N	"	N		
66		WAVE THEORY	LINEAR WAVE	"	Y			"	Y	"	Y	"	Y	AQWA-NAUT-DRIFT	Y			"	Y	"	Y					"	Y				Y	"	Y		
67			STRETCH LINEAR	"	N			"	N	"	Y	"	N	"	N			"	N	"	N					"	N				Y	"	N		
68			STOKE'S 2ND, 3RD OR 5TH ORDER .... PLEASE CIRCLE ..	"	5th			"	N	"	Y	"	N	AQWA-NAUT	2nd			"	N	"	N					"	N.A.				5th SEPT 1984	"	N		
69			STREAM FUNCTION USING THE FORM GIVEN BY .... DEAN	"	N			"	N	"	N	"	N	"	N			"	N	"	Y					"	N.A.				N	"	N		
70			STREAM FUNCTION : THE FORM GIVEN BY .... VON SCHWIND	"	N			"	N	"	N	"	N	"	N			"	N	"	N					"	N.A.				N	"	N		
71			STREAM FUNCTION : THE FORM GIVEN BY .... HUDSPETH	"	N			"	N	"	N	"	N	"	N			"	N	"	N					"	N.A.				N	"	N		

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG -RAM	1 YES /NO	2 PROG -RAM	2 YES /NO	3 PROG -RAM	3 YES /NO	4 PROG -RAM	4 YES /NO	5 PROG -RAM	5 YES /NO	6 PROG -RAM	6 YES /NO	7 PROG -RAM	7 YES /NO	8 PROG -RAM	8 YES /NO
72		A	R I	STREAM FUNCTION : OR ANY OTHER FORM .... PLEASE SPECIFY	DIFCARS DISMARS SEAOFF	N			JDSIMG	N	SAI-HFEM	N	FENRIS WAMLOS	N	AQWA -NAUT	N			NMISPM	N
73		V	E S	EXTENDED VELOCITY POTENTIAL	"	N			"	N	"	N	"	N	"	N				N
74		E		CNOIDAL WAVE THEORY	"	N			"	N	"	N	"	N	"	N				N
75			S	IS THERE PROVISION TO USE FOLLOWING SPECTRA : PIERSON-MOSKOWITZ	"	Y			"	RANDOM WAVE TRAIN	"	Y	"	Y	AQWA -DRIFT	Y				Y
76	D		E	ISSC	"	N			"	IS SYNTH-ESIZED BY	"	Y	"	N	"	Y				Y
77	E S		A	JONSWAP	"	Y			"	A SERIES OF COMPO-	"	Y	"	Y	"	Y				Y
78	C R		S	BRETSCHNEIDER	"	N			"	NENT ELEME-NTARY	"	Y	"	N	"	N				N
79	I P	*	P	SCOTT	"	N			"	WAVES	"	Y	"	N	"	N				N
80	T I	* *	E	OCHI (SIX PARAMETER)	"	N			"		"	Y	"	N	"	N				N
81	O N	* *	C T	INPUT SPECTRA	"	N			"		"	Y	"	N	"	Y				Y
82	*	* *	R	OTHERS	"	N			"		"	N	"	N	"	N				N
83	* *		A	DIRECTIONAL SPECTRA	"	N			"		"	N	"	Y	"	N				N
84	* *	OTHERS		DOES IT CONSIDER EARTH QUAKE SPECTRA	"	N			"	N	"	N	"	N	"	N				N
85	* *			DOES IT CONSIDER CHANGE IN WATER LEVEL DUE TO TIDE	"	N			"	N	"	N	"	N	"	N				N
86		STA		NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	"	SIX			"	SIX	"	SIX	"	SIX	"	SIX				THREE SURGE SWAY YAW

ROW #	9 PROG -RAM	9 YES /NO	10 PROG -RAM	10 YES /NO	11 PROG -RAM	11 YES /NO	12 PROG -RAM	12 YES /NO	13 PROG -RAM	13 YES /NO	14 PROG -RAM	14 YES /NO	15 PROG -RAM	15 YES /NO	16 PROG -RAM	16 YES /NO
72	OSCAR	N						N.A.			? ?	N	TENMORE	N		
73	"	N						N.A.				N	"	N		
74	"	N						N.A.				N	"	N		
75	"	Y						Y				N	"	Y		
76	"	Y						Y				N	"	Y		
77	"	Y						Y				N	"	Y		
78	"	N						Y				N	"	Y		
79	"	N						N				N	"	Y		
80	"	N						N				N	"	N		
81	"	Y						Y				N	"	Y		
82	"	N						N				N	"	N		
83	"	N						Y				N	"	N		
84	"	N						N				N	"	N		
85	"	N						N				N	"	Y		
86	"	SIX					MOORSIM DIFFRAC	SIX				THREE	"	SIX		

* SURGE - YAW FOR SLOW VARYING
HEAVE - PITCH FOR HIGH FREQUENCY

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
87	SOLUTION	TICS	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	DIFCARG	?			TDSIMG	SIX COUPLED DOF	SAJ-HFEM	★	FENRIS WAMLDS	SIX	AQUA-DRIFT	ALL SIX			NMISPM	THREE SURGE SWAY YAW
88	SOLUTION	TICS	IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	"	?			"	?	"	?	"	UNLIMITED	"	N			"	N
89	SOLUTION	DYNAMICS TIME DOMAIN	NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY	DISMAR3 SEAOFF	SIX			"	SIX	"	SIX	"	SIX	AQUA-NAUT-DRIFT	Y			"	THREE SURGE SWAY YAW
90	SOLUTION	DYNAMICS TIME DOMAIN	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY	"	?			"	SIX COUPLED DOF	"	★	"	ALL SIX	"	Y			"	-Do-
91	SOLUTION	DYNAMICS TIME DOMAIN	IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM	"	?			"	?	"	?	"	UNLIMITED	"	N			"	N
92		DYNAMICS TIME DOMAIN	WHAT METHOD OF INTEGRATION USED .... HOUBOLT	"	N			"	N	"	?	"	N	"	N			"	N
93		DYNAMICS TIME DOMAIN	.... WILSON-θ	"	N			"	N	"	?	"	N	"	N			"	N
94		DYNAMICS TIME DOMAIN	.... NEWMARK-β	SEAOFF	Y			"	N	"	?	"	Y	"	N			"	N
95	TECHNIQUE	DYNAMICS TIME DOMAIN	OTHERS .... PLEASE SPECIFY	DISMAR3	Y			"	RUNGE KUTTA 4th ORDER	"	?	"	N	"	2 STAGE PREDICTOR-CORRECTOR			"	ADAMS PREDICTOR/CORRECTOR
96	TECHNIQUE	DYNAMICS TIME DOMAIN	HOW THE TRANSIENT IS HANDLED .... RAMP FUNCTION	DISMAR3 SEAOFF	Y			"	COSINE RAMP	"	?	"	N	"	N			"	N
97	TECHNIQUE	DYNAMICS TIME DOMAIN	.... VARIABLE INTEGRATION TIME	"	N			"	N	"	?	"	Y	"	Y			"	N
98	TECHNIQUE	DYNAMICS TIME DOMAIN	OTHERS .... PLEASE SPECIFY	"	N			"	N	"	?	"	N	"	FILTERING			"	INITIAL RECORD DISCARDED
99	TECHNIQUE	DYNAMICS TIME DOMAIN	MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION	"	N			"	N	"	?	"	N	"	Y			"	N
100		DYNAMICS TIME DOMAIN	OTHERS .... PLEASE SPECIFY	"	PIVOT METHOD			"	GAUSS JORDAN	"	?	"	CHOLESKY	"	N			"	N
101			PLATFORM MOTION TIME HISTORY	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
87	OSCAR	ALL SIX					MOORSIM DIFFRAC	SIX			??	SURGE PITCH	TENMOR	SIX		
88	"	N					"	–				–		N		
89	"	SIX					MOORSIM	SIX				THREE		SIX		
90	"	ALL SIX					"	SIX				SURGE PITCH		ALL SIX		
91	"	N					–	–				–		N		
92	"	N					"	Y				N		N		
93	"	N					"	N				N		N		
94	"	N					"	Y				N		N		
95	"	?					GEAR	Y				RUNGE KUTTA 4th ORDER		SIMPSONS RULE		
96	"	N					COSH	Y				Y		Y		
97	"	N						Y				N		Y		
98	"	?						–				N		N		
99	"	N						Y				N		"		
100	"	[illegible]						N				FOURIER TRAN		DIRECT INVERSION		
101	"	Y						Y				N		Y		

ROW #	**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
			PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
102	** **** ****** ********	PLATFORM RESPONSE STATISTICS .... MEAN VALUE	HARMAN	Y			TDSIMG	Y	SAI-HFEM	Y	FENRIS-WAMUS	N	AQUA-DRIFT	Y			NHISPM	Y	OSCAR	Y					MOORSIM	Y			??	?	TENMOR	Y		
103	PLATFORM RESPONSE OUTPUT	... R.M.S. VALUE	"	Y			"	N	"	Y	"	N	"	Y			"	Y		Y					"	Y				?	"	Y		
104		... (SIGNIFICANT)1/3	"	Y			"	N	"	Y	"	Y	"	Y			"	Y		Y					"	Y				?	"	Y		
105	******** ****** **** **	... EXPECTED MAXIMUM	"	Y			"	N	"	N	"	Y	"	Y			"	N		N					"	Y				?	"	Y		
106		... OTHERS, SPECIFY	"	Y			"	N	"	N	"	N	"	N			"	N		1/10 1/100					"	Y				?	"	N		
107		CAN IT PREDCT RESPONSES IN ANY HEADING FROM RES-PONSES IN ORTHO HEADINGS	"	N			"	N	"	N	"	N	"	Y (?)			"	N		N						N				N	"	Y		
108	** ****	MODEL TEST - INDICATE SCALE	DISMAR3-SEAOFF	Y (55)			"	Y	"	Y	"	—	"	1/40			"	1984-85 (50)		?						1/40 1/825				N	"	1/40		
109	PROGRAM	OTHER AVAILABLE SOFTWARE - LIST PROGRAMS	SEAOFF	N			"	N	"	Y	"	—	"	DnV			"	NSMB		?					SEE BROCH-URE	Y				Y	"	N		
110	VERIFICATION	OTHER PUBLISHED MATERIAL - SPECIFY	"	N			"	N	"	PAPER #4394, OTC (1982)	"	—	"	SPM PUBLI-CATN			"	N		?										Y	"	N		
111	**** **	OTHERS (SPECIFY)	"	N			"	N	"	N	"	—	"	FULL SCALE			"	N		N					"					N	"	N		
112	******* DESCRIPTION	SPREAD MOORING (CATENARY)	ANCOR3 ANCOR4	Y			"	Y	"	Y	"	Y	"	Y			"	Y		Y					"	Y				N	"	Y		
113		SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT	"	Y			"	N	"	N	"	Y	"	Y			"	N		Y					"	Y				N	"	Y		
114		VERTICAL (TAUT) MOORING	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y		Y					"	Y				N	"	Y		
115		HYBRID/OTHER COMBINATION .... SPECIFY	"	Y			"	SLANT TAUT	"	N	"	N	"	HAWSER			"	N		TAUT-BUOY-CATENA-RY					"	—				N	"	Y		
116		SYNTHETIC ROPE - SUCH AS NYLON KEVLAR	"	Y			"	N	"	N	"	Y	"	Y			"	N		Y					"	Y				N	"	Y		

ROW #		**** ****		** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
117		MATERIAL		CHAIN (STEEL)	ANCOR3 ANCOR4	Y			TDSIMG	Y	SAT-HFEM	Y	FENRIS WAMLOC	Y	AQWA-DRIFT	Y			AMISPM	Y
118				WIRE ROPE (STEEL)	"	Y			"	Y	"	Y	"	Y		Y			"	Y
119				COMBINATIONS SUCH AS CHAIN/WIRE ROPE OTHERS, SPECIFY	"	Y			"	N	"	N	"	Y		WIRE/SYNTH. ROPE			"	N
120	M	CATENARY	STATICS	USER SPECIFIED LOAD DISPLACEMENT TABLE	"	Y			"	N	"	N	"	Y		OPTIO-NAL			"	Y
121	O			IS IT BASED ON CATENARY EQUATION	"	Y			"	Y	"	Y	"	N		-DO-			"	Y
122	O R			IS IT BASED ON FINITE ELEMENT METHOD	"	N			"	N	"	N	"	N		N			"	N
123	I			OTHERS (SPECIFY)	"	N			"	N	"	N	"	N		ANALYTICAL FORMULATION			"	N
124	N		DYNAMICS	IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	-DO- + DISMAR3 SEAOFF	Y			"	N	"	Y	"	Y		Y			"	N
125	G	*******	*****	IS THE MASS OF THE MOORING CONSIDERED	DISMAR3 SEAOFF	N			"	N	"	Y	"	Y		N			"	Y
126				IS THE MOORING SYSTEM MODELLED AS A LINEAR SPRING	"	N			"	Y	"	Y	"	N		OPTION-AL			"	Y
127			*****	IS THE MOORING SYSTEM MODELLED AS A NON-LINEAR SPRING	"	Y			"	N	"	Y	"	N		Y			"	Y
128	V			IS GEOMETRIC NON LINEARITY CONSIDERED	"	Y			"	N	"	Y	"	Y		Y			"	Y
129	E			IS MATERIAL NON LINEARITY CONSIDERED	"	Y			"	N	"	N	"	Y		Y			"	N
130	R T		M O	IS THE HYDRODYNAMIC DAMPING CONSIDERED	SEAOFF / DISMAR3	Y / N			"	N	"	Y	"	Y		N			"	N
131	I		O	IS THE STRUCTURAL DAMPING CONSIDERED	"	N			"	N	"	N	"	Y		N			"	N

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
117	OSCAR	Y					FLEX 3D-FLEX 2D-[illegible] DYNALINE	Y			??	N	TENMOR	Y		
118	"	Y						Y				N	"	Y		
119	"	CHAIN WIRE NYLON						N				BAR (?)	"	Y		
120	"	N						N				Y	"	Y		
121	"	Y					FLEX 2D-FLEX 3D	N				N	"	Y		
122	"	N					DYN-LINE	Y				N	"	N		
123	"	N					"	Y				N	"	Y		
124	"	Y					"	Y				N	"	N		
125	"	N					"	Y				N	"	Y		
126	"	N					"	Y				Y	"	N		
127	"	Y					"	N				N	"	Y		
128	"	Y					"	Y				Y	"	Y		
129	"	Y					"	N				N	"	Y		
130	"	N					"	Y				N	"	Y		
131	"	N					"	N				N	"	Y		

ROW #		**** ****			** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
						PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
132	SYSTEM	CAL	RIGID		IS THE MOORING SYSTEM COUPLED WITH PLATFORM	DISMARS SEAOFF	Y			TDSIM6	N	SAT-HFEM	Y	FENRIS WAMLOS	Y	AQWA-DRIFT	Y			NMISPM	N	OSCAR	Y					HOOKSIM DYNLINE	Y			??	N	TENMOR	Y		
133					IS IT BASED ON FINITE EL-EMENT METHOD, W/ OR W/O BENDING STFFNSS, CIRCLE	"	N			"	N	"	N	"	Y	"	N			"	N	"	N					With Bend. Stiff.	Y				N	"	Y		
134					IS IT BASED ON FINITE DIFFERENCE METHOD	"	N			"	N	"	N	"	N	"	N			"	N	"	N					"	N				N	"	Y		
135				HYDRODYNAMIC MODEL	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	SEAOFF / DISMARS	ITEM 20 / N			"	BASIC	"	Y	"	Y	"	N			"	N	"	Y					"	Y				N	"	Y		
136			MODEL		IS IT CAPABLE OF CALCUL-ATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	"	N			"	N	"	Y	"	Y	"	N			"	N	"	Y					"	Y				N	"	Y		
137		MOORING			IS IT CAPABLE OF CONSID-ERING EFFECT OF VORTEX SHEDDING	"	N			"	N	"	Y	"	N	"	N			"	N	"	N						N				N	"	N		
138					IS THE HYDRODYNAMIC MODEL FOR MOORING TWO DIMENSIONAL	"	Y			"	Y	"	Y	"	N	"	N			"	N	"	N					FLEX 2D	Y				N	"	Y		
139					IS THE HYDRODYNAMIC MODEL FOR MOORING THREE DIMENSIONAL	"	N			"	Y	"	N	"	Y	"	Y			"	N	"	N					FLEX 3D	Y				N	"	N		
140					IS THE STRUCTURL MOORING MODEL TWO DIMENSIONAL	"	Y			"	Y	"	Y	"	N	"	N			"	Y	"	N					"	Y				N	"	Y		
141			*****		IS THE STRUCTURL MOORING MODEL THREE DIMENSIONAL	"	Y			"	Y	"	Y	"	Y	"	Y			"	N	"	N					"	Y				N	"	N		
142	CAPABI				IS THE MOORING END AT FOUNDATION MODELED BY A LINEAR AXIAL SPRING	"	Y			"	Y	"	Y	"	Y	"	N			"	Y	"	N					"	Y				N	"	Y		
143			****		IS MOORING END AT FOUND-ATION MODELED BY A LINE-AR & ROTATIONAL SPRING	"	N			"	N	"	N	"	Y	"	N			"	N	"	N					"	Y				N	"	Y		
144		*********			IS IT POSSIBLE TO MODEL AN ARRAY OF INTERCONNE-CTED MOORING LINES	"	N			"	N	"	N	"	Y	"	Y			"	N	"	N					"	Y				N	"	Y		
145					IS THE PROGRAM CAPABLE OF FATIGUE LIFE ANALYSIS	"	SEPT '84			STRAN	Y	"	Y	"	Y	"	N			"	N	"	N					"	N				N	"	Y		
146			DYNA-MICS		IS THE MOORING SYSTEM COUPLED WITH THE PLATFORM MOTIONS	"	Y			TDSIM6	N	"	Y	"	N	"	Y			"	N	"	N					"	N				N	"	Y		

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
147	L	* * INSTAL-LATION ANALYS	IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING	DISMAR3 SEAOFF	Y			TDSIM6	N	SAI-HFEM	N	FENRIS WAMLOS	Y	AQWA-NAUT	Y			NMISPM	N	OSCAR	Y					MOORSIM	N			??	N	TENMOR	Y		
148	I T	MOORING SYSTEM OUTPUT	MOORING LINE LOAD TIME HISTORY	"	Y			"	Y	"	Y	"	Y	AQWA-DRIFT-NAUT	Y			"	Y	"	Y					"	Y				N	"	Y		
149	I		MOORING LINE LOAD STATISTICS ... ... MEAN VALUE	DISMAR3 HARMAN	Y			"	N	"	Y	"	N	"	Y			"	Y	"	Y					"	Y				Y	"	Y		
150	E		... R.M.S. VALUE	"	Y			"	N	"	Y	"	N	"	Y			"	Y	"	Y					"	Y				Y	"	Y		
151	S		... (SIGNIFICANT)1/3	"	Y			"	N	"	Y	"	N	"	Y			"	Y	"	Y					"	Y				N	"	Y		
152			... EXPECTED MAXIMUM	"	Y			"	N	"	N	"	N	"	Y			"	N	"	N					"	Y				N	"	Y		
153			... OTHERS, SPECIFY	"	.			"	N	"	N	"	N	"	N			"	N	"	1/10 1/100					"	N				MAX/MIN	"	N		
154		PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE		Y			"	Y	"	Y	"	N		1/40– 1/100			"	1984 -85 (50)	"	Y						N				N	"	1/40		
155	*		WITH OTHER SOFTWARE - LIST PROGRAMS		N			"	N	"	Y	"	N		DnV NMI			"	NSMB	"	Y						N				Y	"	N		
156	* * *		WITH OTHER PUBLISHED MATERIAL .... SPECIFY		N			"	N	"	N	"	N		NOBLE DENTON BARGE STUDY			"	N	"	Y						N				N	"	N		
157	* * * *		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES		Y			"	N	"	N	"	Y		Y (FD)				N	"	Y						N				N	DWRSR	Y		
158		* * STRUCTURAL	IS THE RISER MODEL TWO DIMENSIONAL		Y					"	-	"	N		Y					"	N						N					"	Y		
159	R		IS THE RISER MODEL THREE DIMENSIONAL		Y					"	–	"	Y		N					"	Y						N					"	Y		
[illegible]	I S		DOES THE PROGRAM USE FINITE ELEMENT METHOD		Y					"	–	"	Y		Y					"	N						N					"	Y		
161	E		DOES THE PROGRAM USE FINITE DIFFERENCE METHOD		N					"	–	"	N		N					"	N						N					"	N		

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO
162	R	MODEL	DOES THE PROGRAM USE SMALL DEFLECTION THEORY	DINTUB -DWRSR	Y					SAI-HFEM	-	FENRIS WAMLOS	N	AQUA-RISER	Y				
163		**	IS THE PROGRAM CAPABLE OF USING LARGE DEFLECTION THEORY	"	Y					"	-	"	Y	"	N				
164		HYDRODYNAMIC	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM	"	SEE ITEM #20					"	-	"	Y	"	Y				
165			IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER	DWRSR	Y					"	-	"	Y	"	Y				
166	S Y		IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING	"	Y					"	-	"	N	"	N				
167	S		IS THE RISER MODELLED AS TWO DIMENSIONAL	DINTUB -DWRSR	Y					"	-	"	N	"	Y				
168	T E	MODEL	IS THE RISER MODELLED AS THREE DIMENSIONAL	"	N					"	-	"	Y	"	N				
169	M	** SOLUTION MODE	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM	"	Y					"	-	"	Y	"	Y				
170	M	**	IS THE PROGRAM PERFORM TIME DOMAIN ANALYSIS	"	Y					"	-	"	Y	"	N				
171		* ***	IS IT CAPABLE OF CLEARANCE ANALYSIS BETWEEN RISERS	DWRSR	Y					"	-	"	Y	"	N				
172		SPECIAL ANALYSIS	IS IT CAPABLE OF INSTALLATION ANALYSIS W/ RISER BOTTOM AS FREE END	"	?					"	-	"	Y	"	Y				
173		*** *	IS IT CAPABLE OF INSTALLATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE	"	?					"	-	"	Y	"	Y				
174		PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE	DINTUB DWRSR	N					"	-	"	N	"	Y				
175	*		WITH OTHER SOFTWARE - LIST PROGRAMS	"	N					"	-	"	N	"	BATTELLE				
176	***		WITH OTHER PUBLISHED MATERIAL .... SPECIFY	"	API					"	-	"	N	"	Y				

ROW #	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
162	OSCAR	N						N					DWRSR	Y		
163	"	Y						N					"	Y		
164	"	Y						N					"	Y		
165	"	Y						N					"	Y		
166	"	N						N					"	N		
167	"	N						N					"	Y		
168	"	Y						N					"	Y		
169	"	Y						N					"	N		
170	"	Y						N					"	Y		
171	"	N						N					"	Y		
172	"	Y						N					"	Y		
173	"	Y						N					"	Y		
174	"	N						N					"	N		
175	"	N						N					"	N		
176	"	N						N					"	API RP2J		

ROW #	****	****	** ** ** ** ****** ** ** ** **	1 PROG-RAM	1 YES/NO	2 PROG-RAM	2 YES/NO	3 PROG-RAM	3 YES/NO	4 PROG-RAM	4 YES/NO	5 PROG-RAM	5 YES/NO	6 PROG-RAM	6 YES/NO	7 PROG-RAM	7 YES/NO	8 PROG-RAM	8 YES/NO	9 PROG-RAM	9 YES/NO	10 PROG-RAM	10 YES/NO	11 PROG-RAM	11 YES/NO	12 PROG-RAM	12 YES/NO	13 PROG-RAM	13 YES/NO	14 PROG-RAM	14 YES/NO	15 PROG-RAM	15 YES/NO	16 PROG-RAM	16 YES/NO
177	STABILITY ANALYSIS	INTACT	INTACT FREE FLOATING	FLOSTA NASTA	Y			EUREKA	Y	SAI-HFEM	N	NV223	Y	AQWA-DRIFT-NAUT	Y			NMISPM	N	OSCAR	Y						N			??	N	FLOSTAB BALANCE	Y		
178			INTACT WITH VERTICAL TAUT TENDONS	"	Y			"	N	"	N	"	Y	"	Y			"	N	"	Y						N				N	"	Y		
179		DAMAGED	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED	"	Y			"	Y	"	N	"	Y	"	Y			"	N	"	Y						N				N	"	Y		
180			DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING	"	Y			"	N	"	N	"	N	"	Y			"	N	"	Y						N				N	"	Y		
181	STRUCTURAL ANALYSIS	LOADING	HYDRODYNAMIC LOADING CONSIDERED	DIFCARS	Y			TDSIMG STEAN	Y	"	N	FENRIS WAMLOS	Y	AQWA LAUNCH	Y			"	N	"	Y					DYNFOXC	Y				N	TENLOAD	Y		
182			IS INERTIA LOADING CONSIDERED	"	Y			"	Y	"	N	"	Y	"	Y					"	Y					"	Y				N	"	Y		
183			IS DYNAMIC LOADING CONSIDERED	"	Y			"	Y	"	N	"	Y	"	Y					"	Y					"	Y				N	"	Y		
184		SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS	"	Y			"	Y	"	N	"	Y	"	N					"	N					NASTRAN	Y				N	DAMS	Y		
185			THREE DIMENSIONAL SPACE FRAME ANALYSIS	"	Y			"	Y	"	N	"	Y	"	N					"	N					"	Y				N	"	Y		
186		FINITE ELEMENT ANALYSIS	BEAM ELEMENT	SAP5 NASTRAN	Y			"	Y	"	N	"	Y	AQWA-DRIFT NAUT LINK	1985					"	N					"	Y				N	"	Y		
187			SHELL ELEMENT	"	Y			"	N	"	N	"	Y	"	1985					"	N						N				N	DAMSFE	Y		
188			PLATE ELEMENT	"	Y			"	Y	"	N	"	Y	"	1985					"	N					"	Y				N	"	Y		
189			STIFFENED PLATE ELEMENT	"	?			"	Y	"	N	"	N	"	1985					"	N					"	Y				N	"	Y		
190			OTHERS .... SPECIFY	"	N			"	N	"	N	"	CABLE TRUSS BAR SOLID AXISYM	"	1985					"	N						N				N	"	SOLID		
191			NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM	"	?			"	?	"	N	"	UNLIMITED	"	1985					"	N						?				N	"	SIX		

ROW #		**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
192	$		SPECTRAL ANALYSIS	SAP5 NASTRAN	Y			TDSIML STRAN	Y	SAI-HFEM	N	FENRIS WAMLOS	Y	ASAS	Y					OSCAR	N						Y			??	N	TENLOAD	Y		
193	* *	OTHER ANALYTICAL CAPABILITY	MODAL ANALYSIS	"	Y			"	N	"	N		N	ASAS (DYNAMIC)	Y					"	N						N				N	DAMS	Y		
194	* * *		FATIGUE LIFE ANALYSIS	VIFAN3	Y			"	Y	"	N		Y	FATJACK	Y					"	N						N				N	SDFATIG DFATIG SFATIG	Y		
195			VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)	PLOT2 PROSP MENTAT	Y			"	—	"	N		Y	ASAS AQWA	Y			NMISPM	N	"	Y					Various programs	Y				Y	ALL PROGS	Y		
196		PRE-PROCESSING AND POST-PROCESSING CAPABILITIES	RESTART CAPABILITIES (LIST ALL THE PROGRAMS)	NASTRAN	Y			"	—	"	N		N	"	Y			"	N	"	Y						N				Y	DAMS TENMOD TENLOAD	Y		
197			PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)	PLOT2 PROSP MENTAT	Y			"	—	"	N		Y	ASAS C-GUL AQWA PLANS	Y			"	TIME HISTORY PLOTS	"	Y						Y				Y	ALL	Y		
198			CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)	NAISC3 NAISC4 PUNSHE ONV7	Y			"	—	"	N		Y	ASAS-BEAMST	Y			"	N	"	N						N				N	DAMS	N		
199			PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION	ALL THE PROGRAMS	FORTRAN 77 (ASCII)			ALL THE PROGRAMS	FORT IV	"	FORT IV		FORT 77	ASAS AQWA	FORT 66			"	FORT 77	"	Y					FORT 77					N	ALL	FORT 77		
200			.... BASIC	"	N			"	N	"	N		N	"	N			"	N	"	N						N				Y (A)	"	N		
201		PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON	.... PASCAL	"	N			"	N	"	N		N	"	N			"	N	"	N						N				N	"	N		
202			.... OTHERS SPECIFY	"	N			"	N	"	N		N	"	N			"	N	"	N						N				K-BASIC JUNE 1984	"	N		
203			COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU	"	—			"	?	"	?		?	"	?			"	?	"	?						40:1 10:1				—	"	?		
204			IS USERS' GUIDE AVAILABLE	"	Y			"	Y	"	Y		Y	"	Y			"	N	"	Y						Y				SEPT 1984	"	Y		
205		DOCUMENTATION	IS THEORETICAL MANUAL AVAILABLE	"	Y			"	Y	"	Y		Y	AQWA (some)	Y			"	N	"	PROPRIETARY						Y				"	"	Y		
206		SUPPORT	ARE THE PROGRAMS SUPPORTED AND MAINTAINED	"	Y			"	Y	"	Y		Y	AQWA ASAS	Y			"	Y	"	Y						Y				Y	"	Y		

ROW #	**** ****	** ** ** ** ****** ** ** ** **	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
			PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
207	MAINTENANCE AND TRAINING	IS ANY TRAINING OFFERED	ALL THE PROGRAMS	Y			ALL THE PROGR-AMS	Y	SAI-HFEM	Y	FENRIS WAMLO	Y	AQWA ASAS	Y			NHISPM	Y	OSCAR	Y						N			??	NOT DECIDED	ALL	Y		
208	** ****	IBM	"	N			"	Y	"	Y	"	N	"	Y			"	N	"	Y						N				N	"	Y		
209		CDC	"	N			"	Y	"	Y	"	N	"	Y			"	N	"	Y					170-175 170-855	Y				N	"	Y		
210	HARDWARE SYSTEM	PRIME COMPUTER	"	N			"	N	"	N	"	N	"	Y			"	N	"	Y						N				N	"	N		
211		VAX	"	N			"	N	"	Y	"	Y	"	Y			"	N	"	Y					CRAY-1-S	N				N	WIND TENMOR TENLOAD BALANCE	Y		
212	**** **	MICRO .... SPECIFY	"	N			EUREKA	CP/M	"	N	"	N	AQWA	IBM PC DEC			"	N	"	N						N				CP/M (9/84) MSDOS 12/84	ALL	N		
213		OTHERS .... SPECIFY	"	SPERRY O.S. EXEC8			EUREKA TDSIM6	HONEYWELL UNIVAC	"	N	"	UNIVAC	AQWA ASAS	ICL			"	SEL(GOULD)	"	UNIVAC DATA GEN						Y					"	N		
214	** ****	LEASE (PRICE $ .00)	"	Y			TDSIM6	Y	"	Y	"	Y	"	Y			"	N	"	Y						N					"	Y		
215	ACCESSIBILITY ARRANGEMENT	PURCHASE (PRICE $ .00)	"	N			"	$20000	"	Y	"	Y	"	Y			"	N	"	Y						N				TO BE DETERMINED	"	Y		
216		CONSULTANCY BASIS	"	Y			"	Y	"	Y	"	Y	"	Y			"	Y	"	Y						Y				Y	"	Y		
217	** ****	OTHERS .... SPECIFY	"	N			"	?	"	N	"	N	"	?			"	N	"	N														
218	REMARKS AND NOTES																													WILL SELL COMPILED VERSION ONLY				
219																																		
220																																		

TABLE IV(A) CONT

ROW #		**** ** ****			** ** ** ****** ** ** **
27	*	S			DOES THE PROGRAM ER NON-LINEAR WA
28	* *			VISCOUS	DO DRAG FORCE CA ON CONSIDER MEAN NT & WAVE PARTIC
29	* *		ORDER		IS CURRENT AND W CTION CONSIDERED ULTANT FRICTIONA
30	* *				IS ITERATION OF USED FOR CONVERG
31	* *			FORCES	DOES IT USE PREVIOUS TIME STEP RESULT PRESENT STEP CAL
32	* *				IS THE CONVERGEN TOLERANCE BUILT- PROGRAM
33	* *				DOES THE USER SP THE CONVERGENCE TOLERANCE
34	******	********	***	ADDMASS	IS THE ADDED MAS AN INPUT TO THE
35					CIRCLE / COMPUTI METHOD : 2D,3D(A SHAPE), OTHERS
36			REGULAR WA	DAMPING	IS THE WAVE DRAG CONSIDERED IN TH DAMPING
37					IS THE DAMPING D WAVE FRICTION CO
38	EQUAT	TIM			IS THE CURRENT D DAMPING CONSIDER
39				COEFFICIEN	IS THE CURRENT F DAMPING CONSIDER
40					IS THE RADIATION CONSIDERED
41					IS THE STRUCTURA DAMPING CONSIDER

TABLE IV (A) SUMMARY OF TIME DOMAIN SOFTWARE CAPABILITIES
(BASED ON DIFFRACTION THEORY OR COMBINATION OF DIFFRACTION THEORY, STRIP THEORY, AND MORISON'S EQUATION)

NAVAL CIVIL ENGINEERING LABORATORY

REVIEW OF SEMISUBMERSIBLE AND TENSION LEG PLATFORM ANALYSIS TECHNIQUES
(SOFTWARE REVIEW)

ROW #		**** ****	** ** ** ** ****** ** ** ** **	A		B		C		D	
				PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO	PROG-RAM	YES/NO
1	*	WIND FORCE CALCULAT-IONS	CALCULATES STATIC WIND FORCES			?	?				
2	* *		CALCULATES DYNAMIC WIND FORCE USING SPECTRAL FORMULATION								
3	* *		IS THE WIND FORCE AN INPUT TO THE PROGRAM								
4	* *	CURRENT FORCE CALCULATION	IS THE INTERACTION BETWEEN WAVE AND CURRENT CONSIDERED								
5	*		CURRENT FORCES CALCULA-TED INDEPENDENTLY AND ADDED TO WAVE FORCES								
6			IS THE CURRENT FORCE AN INPUT TO THE PROGRAM								
7		. . . . . / ::: MEMBER:: / ORIENTATION	IS PROGRAM CAPABLE OF CALCULATING WAVE FORCE ON : INCLINED MEMBER			HYDRAL	Y				
8	ENVIRO		VERTICAL MEMBER			"	Y				
9			HORIZ. MEMBER			"	Y				
10		X-SECTI	DOES IT USE EQUIVALENT CIRCULAR CROSS SECTION FOR NONCIRCULAR SECTION			"	N				
11			DOES IT USE MODIFIED C AND C VALUES FOR NON CIRCULAR X-SECTION			"	N				

TABLE IV(A) [CON

ROW #				**** ** ****	** ** ** ** ****** ** ** ** **
12	N	W	:	O N	OTHER METHODS,IF AN CALCULATE WAVE FORC NON CIRCULAR X-SECT
13	M	A			IS THE FORCE CALCUL AT THE LONGL AXIS O MEMBER
14	E N	V			ANY METHOD TO CALC DISTRIBUTION ON SUR IF YES, PLEASE SPEC
15	T	E	MEMBER INTER-ACTION		IS THE INTERACTION MEMBERS CONSIDERED COLUMN AND COLUMN
16	A				COLUMN AND PONTOO
17	L	F			PONTOON AND PONTO
18		O	FIRST ORDER		IS THE PROGRAM BASE DIFFRACTION THEORY, CIFY THE TYPE
19		R			IS IT BASED ON HYBR ELEMENT W/COMBINATI DIFFRACTION & MO
20	F	C			DIFFRACTION AND FINITE ELEMENT
21	O	E			OR ANY OTHER COM TION
22	R	S .	SECOND	DRIFT	DOES IT CONSIDER TH WAVE ELEVATION
23	C	.			DOES THE PROGRAM AC REFLECTION OF 1ST O WAVES FROM THE BODY
24	E S	.		FORCES	DOES IT ACCOUNT FOR ITIONAL PRESSURE DU DISPLACEMENT OF BOD
25		.			DOES IT ACCOUNT FOR ITIONAL PRESSURE DU ROTATION OF BODY
26	*				DOES IT ACCOUNT FOR A FIXED BODY BY LOW QUENCY 2ND ORDER WA

TABLE IV(A) [CONTINUED]

ROW #		**** ** ****			** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
42	I O	E	V E S	T S	IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM			HYDRAL	N				
43	N			STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM			〃	N				
44			***		IS THE STIFFNESS MATRIX COMPUTED			〃	Y				
45	O	D	***	ADDMASS	IS THE ADDED MASS MATRIX AN INPUT TO THE PROGRAM			〃	N				
46	F	O	I		CIRCLE / COMPUTING METHOD : 2D,3D(ARBITRARY SHAPE), OTHERS			〃	Y				
47		M	R R	DAMPING	IS THE WAVE DRAG DAMPING CONSIDERED IN THE DAMPING			〃	Y				
48	M		E G		IS THE DAMPING DUE TO WAVE FRICTION CONSIDERED			〃	?				
49	O T	A	U L		IS THE CURRENT DRAG DAMPING CONSIDERED			〃	?				
50	I	I	A R	COEFFICIENTS	IS THE CURRENT FRICTION DAMPING CONSIDERED			〃	?				
51	O	N			IS THE RADIATION DAMPING CONSIDERED			〃	Y				
52	N		W A		IS THE STRUCTURAL DAMPING CONSIDERED			〃	N				
53	*		V E		IS THE DAMPING COEFF MATRIX AN INPUT TO THE PROGRAM			〃	N				
54	****	***	S	STIFFNS	IS THE STIFFNESS MATRIX AN INPUT TO THE PROGRAM			〃	N				
55		*	***		IS THE STIFFNESS MATRIX COMPUTED			〃	Y				
56	*	**	STATIC WIND		IS WIND (STATIC) VEL. SPECIFIED AT A REFERENCE HEIGHT			〃	N				

TABLE IV(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
87		TICS	WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY			NONTID	?				
88	SOLUTION		IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM			〃	?				
89			NO OF RIGID BODY DEGREES OF FREEDOM INCLUDED IN THE SOLN .... SPECIFY			NONTID DRIFT	SIX THREE				
90			WHAT ARE THE COUPLED DEGREES OF FREEDOM .... SPECIFY			〃	?				
91			IN CASE OF FINITE ELEMENT METHOD, NO OF DEGREES OF FREEDOM			〃	?				
92		DYNAMICS	METHOD OF INTEGRATION USED .... HOUBOLT			〃	?				
93			.... WILSON - θ			〃	?				
94			.... NEWMARK - β			〃	?				
95	TECHNIQUE ****		OTHERS .... PLEASE SPECIFY			〃	?				
96		TIME DOMAIN	HOW THE TRANSIENT IS HANDLED .... RAMP FUNCTION			〃	?				
97			.... VARIABLE INTEGR-ATION TIME			〃	?				
98			OTHERS .... PLEASE SPECIFY			〃	?				
99			MATRIX SOLVER USED IN SOLVING THE SYSTEM EQNS. .. GAUSSIAN ELIMINATION			〃	?				
100			OTHERS .... PLEASE SPECIFY			〃	?				
101			PLATFORM MOTION TIME HISTORY			〃	Y				

TABLE IV(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG -RAM	A YES /NO	B PROG -RAM	B YES /NO	C PROG -RAM	C YES /NO	D PROG -RAM	D YES /NO
102	PLATFORM RESPONSE OUTPUT		PLATFORM RESPONSE STATISTICS ... ... MEAN VALUE			NONTID DRIFT	?				
103			... R.M.S. VALUE			"	?				
104			... (SIGNIFICANT)1/3			"	?				
105			... EXPECTED MAXIMUM			"	?				
106			... OTHERS, SPECIFY			"	?				
107			CAN IT CALC RESPONSES IN ANY HEADING FROM RESPONSES IN ORTHOGNL HEADINGS			"	N				
108	** **** PROGRAM VERIFICATION ** ****		MODEL TEST - INDICATE SCALE			"	Y				
109			OTHER AVAILABLE SOFTWARE - LIST PROGRAMS			"	N				
110			OTHER PUBLISHED MATERIAL - SPECIFY			"	N				
111			OTHERS (SPECIFY)			"	N				
112	**** M O	DESCRIPTION	SPREAD MOORING (CATENARY)			MORA	Y				
113			SPREAD (CATENARY) MOORING WITH LUMPED WEIGHT			"	?				
114			VERTICAL (TAUT) MOORING			"	Y				
115			HYBRID/OTHER COMBINATION .... SPECIFY			"	?				
116			SYNTHETIC ROPE - SUCH AS NYLON KEVLAR			"	?				

TABLE IV(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG -RAM	A YES /NO	B PROG -RAM	B YES /NO	C PROG -RAM	C YES /NO	D PROG -RAM	D YES /NO
147		* * INSTAL- LATION ANALYS	IS THE PROGRAM CAPABLE OF TWO BODY DYNAMICS DURING TENDON LOWERING			MORA	N				
148		MOORING SYSTEM OUTPUT	MOORING LINE LOAD TIME HISTORY			"	Y				
149			MOORING LINE LOAD STATISTICS ... ... MEAN VALUE			"	Y				
150			... R.M.S. VALUE			"	?				
151			... (SIGNIFICANT)1/3			"	Y				
152			... EXPECTED MAXIMUM			"	?				
153			... OTHERS, SPECIFY			"	?				
154		PROGRAM VERIFICATN	WITH MODEL TESTS - INDICATE SCALE			"	?				
155	*		WITH OTHER SOFTWARE - LIST PROGRAMS			"	?				
156	* * *		WITH OTHER PUBLISHED MATERIAL .... SPECIFY			"	?				
157	* *		DOES THE PROGRAM SUITE HAVE RISER ANALYSIS CAPABILITIES			"	N				
158	* *	* * STRUCTURAL	IS THE RISER MODEL TWO DIMENSIONAL								
159	R		IS THE RISER MODEL THREE DIMENSIONAL								
160	I		DOES THE PROGRAM USE FINITE ELEMENT METHOD								
161	S E		DOES THE PROGRAM USE FINITE DIFFERENCE METHOD								

TABLE IV(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
162	R	MODEL **	DOES THE PROGRAM USE SMALL DEFLECTION THEORY								
163			IS THE PROGRAM CAPABLE OF USING LARGE DEFLECTION THEORY								
164		HYDRODYNAMIC MODEL	IS IT BASED ON MORISON'S EQUATION, SPECIFY THE FORM								
165			IS IT CAPABLE OF CALCULATING HYDRODYNAMIC FORCE FOR VARIABLE DIAMETER								
166	S Y		IS IT CAPABLE OF CONSIDERING EFFECT OF VORTEX SHEDDING								
167	S		IS THE RISER MODELLED AS TWO DIMENSIONAL								
168	T		IS THE RISER MODELLED AS THREE DIMENSIONAL								
169	E M	** SOLUTION MODE	IS THE PROGRAM COUPLED WITH MOTION ANALYSIS PROGRAM								
170	M	**	IS THE PROGRAM PERFORM TIME DOMAIN ANALYSIS								
171		* ***	IS IT CAPABLE OF CLEARANCE ANALYSIS BETWEEN RISERS								
172		SPECIAL ANALYSIS	IS IT CAPABLE OF INSTALLATION ANALYSIS W/ RISER BOTTOM AS FREE END								
173		*** *	IS IT CAPABLE OF INSTALLATION ANALYSIS W/BOTTOM END SUPPORTED BY GUIDE								
174			WITH MODEL TESTS - INDICATE SCALE								
175	*	PROGRAM VERIFICATN	WITH OTHER SOFTWARE - LIST PROGRAMS								
176	* * *		WITH OTHER PUBLISHED MATERIAL .... SPECIFY								

TABLE IV(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
177	* *** STABILITY ANALYSIS	INTACT	INTACT FREE FLOATING			?	N				
178			INTACT WITH VERTICAL TAUT TENDONS			?	N				
179		DAMAGED	DAMAGED EQUILIBRIUM WITH COMPARTMENT (S) DAMAGED			?	N				
180	*** *		DAMAGED EQUILIBRIUM WITH TENDON (S) BREAKING			?	N				
181	**** STRUCTURAL ANALYSIS	LOADING	HYDRODYNAMIC LOADING CONSIDERED								
182			IS INERTIA LOADING CONSIDERED								
183			IS DYNAMIC LOADING CONSIDERED								
184		SPACE FRAME ANALYSIS	TWO DIMENSIONAL SPACE FRAME ANALYSIS								
185			THREE DIMENSIONAL SPACE FRAME ANALYSIS								
186		* *** FINITE ELEMENT ANALYSIS	BEAM ELEMENT								
187			SHELL ELEMENT								
188			PLATE ELEMENT								
189			STIFFENED PLATE ELEMENT								
190		*** *	OTHERS .... SPECIFY								
191		*** *	NO OF DEGREES OF FREEDOM PER ELEMENT AND TOTAL DEGREES OF FREEDOM								

TABLE IV(A) [CONTINUED]

ROW #		**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
192	I S	OTHER ANALYTICAL CAPABILITY	SPECTRAL ANALYSIS								
193	*		MODAL ANALYSIS								
194	* * * *		FATIGUE LIFE ANALYSIS								
195	PRE-PROCESSING AND POST-PROCESSING CAPABILITIES		VERIFICATION OF INPUT (LIST ALL THE PROGRAMS)								
196			RESTART CAPABILITIES (LIST ALL THE PROGRAMS)			NONTID	Y				
197			PLOTTING CAPABILITIES (LIST ALL THE PROGRAMS)			PLOT	Y				
198			CODE CHECK CAPABILITIES (LIST ALL THE PROGRAMS)								
199	PROGRAMMING LANGUAGE AND COMPUTER COST COMPARISON		PROGRAMMING LANGUAGE .. FORTRAN ( ) SPECIFY THE VERSION			NONTID DRIFT HYDRAL	Y				
200			.... BASIC								
201			.... PASCAL								
202			.... OTHERS SPECIFY								
203			COMPUTER RUNNING COST - RATIO OF SIMULATED TIME TO CPU								
204	DOCUMENTATION		IS USERS' GUIDE AVAILABLE			MORA	Y				
205			IS THEORETICAL MANUAL AVAILABLE			〃	Y				
206	SUPPORT		ARE THE PROGRAMS SUPPORTED AND MAINTAINED			〃	Y				

TABLE IV(A) [CONTINUED]

ROW #	**** ** ****	** ** ** ** ****** ** ** ** **	A PROG-RAM	A YES/NO	B PROG-RAM	B YES/NO	C PROG-RAM	C YES/NO	D PROG-RAM	D YES/NO
207	MAINTENANCE AND TRAINING	IS ANY TRAINING OFFERED			MORA	Y				
208	HARDWARE SYSTEM (** **** / **** **)	IBM								
209		CDC								
210		PRIME COMPUTER								
211		VAX								
212		MICRO .... SPECIFY								
213		OTHERS .... SPECIFY			MORA	BOEING				
214	ACCESSIBILITY ARRANGEMENT (** **** / ** ****)	LEASE (PRICE $ .00)			MORA	—				
215		PURCHASE (PRICE $ .00)			"	$40,000				
216		CONSULTANCY BASIS			"	Y				
217		OTHERS .... SPECIFY			"	?				
218	REMARKS AND NOTES									
219										
220										

5.0 CORRESPONDENCE FROM VARIOUS ORGANIZATIONS

TECNOMARE S.P.A. - SOCIETÀ PER LO SVILUPPO DELLE TECNOLOGIE MARINE

BROWN & ROOT INC.
P.O.Box 4302
Building 29, Room 1021
HOUSTON, TEXAS 77210

Venezia, Aug. 29, 1983

ns. rif. / our ref. 2029/83/AUDA/PS/eb

To the kind attention of Mr. Farmad Rajabi

Dear Sir,

This is our reply to your telex dated 9/8/83 relevant to your survey on the computer programs available for motion and structural analysis of tension leg platforms.

Please find enclosed the computer procedures used in Tecnomare to design tension leg platforms.
You will also find the answers to the questions you presented in your referenced telex.

We hope you will find helpful information in our documents.
We remain

Yours faithfully,
TECNOMARE S.p.A.

Vincenzo Di Tella
Manager,
Technical Division

Encl: AUDA-REL-002 "Description of the procedures used in Tecnomare to design tension leg platforms"

PMB Systems Engineering Inc.

Engineering Analysis, Structural Design, Offshore Engineering
500 Sansome Street, Suite 400
San Francisco, California 94111 ☐ (415) 986-4166
RCA TELEX 278058

April 24, 1984

Dr. F. Rajabi
BROWN & ROOT, INC.
P.O. BOX 1051
Houston, Texas 77251

Dear Dr. Rajabi:

Enclosed please find a copy of the completed questionnaire(Table III). It describes the program 'INTRA-WACS2' based on the questions asked in the questionnaire.

Thank you for giving us the opportunity to provide you with this information . Look forward to hearing from you soon.

Sincerely,
PMB SYSTEMS ENGINEERING INC.

John Chang

John Chang
Lead Senior Engineer

JYC/sw

Rcv: @1IM/1.00123 Line: 1

RCA SEP 15 1620
MAR EMG HOU

MAR EMG HOU

TELEX TO: BROWN " ROOT, HOUSTON

ATTN: DR. FARHAD RAJABI

FROM: PMB SYSTEMS ENGINEERING INC.

DATE: SEPTEMBER 15, 1983

THE PACKAGE WE SENT YOU AUGUST 12, 1983 COVERS OUR SEMI-SUBMERSIBLE ANALYSIS CAPABILITIES. PLEASE REFER TO THIS PACKAGE FOR YOUR INFORMATION.

REGARDS,

JOHN CHANG

MAR EMG HOU

.....
REPLY TO THIS TELEX VIA RCA

Time: 15:26 09/15/83 ???
Connect Time : 109 seconds

PMB Systems Engineering Inc.

500 Sansome Street, Suite 400
San Francisco, California 94111 ☐ (415) 986-4166
Telex 278058

August 12, 1983

BROWN & ROOT, INC.
P. O. Box 4302
Building 29, Room 1021
Houston, Texas 77210

Attention: Mr. Farhad Rajabi

Gentlemen:

In response to your request for information regarding our TLP analysis software, we can provide all requested information except for the requested manuals, which are proprietary.

Enclosed is a description of the INTRA-WACS 2 program which gives general information on the program and applicability of the program to other floating structures.

Concerning validation status, most of the verification has entailed comparisons with other analytical tools and with the theory. There has been a very limited comparison against wave tank tests.

As to availability, the INTRA-WACS 2 enhancement package can be purchased from PMB for a license fee of $55,000, but the licensee must already have a license to the basic INTRA program which has to be obtained from Shell Oil Company. The person to contact for specifics is:

John McCarthy
Patents and Licenses,
Shell Oil Company
P. O. Box 2099
Houston, Texas 77001

We hope you will find this information useful for your purpose.

Very truly yours,

PMB SYSTEMS ENGINEERING INC.

R.W. Litton

R. W. Litton

RWL:mjw

Encl.

J. RANDOLPH PAULLING, INC.
NAVAL ARCHITECT
P. C. Box 278
Point Richmond, CA 94807

1 May 1984

Dr. Farhad Rajabi
Brown and Root Development, Inc.
P. O. Box 1051
Houston, Texas 77251

Re: Survey of platform software.

Dear Dr. Rajabi:

I enclose the two survey forms for my programs SPLASHD and TDSIM6 with a few minor corrections and additions. As I mentioned during our telephone conversation, these programs, which were the ones specifically named by NCEL, comprise only a part of my software library intended for the analysis of floating structures. In order to aid you in completing your survey, I enclose a set of brief descriptions of the other programs which include 2-D and 3-D potential theory, structural analysis and riser/mooring member programs. A somewhat sketchy and incomplete flow chart is included which illustrates some of the program linkages.

In developing this library, I have followed the concept of modularity in which a number of program segments have been developed, each of which possesses certain stand-alone capability and at the same time can be linked to other program modules to provide enhanced capability. As an example, SPLASHD is capable of treating a platform consisting of slender sparsely distributed cylindrical members subject to a directional random seaway. If we wish to consider a platform containing large members, e.g., the corner columns of a TLP, plus slender bracing members, The hydrodynamic properties of the "fat" members can be computed by the 3-D program HYDRO3 and input to SPLASHD. The HYDRO3 computation takes into account the hydrodynamic interference between members as well as the finite member size in relation to water depth and wave length. The addition of the small member forces, the solution for the motion and the superposition of elementary solutions is then accomplished within SPLASHD. If only fat members are present, HYDRO3 contains the stand alone equation solving capability.

As a second example of this extended interactive capability, both SPLASHD and TDSIM6 produce output files of element structural loads which may be input to a FE structural analysis. A complete structural package has been developed in conjunction with the firm of Structural Software Development, Inc. in which SPLASHD provides the loads input to the FE program STRAN. A postprocessing module has been written in which computations of cumulative fatigue damage and both short and long term extreme value statistics are performed.

Structural loading outputs are obtained from HYDRO2 in the form of longitudinal distributions of shears and bending moments, pressure distributions and catamaran cross structure loads. HYDRO3 produces files of pressure distributions.

The concept of modularity is maintained within the individual program structure as well. Most of the fundamental computations are performed by subroutines which can be modified or replaced in order to introduce a different phenomenon or device. Examples are the procedures for computing the wave properties in pogram TDSIM6. In using this program for floating platforms, it is more important to be able to represent the random nature of the wave properties by superposing elementary waves than to have the detailed internal structure of a single component wave. The superposition is accomplished in the stretched linear theory which, in fact, is a kind of "one and one-half order" wave theory. Should the need arise to have a detailed single component wave, the present subroutine can be merely replaced by appropriate subroutines for another wave theory. This subroutine is given a provision for placing the required pressures, velocities and other properties in a COMMON block for transmission to the calling program.

Similar capabilities are contained in the programs for treating special kinds of mooring or positioning systems. TDSIM6, especially, is written with a view towards adding subroutines for dynamic positioning or for the inclusion of specialized mooring systems via table look-up functions in which the force versus displacement characteristics might be computed externally or obtained experimentally.

I am engaged in a continuing process of program upgrading which, at present, includes comprehensive drift force computations and the addition to TDSIM6 of a convolution integral capability of including frequency-dependent forces. For some time, I have been developing microcomputer preprocessing capabilities for data preparation and checking and use a CP/M system as my own workstation. In view of the increasing capabilities of small computers, however, I expect to have several of the programs running in microcomputer form in the future.

In general, I have not attempted to market the programs widely, but rather I prefer to work on a close consulting basis with the individual client. The program systems which have been delivered have usually included custom features, and in several cases, at the client's request, the programs have been updated and enhanced with new features after delivery. About ten program systems, comprising some or all of the modules, are in use at present by oil companies, design firms and shipyards. In addition to program delivery, I frequently provide computing services on a consulting basis.

If you should require any additional information on the program systems, please do not hesitate to contact me.

Very truly yours,

J. Randolph Paulling

J. RANDOLPH PAULLING, INC.
NAVAL ARCHITECT
119 CRESTVIEW DRIVE
ORINDA, CALIFORNIA 94563

J. Randolph Paulling, Inc. offers a complete library of computer programs intended for the static and dynamic analysis of floating offshore structures of virtually any geometry. The programs, in most cases, may be run in either a stand-alone mode in order to perform simple analyses, or they may be linked in order to perform more comprehensive analyses of, e.g., structural response to random wave loading. The programs are listed below and more detailed descriptions are given in the following pages.

EUREKA	Ship and platform hydrostatics and stability.
SPLASHD	Quasi-linear frequency-domain analysis of platform response in regular or random waves.
TDSIM6	Nonlinear time-domain analysis of platform response to waves and/or current.
HYDRO2/CATMO	Strip-theory hydrodynamic analysis of wave forces, motion-dependent force coefficients and motions of single or twin hull ships or platforms.
HYDRO3	Three-dimensional source-distribution program for wave forces, motion-dependent force coefficients for three-dimensional floating bodies with zero forward speed.
MLTPIP	Quasi-linear finite-element dynamic analysis of the coupled response of the platform with one or more vertical flexible pipe members representing risers or TLP mooring members.

STRAN/SPLASHD Comprehensive finite element structural package for space-frame platform analysis. Includes loads predictor, structural response, and long-term fatique and extreme event predictions for random sea environment.

The programs individually or in total may be made available to clients through a lease or licensing arrangement. Alternatively, J. Randolph Paulling, Inc. can provide complete project analysis services, including data preparation, program execution, result interpretation and submission of results in project report form.

EUREKA

This is a general purpose hydrostatics characteristics program which is capable of treating a single hull ship, a catamaran, a tower structure or a floating body consisting of a combination of several members of irregular geometry. The program is intended primarily for computing the fundamental hydrostatic properties and transverse stability at large angles of heel of the floating body. The following additional functions are included within the range of capabilities:

(1) Damaged stability may be computed by designating specified parts of the interior to be open to the sea.

(2) Designated interior spaces may be specified to contain a given quantity of ballast water, and its effect will be included in the computation of stability.

(3) A derrick force may be applied through a single or multi-leg sling.

(4) Wind heeling moment may be computed and compliance with the ABS criterion checked.

(5) Conventional hydrostatic properties and tank capacity tables may be computed.

SPLASHD

This program utilizes linear wave and platform motion theory to compute the rigid-body response of a floating space-frame type structure. The fluid forces on members of the structure are computed by SPLASHD using a modified form of the Morison formula with an equivalent linearized drag force. The equivalent linearization requires that the solution for the platform motion be accomplished by means of an iterative procedure. In addition to the slender member forces which are computed internally by SPLASHD, a table of frequency-dependent forces and coefficients may be input from an external source in order to represent the hydrodynamic characteristics of non-slender parts of the platform. Additional features of the program include:

(1) Moorings may be represented and these may include slanted or vertical tension members and simple catenary moorings.

(2) A number of standard wave spectra are built into the program to represent random seas. These include the Pierson-Moskowitz, Bretschneider, Jonswap, ISSC and Scott, unidirectional or directional with COS^2 or COS^4 spreading.

(3) Velocities, accelerations and relative vertical motion at a series of locations within the platform may be computed.

(4) The resultant hydrodynamic and inertia loads on each member may be computed and expressed in the form of equivalent nodal forces. These may then be used as input to a finite element analysis of the platform structure.

TDSIM6

This program performs a step-by-step numerical integration of the equations of motion of the platform in order to produce a time history of platform motion and mooring tensions. The following specific nonlinear effects are included:

(1) The complete nonlinear terms in the rotational equations of motion.

(2) Fluid forces computed on slender tubular members by a modification of the Morison formula, taking into consideration the combination of waves and currents. The forces are computed for the instantaneous wetted length of the member at the instantaneous position of wave and member.

(3) Mooring system forces are computed for large displacements from the mean position. Vertical or slanted tension members and simple catenary lines may be used.

A multi-component wave system may be input. The program contains a printer plotting routine and produces output in a format which is easily adaptable to graphics postprocessing.

HYDRO2/CATMO

These programs contain an adaptation of the Frank close fit procedure for computing the wave and motion-dependent forces on a single or twin hull configuration using the strip theory procedure. In addition to solving for the platform motion response to waves, the distribution of hydrodynamic loads along the length of the hull or hulls is computed. For a twin hull configuration, the forces and moments in the transverse connecting structure may be computed.

This program may be used as a preprocessor to SPLASHD in order to produce the table of frequency-dependent wave forces and motion-dependent force coefficients for a part of the platform. An example would be a twin hull semi-submersible. In this case, HYDRO2 would be used to compute the inviscid fluid forces on the twin parallel hulls, while the forces on the platform columns and bracing members, as well as the viscous drag forces on the hulls, would be computed by the internal capabilities of SPLASHD.

HYDRO3

This program utilizes the Green's function method in solving for the fluid forces and motions of a floating body in waves. The procedure is based upon ideal fluid theory and is suitable for bodies whose cross-sectional dimensions are large compared to the wave length of interest, resulting in appreciable distortion of the wave systems. A series of regular waves are assumed to act upon the floating body and as a result, the body is set into oscillatory motion. The following quantities are found, in addition to the body motion, at each wave frequency.

(1) The incident wave forces and moments.

(2) The diffraction wave forces and moments.

(3) The added mass, damping and hydrostatic force coefficient matrices.

(4) The pressure distribution over the wetted surface of the body.

HYDRO3 may be used as a preprocessor to supply tables of frequency-dependent wave forces and coefficient to SPLASHD. It is suitable for treating such bodies or parts of bodies as barge hulls of low length to beam ratio or vertical surface piercing columns of large diameter.

MLTPIP

This program represents an extension of an earlier program developed for the analysis of a single slender vertical member such as a riser pipe or the cold water pipe of an ocean thermal energy system. The current version is capable of treating several pipe members simultaneously and each may have different properties. Such members might represent, for example, the mooring members or production risers of a Tension Leg Platform.

A mathematical model is employed which solves for the coupled dynamic response of the platform and pipe system to wave and current excitation, and it is this simultaneous coupled treatment of pipe and platform dynamics which distinguishes MLTPIP from other riser programs. The platform is considered to be a rigid body having six degrees of motion freedom, with fluid forces acting upon it due to wave action and its own motions. These forces are computed by standard linear ship or platform motion theory, and several of the program described in the present system may serve as such preprocessors. The pipes are assumed to be attached to the platform at several arbitrary locations, and they exert additional forces which depend on the platform motion, the pipe motion and the properties of the connection between pipe and platform.

The pipe or pipes are represented by the finite-element method including provision for variation of the pipe tension, stiffness, diameter, weight and buoyancy along the length. The pipe finite element is a beam element having both bending and axial stiffness and tension. Wave and other fluid forces on the pipe are represented by a variation of the Morison formula in which the viscous drag is replaced by an equivalent linear drag force. A current may act simultaneously with the waves and wave-induced pipe motion, and the drag force is then assumed to depend on the resultant velocity due to these three effects. The method employed in computing the equivalent linear drag coefficient involves an iterative procedure which is built into the program, requiring no user intervention.

The physical connections between the platform and pipes, and between the pipes and the seafloor, are modelled by elements which include spring restraint and damping restraint. By specifying appropriate values for the coefficients, it is possible to accurately model such connecting members as ball joints and riser tensioners.

The output of the computation includes the following quantities, which may be computed for either regular or random waves:

Motions in 6 DOF for the platform CG and for each node of the pipes.

Forces between the platform and each pipe.

Forces between each pipe and the seafloor.

Stresses at the midlength of each pipe element.

Relative angular motion between pipe segments at hinges in the pipe.

PROGRAM STRAN

TITLE Structural Analysis and Fatigue Calculations for Platforms Subject to Random Sea States

KEYWORDS

Large capacity; linear elastic; finite element; fatigue analysis.

DESCRIPTION

STRAN is a large capacity, linear elastic, finite element analysis program for the structural analysis of fixed base, tension leg and semisubmersible platforms. STRAN has been developed to permit an analysis of the platform's structure whose response or hydrodynamic loading has been determined using the frequency domain analysis program SPLASHD. The structure geometry and frequency dependent forces, as output by SPLASHD, are input to STRAN for the structural analysis.

STRAN accepts frequency dependent force definitions at both node and member locations. The force definitions are processed to produce frequency dependent displacements and stresses. For a given wave spectrum these displacements and stresses are integrated to yield response spectra and short-term statistics.

STRAN contains a small library of linear elastic finite elements including truss, beam, membrane and plate elements. A large capacity, active column equation solution procedure which utilizes a profile minimization technique has been incorporated into the program. The ability to plot the structural model and output quantities has also been included.

Fatigue damage calculations can be computed using a user supplied or standardized S-N curve. Combining several of these analyses using a wave scatter diagram allows prediction of fatigue life.

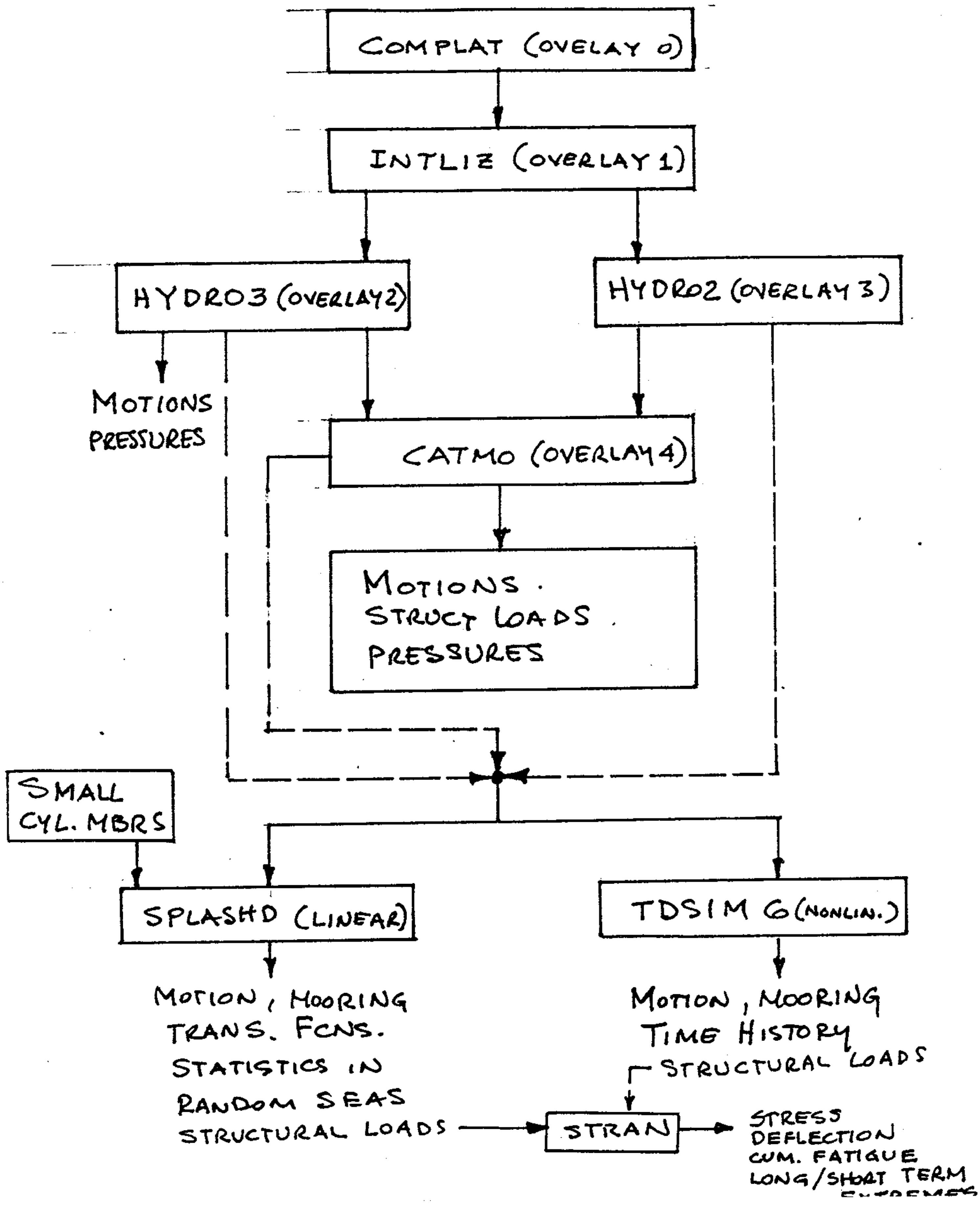
APPLICATIONS

Stress and Fatigue Analysis of

- Fixed Base Platforms
- Semisubmersibles
- Tension Leg Platforms

MACHINE VERSIONS

IBM 370; PRIME; VAX


COMPLAT (OVELAY 0)
INTLIZ (OVERLAY 1)
HYDRO3 (OVERLAY2)
HYDRO2 (OVERLAY 3)
MOTIONS
PRESSURES
CATMO (OVERLAY 4)
MOTIONS
STRUCT LOADS
PRESSURES
SMALL
CYL. MBRS
SPLASHD (LINEAR)
TDSIM 6 (NONLIN.)
MOTION, MOORING
TRANS. FCNS.
STATISTICS IN
RANDOM SEAS
STRUCTURAL LOADS
MOTION, MOORING
TIME HISTORY
STRUCTURAL LOADS
STRAN
STRESS
DEFLECTION
CUM. FATIGUE
LONG/SHORT TERM

J. RANDOLPH PAULLING, INC.
NAVAL ARCHITECT
119 CRESTVIEW DRIVE
ORINDA, CALIFORNIA 94563

26 August 1983

Brown and Root, Inc.
Attn: Mr. Farhad Rajabi
Building 29, Room 1021
P. O. Box 4302
Houston, Texas 77210

Ref: Your TELEX 08/12/83

Dear Mr. Rajabi:

It is my understanding that NCEL has now supplied you with copies of the theoretical and user's manuals for my programs EUREKA, SPLASHD and TDSIM6, and the purpose of this letter is to supply partial answers to some of your other questions.

(1) The programs are wholly owned by J. Randolph Paulling, Inc. and are available on a purchase or lease basis. Alternatively, I can provide analysis services for clients on a specific project basis.

(2) I am enclosing a list of my publications on platform analysis, some of which contain comparisons of experiment with theoretical predictions obtained using these programs and their predecessors. Unfortunately, the most recent and thorough testing of the programs has been conducted using proprietary experimental data, and these comparisons have not been released for publication.

(3) The programs are applicable to a wide variety of floating structures in addition to TLPs, including moored or unmoored semisubmersibles. I have developed other software suitable for ships, barges and flexible members such as risers and moorings. In addition to motions analysis, I have the capability for a completely integrated motions, loads and structural response analysis, including cumulative fatigue and long term extreme statistics.

If you have other questions concerning the programs and their applications, please feel free to contact me.

Very truly yours,

J. Randolph Paulling

J. Randolph Paulling

"Wave Induced Forces and Motions of Tubular Structures," Proceedings of 8th Symposium on Naval Hydrodynamics, Office of Naval Research, ARC-179, August 1970.

"Analysis of the Tension Leg Stable Platform," (with E. E. Horton), Offshore Technology Conference Paper No. OTC 1263, Houston, Texas, 1970. (Also published in Society of Petroleum Engineers Journal, Sept. 1971, pp. 285-294.)

"Optimization of Stable Platform Characteristics," 4th Annual Offshore Technology Conference, Houston, Texas, May 1972, Paper OTC 1553 (with Horton et al)

"Elastic Response of Platform Structures to Wave Loadings," Proceedings, International Symposium on Dynamics of Marine Vehicles and Structures in Waves, University College London, April 1974.

"Numerical Methods of Ship Structural Analysis," Proceedings, International Ship Structural Congress, (State-of-the-Art Report by committee chaired by J. R. Paulling), M.I.T. Cambridge, Massachusetts, 1976 (6th ISSC) Germanischer Lloyd, Hamburg, 1973 (5th ISSC).

"Time Domain Simulation of Semisubmersible Platform Motion with Application to the Tension-Leg Platform," Paper No. T6-2, Proceedings of Spring Meeting/Star Symposium, SNAME, May 1977.

"Analysis of Semisubmersible Catamaran-Type Platforms," (with (Y. S. Hong, H. H. Chen and S. G. Stiansen), Proceedings, Offshore Technology Conference, Paper No. 0TC 2975, Houston, May 1977.

"Wave Induced Forces on Ocean Structures," Lecture Notes, Deep-Sea Oil Production Structures, Continuing Education in Engineering, University Extension and the College of Engineering, University of California, Berkeley, 30 pp., January 23-27, 1978.

"Dynamic Analysis of Floating Structures," Lecture Notes, Deep-Sea Oil Production Structures, Continuing Education in Engineering, University Extension and the College of Engineering, University of California, Berkeley, 29 pp., January 23-27, 1978.

"Structural Loads on Twin-Hull Semisubmersible Platforms," (with (Y. S. Hong, S. G. Stiansen and H. H. Chen), Proceedings, Offshore Technology Conference, Paper No. 0TC 3246, Houston, May 1978.

"Frequency Domain Analysis of OTEC CW Pipe and Platform Dynamics," Proceedings, Offshore Technology Conference, Paper No. 0TC 3543, Houston, May 1979.

"Analytical Modelling of the Coupled Dynamics of the OTEC Cold Water Pipe and Platform," DOE-NOAA Technical Workshop on Ocean Thermal Energy Conversion, CW Pipe Technology, January 1979.

"The Response of Floating Platforms to Ocean Waves," Proceedings of the Australia Symposium on Ship Technology, Royal Institute of Naval Architects, Australian Branch, 5-7 November 1979.

"An Equivalent Linear Representation of the Forces Exerted on the OTEC CW Pipe by Combined Effects of Waves and Current," Proceedings, Ocean Engineering for OTEC OED9 ASME, New Orleans, LA, 3-7 Feb. 1980, pp. 21-28.

"Analysis and Design of the Cold-Water Pipe (CWP) for the OTEC System with Application to OTEC-1," (with Allan T. Maris), Marine Technology, Vol. 17, No. 3, July 1980, pp. 281-289.

"Theory and User Manual for OTEC CW Pipe Programs," Johns Hopkins University/
Applied Physics Laboratory, Contract #N00024-78-C-5384, July 1980.

"The Response of Moored Floating Platforms to Ocean Waves," U.S. Naval Civil Engineering Laboratory, Tech. Note 1604, March 1981.

"The Sensitivity of Predicted Loads and Responses of Floating Platforms to Computational Methods," Proceedings, Second International Symposium on Integrity of Offshore Structures, Glasgow, Scotland, July 1981.

"Mathieu Instabilities in TLP Response," Proceedings, Ocean Structural Dynamics Symposium 1982, Oregon State University, 1982.

"A Comparison of Stability Characteristics of Ships and Offshore Structures," Proceedings, Second International Conference on Stability of Ships and Ocean Vehicles, Society of Naval Architects of Japan, Tokyo, 1982.

9 April 1984

Dr. F. Rajabi
Brown & Root Development, Inc.
P.O. Box 1051
Houston, Texas 77251

Dear Dr. Rajabi:

Enclosed are the forms with our remarks. I am sorry to have to say, but your requests are starting to take considerable labor time. Therefore, we would appreciate it if we could receive some information about the results of this investigation.

Sincerely,

Nils Salvesen

Nils Salvesen
Manager, Ship Hydrodynamics

NS/djk

Enclosure

22 September 1983

Dr. Farhad Rajabi
Brown & Root
P.O. Box 4302
Building 29, Room 1021
Houston, Texas 77210

Dear Dr. Rajabi:

In reference to your telecopy of 15 September 1983 regarding computer programs available for motion and structural analysis of semisubmersibles, I would like to inform that the basic hybrid-finite-element method (HFEM) computer program which is part of our TLP computer program system, is universally applicable to any platform configuration.

The HFEM program solves the fully three-dimensional linear and second-order wave diffraction potential flow problem for any platform configuration. The data computed by the HFEM progrma includes for six-degree-of-freedom motions

- hydrodynamic added mass
- wave-radiation damping coefficient
- linear wave exciting forces and moments
- linear wave run-up along platform
- acceleration and velocity for any fluid particle modified by the body diffraction
- displacement, velocity and acceleration for the six-degree-of-freedom body motions
- second-order drift exciting forces and moments
- second-order double-frequency "springing" exciting forces

The method is applicable to deep water as well as finite depth.

We have a complete user's manual for the HFEM program:

"A Hybrid-Finite-Element Method (HFEM) Program for Calculating Water Wave Diffraction by Three-Dimensional Bodies," by Dick K. Yue

SAI Report #463-82-333-LJ, December 1982.
For distribution of manual contact:
Dr. Nils Salvesen
134 Holiday Court, Suite 318
Annapolis, MD 21401
(301) 266-0990

This manual includes

- description of theoretical approach
- user's instruction
- numerical examples
- verification and error estimates

The HFEM program is available under a nonexclusive license agreement between the parties involved.

We would appreciate it if you let us have a copy of your report of this survey for the U.S. Naval Civil Engineering Laboratory since we like to have a complete knowledge about any statements made about our computer capabilities.

Sincerely,

Nils Salvesen
Manager, Ship Hydrodynamics

NS/djk

15 August 1983

Mr. Farhad Rajabi
Brown and Root Development, Inc.
Building 29, Room 1021
P.O. Box 4302
Houston, Texas 77210

Dear Mr. Rajabi:

Enclosed is a General Information Document on "The SAI TLP Motion and Load Computer Code System." This is in response to you 8 August request for information concerning SAI's capabilities in predicting the responses for TLPs. It is believed that our computer code system is probably one of the most advanced and complete systems in existence today for predicting the linear and nonlinear responses of TLPs. Please let us know if you need any additional information or if you need copies of any of the SAI reports referred to in the enclosed document.

Sincerely,

Nils Salvesen

Nils Salvesen
Manager, Ship Hydrodynamics Division

Enclosure
NS/djk

Science Applications, Inc. 134 Holiday Court, Suite 318, Annapolis, Maryland 21401, (301) 266-0990; Wash., D.C.: (202) 261-8026

SAI Offices: Albuquerque, Ann Arbor, Arlington, Atlanta, Boston, Chicago, Huntsville, La Jolla, Los Angeles, McLean, Palo Alto, Santa Barbara, Sunnyvale, and Tucson.

VERITAS TECHNICAL SERVICES, INC.

A Subsidiary of Det norske Veritas

1325 SOUTH DAIRY ASHFORD, SUITE 300
HOUSTON, TEXAS 77077
(713) 558-1733
TELEX: 166-376

April 24, 1984

Brown & Root Dev., Inc.
P.O. Box 1051
Houston, Texas 77251

Attention: Dr. F. Rajabi

Subject: Program Questionaires

Dear Dr. Rajabi:

Enclosed please find the questionaires Tables I-IV describing the features of the SESAM' 80 system, except for the hydrostatic stability programs (called NV223). Depending on the type of analysis to be performed, various modules will be used:

Table I: Frequency Domain/Morison

WAMLOS	Wave loads and motion response in regular waves.
PREFRAME	Preprocessor for frame models.
PREFEM	Preprocessor for plate & shell models.
PRESEL	Coupling of superelements.
SESTRA	F. E. analysis of linear elastic models.
POSTFRAME	Postprocessor for frame models.
POSTFEM	Postprocessor for plate & shell models.

Table II: Frequency domain/Diffraction

Same as I. WAMLOS can utilize hybrid diffraction/Morison models.

Table III: Time domain/Morison

Under development. FENRIS is a general nonlinear F.E. program. For wave and current loading it will utilize a program called WAJAC.

Table IV: Time domain/Diffraction

Under development. The wave loading module will in this case be WAMLOS.

The pre- and postprocessors mentioned in Table I are coupled to FENRIS.

I hope this information was what you were looking for. Please call me or Dr. Nils Sandsmark if you have any questions about the programs.

Yours very truly,

for VERITAS TECHNICAL SERVICES, INC.

Ron Borresen

Ron Borresen

RB:ss

Enclosures

VERITAS TECHNICAL SERVICES, INC.

A Subsidiary of Det norske Veritas

16340 PARK 10 PLACE DRIVE
HOUSTON, TEXAS 77084
(713) 578-0328
TELEX: 775-491

September 13, 1983

Brown and Root, Inc.
P. O. Box 4302
Building 29, Room 1021
Houston, Texas 77210

Attn.: Farhad Rajabi

Subject: Computer Programs for TLP's.

1. **General information**

The programs available for analysis of tension leg platforms are generally split into two categories:

Category I : Motion response analysis programs.

Category II: Global and local structural analysis programs.

Motion Response Analysis Programs:

(I-1) NV1427 : Dynamic analysis of tethered structures.

(I-2) NV1461 (WAMLOS): Wave loads and motion response of compliant structures.

(I-3) MOSSI : Time domain analysis of floating structures.

NV1427 may be used for linear and nonlinear analysis (time domain). The program can handle wind forces fluctuating in time and slowly varying wave drift forces. Viscous damping is accounted for. The waves wind and current may come from arbitrary individual directions. The output is time histories of motions, exciting forces and tether forces.

NV1461, or WAMLOS, is used for linear (frequency domain) motion analysis of a compliant structure. 3D diffraction theory or Morison's formula may be used for different members of the same model. Motion response and second-order wave drift forces are calculated.

MOSSI has features similar to NV1427.

Global and Local Structural Analysis Programs:

(II-1) SESAM 69 : General finite element system.

(II-2)	SESAM 80	:	General linear finite element system. Development of this system which will replace SESAM 69 is almost complete.
(II-3)	FENRIS	:	Nonlinear general finite element system (nonlinear part of SESAM 80).
(II-4)	TUJAP	:	Tubular joint analysis system (integrated within SESAM 80)
(II-5)	FANSY	:	Deterministic and probalistic fatigue analysis system (intergrated within SESAM 80)

Some brochures describing the basic features of these programs are enclosed.

2. **Theory Manuals:**

The theoretical background is generally explained (or referred to) in the User's Manuals.

3. **User's Manuals:**

User's manuals for NV1461 and the various modules of the SESAM 69 and SESAM 80 systems are available for purchase.

4. **Availability:**

NV1427 is developed by DnV, but so far it is not relased for external use. NV1461, SESAM 69 and SESAM 80 are also owned by DnV, and these programs are available for external use. FENRIS is a joint development of several organizations, of which DnV is one. DnV does have responsibility for marketing of FENRIS.

MOSSI is not owned by DnV, but is available through leasing.

The programs NV1427 and NV1461 are presently running on VAX 750/780 computer systems, whilst the SESAM 69 and SESAM 80 programs are available on several computer systems (Univac, IBM, CDC) through service bureaus.

5. **Validation Status:**

The programs for hydrodynamic loading and motion response are based on program modules which has been used for a long time, and several comparison studies using results from model tests and other programs have been done. The SESAM 69 programs have also been extensively used for more than a decade, whilst the new modules of the SESAM 80 programs are all being thoroughly tested and validated before they are released. Extensions to SESAM 80, under the TUJAP and FANSY projects are currently under development.

6. **Applicability to Other Structures:**

The programs NV1427 and NV1461 have been developed for arbitrary floating structures with catenary mooring systems, but they have been modified to include TLP's, so these programs are versatile.
The SESAM 69 and SESAM 80 programs are general purpose systems which may be used for any kind of structure.

We hope this information will be helpful to you. Please contact us if you need further information.

Yours sincerely,

Ron Borresen

Ron Borresen

RB:nj

Enclosures:

Rcv: @1IM/3.00197 Line: 3

166299 B R MAR
9
266)01 ATKINS G
GJR /730 16.9.83

ATTENTION: DR. FARHAD RAJABI 29-1021 691-1058

FROM: STEVE IZATT, ATKINS R+D

THANK YOU FOR YOUR TELEX DATED 9/14/83.

I THINK THAT THE DOCUMENTATION SENT TO YOU ON IITH AUGUST ALSO COVERS OUR CAPABILITY FOR THE ANALYSIS AND DESIGN OF SEMI-SUBMERSIBLES. HOWEVER, IF YOU REQUIRE MORE DETAILED INFORMATION THEN PLEASE DO NOT HESITATE TO CONTACT ME.

266701 ATKINS G TIME SENT 1645
166299 B R MAR

LTLL

1#83)05456

Time: 10:45 10/16/83 ???
Connect Time : 111 seconds

Woodcote Grove Ashley Road
Epsom Surrey KT18 5BW England

Telephone Epsom 26140 (STD code: 037 27)
Cables Kinsopar Epsom
Telex 266701 (AB: Atkins G)

Atkins
Research and Development

Telephone ext 2637

Your ref

Our ref 08620.11/SJI/hh

Date 11th August 1983

Farhad Rajabi
Brown & Root Houston
P.O. Box 4302
Building 29
Room 1021
Houston

Dear Mr. Rajabi,

Thank you for your telex dated 9/8/83 requesting information on our computer software for the analysis of TLP's.

In view of your short timescale, I have tried to find available publications describing our software capability rather than draw up a new portfolio. However, the enclosed document describes the two most applicable programs for stress and hydrodynamic analysis. I have also included a brief description of the work which we carried out for the CONOCO, Hutton TLP project. I should also point out that we have been involved is other similar projects including the BP, Tethered Buoyant Platform project.

I hope that the information is sufficient, however if you need further details please do not hesitate to contact me.

Yours sincerely,
For ATKINS RESEARCH AND DEVELOPMENT

S.J. Izatt

Encl.

London Centre for Marine Technology

University College London · Department of Mechanical Engineering
Torrington Place, London WC1E 7JE
Telex: 296273 Telephone: 01-387 7050 Ext. 579/822

30th April 1984

Dr F Rajabi
Brown & Root Development Inc.
P O Box 1051
Houston
Texas 77257
USA

Dear Dr Rajabi

Thank you for your letter of 12th April together with the enclosed questionnaires.

We have completed the questionnaires as requested. These are enclosed.

Yours sincerely

Minoo Patel

Dr Minoo Patel

Table IV not received

NMI LTD

Feltham, Middlesex TW14 0LQ
Tel: 01-977 0933. Telex: 263118

cc: Mr Bowden
Dr Dacunha

Brown & Root Development Inc.
PO Box 1051
Houston
Texas 77251
USA

Your reference:

Our reference:

Date: 19 April 1984

P/No:

Attention: Dr F Rajabi

Dear Dr Rajabi

Computer Program Questionnaire

I enclose revised versions of your tables 2 and 4, supplied with your letter of 12 April 1984. Table 2 relates to our NMIWAVE program, and simply contains a number of corrections to your earlier table. Table 4 relates to a new program, which we have called NMISPM (for the time being). This is a time-history simulation program which is attached to NMIWAVE, and derives hydrodynamic data from it, but then performs a time-domain analysis of moored vessels such as single-point mooring systems.

I hope we have understood your requirements correctly. These were not always entirely clear, and we should be pleased to clarify our replies where necessary. You will appreciate that we also had to complete these tables somewhat hurriedly in order to meet your deadline, and therefore were unable to make as many, or as full comments as we might have wished.

I also hope to send you a completed table 3, relating to a new riser analysis program. The staff member who knows most about this program is on leave until 26 April, and will deal with your questionnaire on his return.

Please let us know if we can help further.

Yours sincerely

R G STANDING

Hydrodynamics Division

NMI LTD

Tel: 01-977 0933. Telex: 263118

AIR MAIL

Feltham, Middlesex TW14 0LQ

Brown & Root Inc.
PO Box 4302
Building 29
Room 1021
HOUSTON
Texas 77210,U.S.A.

Your reference:
Our reference: BSB/RGS/ajd
Date: 12 August 1983
P/No:

Attention; Mr Farhad Rajabi

Dear Mr Rajabi

NMIWAVE

Thank you for your telex dated 9 August 1983, enquiring about computer programs suitable for analysing tethered buoyant platforms in waves. We are pleased to enclose a number of leaflets and reports describing our NMIWAVE program, which was intended specifically for this type of analysis, and has been validated experimentally for this purpose.

NMIWAVE is based on a mixture of 3-dimensional linear wave diffraction theory and a linearised form of Morison's equation. It solves linearised response equations by frequency - domain methods, representing effects of tether pre-tension and stifness. The theoretical background and some of the validation of this program are described in the enclosed Reports R74, R47 and R59. A user manual for this original version of NMIWAVE is also enclosed.

This basic version is available for use at NMI or through the SIA computer bureau, or for purchase under licence. The purchase price would normally include installation on your machine, a 2-day introductory course, demonstration on your premises, and maintenance for a 3-year period. We should be pleased to provide a purchase price and further details, if required.

We have made several additions and modifications to NMIWAVE since it was first released in 1978. These later additions are currently only available at NMI on our in-house computer. We can arrange for you to have access to this machine directly, or would be pleased to prepare the data for you. These later additions include :

- wave spectral superposition
- modifications to drag linearisation so as to include wave spectral and current effects
- extra viscous damping of resonant motions
- various additional printed outputs
- plottings of structure and response transfer functions
- wave drift forces [mean and slowly]- varying and low frequency response.

continued

Our new drift force programs are described in a series of reports summarised in the enclosed issue of NMI News, and in the enclosed Report R.147.

The program has been used to analyse a wide variety of structures including tension by platforms [for commercial clients and research investigations], barges, tankers and other ships, jack-up rigs, semisubmersibles, floating storage platforms, fixed gravity platforms and various fixed caissons and a moored drill-ship.

These versions of NMIWAVE are all concerned with the overall wave loads on the structure and its response. We also worked with BP and Atkins R & D so as to link NMIWAVE with the ASAS structural analysis suite. Before we can give details of the availability of this continued suite, however, we should need to discuss the matter with BP and Atkins, who each own parts of the package.

I hope the above information is sufficient for your immediate purposes. Please let me know if you need further information. Technical enquiries should be directed to Dr R.G. Standing [extension 5183].

Yours sincerely,

B. S. Bowden.

B.S. BOWDEN
Head of Hydrodynamics Division.

Encs:

NMI

RCA AUG 11 0443+

L A MARINE HOU

263118 MARFEL G

12.8.83 9.45

ATTN: FARHAD RAJABI → 29-1021

REF: YOUR TELEX DATED 9 AUGUST 1983

IN REPLY TO YOUR TELEX, OUR CMPUTER PROGRAM NMIWAVE IS INTENDED FOR ANALYSIS OF TENSION LEG PLATFORMS IN WAVES. WE SHALL BE SENDING YOU FURTHER DETAILS BY MAIL.

REGARDS

R G STANDING

NMI LTD

+

L A MARINE HOU

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ATTENTION DR FARHAD RAJABI, BROWN AND ROOT, HOUSTON

FROM: NMI LTD, FELTHAM, MIDDLESEX, UK

THANK YOU FOR YOUR TELEX OF 14 SEPTEMBER. THE NMIWAVE PROGRAM, DESCRIBED IN OUR EARLIER TELEX AND LETTER, CAN ANALYSE BOTH TLP AND SEMISUBMERSIBLE PLATFORMS. YOU SHOULD NOW HAVE THE INFORMATION THAT YOU REQUIRE.

PDEASE LET US KNOW IF WE CAN HELP FURTHER.

REGARDS

R G STANDING
NMI LTD

166299 B R MAR

263118 MARFEL G

0658 09/21
VIA TRT

?
Time: 05:55 09/21/83 CDT
Connect Time : 161 seconds

Battelle
Petroleum Technology Center
1100 Rankin Road
Houston, Texas 77073
(713) 821-9330
Telex 24-5454

April 12, 1984

Mr. Farhad Rajahi
Brown and Root Development, Inc.
P. O. Box 1051
Houston, Texas 77251

Dear Farhad:

Referencing your 5 April letter regarding your NCEL vessel motion survey, I have enclosed the data relative to Battelle's DWVSL program. Your survey obviously is geared to programs with much more capability than ours. I felt almost bad answering "no" to so many questions. However, in the interest of completeness, I offer our contribution to your survey.

Please let me know if I can be of further assistance to you on this matter.

Best Regards,

Rich

Richard J. Olson
Principal Research Scientist

RJO/ldh

Enclosure

Battelle
Petroleum Technology Center
1100 Rankin Road
Houston, Texas 77073
(713) 821-9330
Telex 24-5454

October 6, 1983

Dr. Farhad Rajabi
Brown & Root
Bldg. 29, Room 1021
P. O. Box 4302
Houston, Tx 77210

Dear Farhad:

In response to your telex regarding motion and structural analysis computer programs for semisubmersibles and TLP's, we supply the following information concerning Battelle's program DWVSL:

1) General Information: The vessel motion program DWVSL, was written to generate response amplitude operators and phase angles for input into a marine riser analysis program. DWVSL calculates the RAO's for vessels consisting of an assembly of vertical columns and horizontal pontoons. The model is extremely simple, requiring only the size, location and hydrodynamic properties of all members, global platform information, and mooring parameters to calculate the RAO's for the vessel. The program was not intended to be a vessel design program, rather it was intended to supply approximate motion characteristics of a vessel for a riser analysis progam suite.

2) Theoretical Background: There is no formal theoretical manual, nor have any papers been written about this program. However, the following general information should give you some idea about the program:

Assumptions - Drag and diffraction ignored
Motions assumed small
Deep water Airy wave theory
Moorings are linear elastic springs
Geometry is three dimensional, but response calculated in two dimensions (direction of wave propagation)

Approach - Equilibrium equations (3 d.o.f.) written for structure including lumped mass description of vessel (vessel mass and radii of gyration at the c.g.), added mass due to wave loading, hydrostatic stiffness due to immersion of members, linear spring mooring stiffness, and applied wave loads due to horizontal acceleration of the fluid (only components of force in direction of wave propagation retained in equilibrium equation). Motion taken as sinusoidal at frequency of incident wave.

Solutions - DWVSL calculates the coupled natural frequencies of the platform, wave forces and moments, and platform motion response in the direction of wave propagation (surge, heave and pitch). Reference point for motion can be located anywhere on the vessel.

3) User's Manual: Enclosed.

4) Availability: DWVSL is nominally part of a Battelle marine riser analysis program suite, DWRSR ($40,000). However, the program can be purchased separately (source code) for $5,000. Access to the program could be arranged on Battelle's computers on a computer time plus royalty basis if desired.

5) Validation: Program DWVSL has been validated by comparison with wave tank results and other computer programs. Figures A-1 through A-3 show a comparison for a TLP. Figures A-4 through A-7 and Tables A-1 and A-2 show a comparison for a semisubmersible. For reference, programs compared against include VOTBP, NMI-WAVE, MOSAS, and NV407 from Vickers Offshore, National Maritime Institute, Earl & Wright, and DnV respectively.

6) Applicability: DWVSL is only useful for pontoon and column type structures.

I hope that this information is helpful in preparing your survey. I apologize for the delay in sending this information off to you, but I have been out of the country. If you have further questions about DWVSL, please do not hesitate to call me at 821-9330.

Best Regards,

Richard J. Olson

Richard J. Olson
Principal Research Scientist

RJO:eb
Enclosures

VO Offshore Limited

197 Knightsbridge
London SW7 1RB
England

Telephone 01-581-1393
Telex 8814702

For the attention of:

Farhad Rajabi Esq

Brown & Root Inc.
P O Box 3
Houston
Texas 77001

Your Ref

Our Ref VO/GRP/SB 596

Date 4 November 1983

Dear Mr Rajabi,

Following your telex, reference 08/09/83 PV TLX 166299 concerning the survey for the US Naval Civil Engineering Laboratory on computer programs for Motion and Structural Analysis of Tension Leg and Semisubmersible platforms, we enclose the attached information.

We apologise for the delay in replying due to an internal mailing problem and trust the data is still of value to you.

Should you require further information please do not hesitate to contact the undersigned.

Yours sincerely,

Graham R Perrett
Projects Director, London

MARIN

Maritime Research Institute Netherlands

2, Haagsteeg; P.O. Box 28
6700 AA Wageningen, The Netherlands
Telephone +31 8370 19140, Telex 45148 nsmb nl
Bank: ABN Wageningen accountnr. 53.93.39.156

Dr. F. Rajabi
Brown & Root Development, Inc.
P.O. Box 1051
HOUSTON, Texas 77251
U.S.A.

1984-05-23

Dear Mr. Rajabi,

As promised we herewith send you the questionnaire on software for TLP's and semi-sumbersibles.

We only filled in Table IV and Table II, because Table I and Table III were not covered by our programs.

We apologize for the delay in answering your letter of 1984-04-09.

Yours sincerely,
MARITIME RESEARCH INSTITUTE NETHERLANDS

Ir Tan Seng Gie
Head Ocean Engineering Division

Encl.: questionnaire

RHMH:bb

Rcv: @1IM/3.02234 Line: 3

166299 B R MAR

45148 NSMB NL

1984-05-22

TO: BROWN AND ROOT DEVELOPMENT INC., HOUSTON

ATTN.: DR. F. RAJABI

FROM: NSMB, W.C. DE BOOM

SUBJECT: QUESTIONNAIRE COMPUTER PROGRAMS

YOUR LETTER DATED 1984-04-09

RE.: YOUR TELECON DATED 1984-05-11.

PLEASE BE ADVISED THAT THE SUBJECT QUESTIONNAIRE WILL BE MAILED (EXPRESS DELIVERY) TODAY 1984-05-22.

WE APOLOGIZE FOR THE DELAY IN ANSWERING YOUR LETTER AND HOPE THE INFORMATION WILL ARRIVE STILL IN TIME IN YOUR OFFICE.

REGARDS,

45148 NSMB NL
NNNN
MAY 22 07:37

166299 B R MAR

0240 05/22
VIA TRT

Time: 01:38 05/22/84 ???
Connect Time : 120 seconds

NSMB

Netherlands Ship Model Basin

The Wageningen/Ede Laboratories of
Maritime Research Institute Netherlands
(MARIN)

Wageningen Laboratories: 2, Haagsteeg;
P.O. Box 28, 6700 AA Wageningen
Telephone + 31 8370 93911, Telex 45148 nsmb nl

Ede Laboratory: 10, Niels Bohrstraat, 6716 AM Ede
Telephone + 31 8380 37177

Bank:
ABN Wageningen account No. 53.93.39.156 (MARIN)

Commercial register Rotterdam No. 146201

Mr. Farhad Rajabi
P.O. Box 4302
Building 29, Room 1021
HOUSTON, Texas 77210
U.S.A.

1983-09-20

Your ref.: Job charge XF-0030.

Dear Mr. Rajabi,

We herewith send you in twofold Publication No. 400, entitled:

"Hydrodynamic aspects of semi-submersible platforms", by

Dr.Ir. J.P. Hooft.

Yours sincerely,
NETHERLANDS SHIP MODEL BASIN

p.p.
Ir Tan Seng Gie
Head Ocean Engineering Division

Encl.: as mentioned above

BB:bb

NSMB

Netherlands Ship Model Basin

The Wageningen/Ede Laboratories of
Maritime Research Institute Netherlands
(MARIN)

Wageningen Laboratories: 2, Haagsteeg;
P.O. Box 28, 6700 AA Wageningen
Telephone +31 8370 19140, Telex 45148 nsmb nl

Ede Laboratory: 10, Niels Bohrstraat, 6716 AM Ede
Telephone +31 8380 19115

Bank:
ABN Wageningen accountnr. 53.93.39.156 (MARIN)

New telephone number Wageningen laboratories
+31 8370 93911 (from 25 June 1982)

Mr. Farhad Rajabi
P.O. Box 4302
Building 29, Room 1021
HOUSTON, Texas 77210
U.S.A.

1983-08-12

Your ref.: Job charge XF-0030.

Dear Mr. Rajabi,

We herewith send you the following documentation:

- Brochure MARIN;
- Brochure Computer Programmes for Ocean Engineering;
- OTC Paper 4487;
- OTC Paper 4074;
- MARIN Report No. 14;
- NSMB Publication No. 510;
- NSMB Publication No. 650;
- NSMB Publication No. 692.

Yours sincerely,
NETHERLANDS SHIP MODEL BASIN

Ir Tan Seng Gie
Head Ocean Engineering Division

Encl.: as mentioned above

WCdB:bb

Rcv: @1IM/3.00214 Line: 3

166299 B R MAR

451488 NSMB NL

1983-09-20

TO: BROWN AND ROOT, HOUSTON, ATTN.: DR. FARHAD RAJABI

FROM: NETHERLANDS SHIP MODEL BASIN, W.C. DE BOOM

SUBJECT: SEMI-SUB ANALYSIS CAPABILITY

YOUR TLX OF 1983-09-14

OUR REF.: DIV OP

IN ANSWER TO YOUR TELEX OF 1983-09-14 WE CAN INFORM YOU THAT THE COMPUTER PROGRAMS MENTIONED IN OUR TELEX REPLY TO YOUR EARLIER ENQUIRY FOR INFORMATION ABOUT TLP ANALYSIS CAPABILITIES APPLY ALSO FOR SEMI-SUBMERSIBLES.

THE PROGRAMS: DIFFRAC
DBDRIFT
DRIFTP
IMPRESS1
IMPRESS2
MOORSIM

CAN ALSO BE USED FOR SEMI-SUBMERSIBLES.
(SEE OUR TELEX OF 1983-08-09 AND THE INFORMATION WE SENT YOU ENCLOSED WITH OUR LETTER OF 1983-08-12).

IF WAVE FORCES AND WAVE INDUCED LINEAR MOTIONS HAVE TO BE COMPUTED FOR A 'SLENDER' SEMI-SUBMERSIBLE, FOR WHICH CAN BE ASSUMED THAT NO MUTAL INTERACTION BETWEEN COLUMNS EXISTS CAUSED BY DIFFRACTION EFFECTS, AN ALTERNATIVE LESS COSTLY PROGRAM CAN BE OFFERED: THE PROGRAM SEMI-SUB.

THE PROGRAM SEMI-SUB CALCULATES EXCITATION AND REACTION FORCES AND THE RESULTING MOTIONS OF SEMI-SUBMERSIBLES IN REGULAR WAVES IN SHALLOW OR DEEP WATER.

- PROGRAM AVAILABILITY:
  SEE OUR TELEX OF 1983-08-09.
  PRESENT SITUATION: PROGRAM RUN BY NSMB ON BASIS OF LUMPS SUM QUOTATIONS.
  PROPOSED FOR 1984: PROGRAM WILL BE MADE AVAILABLE THROUGH DUTCH COMPUTER CENTRE ENR.

- PROGRAM'S THEORETICAL BACKGROUND AND VALIDATION:
  SEE THE BROCHURE WE ENCLOSED WITH OUR LETTER OF 1983-08-12.

  NSMB PUBLICATION ESPECIALLY DEALING WITH THE PROGRAM SEMI-SUB IS MAILED TO YOU.

- THE PROGRAM SEMI-SUB DOES NOT OFFER ANY POSSIBILITY FOR CALCULATION OF MEAN AND SLOW VARYING WAVE DRIFT FORCES. IF

THAT INFORMATION IS REQUIRED (FOR DESIGN OF MOORING SYSTEM OR DYNAMIC POSITIONING SYSTEM) THE PROGRAM PACKAGE BASED ON DIFFRAC AS DESCRIBED IN THE TELEX OF 1983-08-09 IS REQUIRED.

WE HOPE THIS TELEX AND THE PUBLICATION MAILED INFORM YOU SUFFICIENTLY FOR THE TIME BEING.

BEST REGARDS,
451488 NSMB NL
166299 B R MAR

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VIA TRT

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45148C NSMB NLMSG 08/AVG

1983-08-12

ATTN.: MR. FARHAD RAJABI

FROM: NETHERLANDS SHIP MODEL BASIN, W.C. DE BOOM

SUBJECT: TLP ANALYSIS CAPABILITY

YR TELEX OF 1983-08-09
YR JOB CHARGE: XF-0030

NSMB REF.: DIV. OP

WE HAVE PLEASURE TO INFORM YOU BELOW ABOUT N.S.M.B.'S COMPUTER ANALYSIS CAPABILITIES FOR TLP'S:

1. PROGRAM DESCRIPTION:
   A. PROGRAM DIFFRAC -
      WAVE DIFFRACTION PROGRAM TO CALCULATE WAVE LOADS AND MOTION RESPONSES (FIRST ORDER) IN REGULAR WAVES.
      THE PROGRAM IS BASED ON A THREE-DIMENSIONAL SOURCE DISTRIBUTION TECHNIQUE TO SOLVE THE LINEARIZED VELOCITY POTENTIAL PROBLEM.
   B. PROGRAMS DBDRIFT AND DRIFTP -
      THESE PROGRAMS COMPUTE, ON BASIS OF RESULTS GENERATED BY THE PROGRAM DIFFRAC, THE MEAN AND LOW FREQUENCY SECOND ORDER WAVE EXCITED FORCES AND MOMENTS.
      (ADAPTATIONS TO THE PROGRAM DRIFTP ALLOW THE CALCULATION OF HIGH FREQUENCY SECOND ORDER WAVE EXCITED FORCES/MOMENTS AS WELL).
   C. PROGRAMS IMPRES 1 AND IMPRES 2 -
      THESE PROGRAMS COMPUTE TIME DOMAIN RECORDS OF FIRST ORDER AND SECOND ORDER WAVE LOADS FOR A ARBITRARY WAVE TRAIN.
   D. PROGRAM MOORSIM -
      TIME DOMAIN SIMULATION FOR COMPUTATION OF INSTANTANEOUS STRUCTURE'S MOTIONS AND MOORING FORCES DUE TO IRREGULAR WAVES AND OTHER ENVIRONMENTAL LOADS SUCH AS WIND AND CURRENT FORCES.

      TIME TRACES OF TLP MOTIONS AND TETHER FORCES, INCLUDING EFFECTS DUE TO MEAN AND VARYING WAVE DRIFT FORCES, ARE RESULTING FROM THESE COMPUTATIONS.

2. PROGRAM AVAILABILITY:
   THE NSMB COMPUTER PROGRAMS ARE RUN BY NSMB ONLY.
   UPON REQUEST NSMB WILL PROVIDE A LUMP SUM QUOTATION FOR CALCULATION OF A CERTAIN DESIGN CASE. THIS PROCEDURE IS ADVANTAGEOUS SINCE ALL NSMB'S EXPERIENCE WILL BENEFIT THE EXECUTION OF CALCULATIONS OF NEW PROJECTS,

   THE PROGRAMS DIFFRAC DBDRIFT AND IMPRES I WILL BECOME AVAILABLE FOR OFFSHORE INDUSTRY IN THE COURSE OF NEXT YEAR THROUGH THE DUTCH COMPUTER CENTRE ENR, PETTEN, THE NETHERLANDS. THIS

COMPUTER CENTRE IS EQUIPPED WITH A CDC CYBER 170-175 COMPUTER.

THE NSMB IS INVESTIGATING POSSIBILITIES TO MAKE THESE PROGRAMS ALSO AVAILABLE THROUGH A COMPUTER CENTRE IN THE U.S.A. WITHIN A FEW YEARS.

3. PROGRAMS' THEORETICAL BACKGROUND AND VALIDATION:
THE THEORETICAL BACKGROUND OF THE PROGRAMS IS DESCRIBED IN A NUMBER OF NSMB PUBLICATIONS AND TECHNICAL PAPERS.

THE APPLICATION FOR TLP'S IS DESCRIBED EXTENSIVELY IN TWO OTC PAPERS:
OTC PAPER NO. 4074. TAN, S.G. AND DE BOOM, W.C.: ''THE WAVE INDUCED MOTIONS OF A TENSION LEG PLATFORM IN DEEP WATER''. PROC. THIRTHEENTH ANNUAL OFFSHORE TECHNOLOGY CONF., HOUSTON 1981.

OTC PAPER NO. 4487. DE BOOM, W.C., PINKSTER, J.A. AND TAN, S.G.: ''MOTIONS AND TETHER FORCE PREDICTION FOR A DEEP WATER TENSION LEG PLATFORM''. PROC. FIFTEENTH ANNUAL OFFSHORE TECHNOLOGY CONF., HOUSTON 1983.

COPIES OF THESE TWO PAPERS AND OTHER RELEVANT NSMB PUBLICATIONS HAVE BEEN MAILED TO YOU.

THE TWO OTC PAPERS MENTIONED ABOVE SHOW THE CORRELATION BETWEEN MODEL TEST MEASUREMENTS AND COMPUTER PREDICTIONS FOR A TLP.
IN THE OTHER PUBLICATIONS FORWARDED TO YOU CORRELATIONS BETWEEN MODEL TESTS AND COMPUTATIONS ARE SHOWN FOR OTHER APPLICATIONS OF THE PROGRAM (SEE NEXT ITEM).

4. THE SET OF PROGRAMS DESCRIBED IN ITEM 1 IS ALSO APPLICABLE FOR:
- TANKERS MOORED TO A JETTY
- TANKERS IN SPREAD MOORING SYSTEM
AND GENERALLY FOR ALL MOORED FLOATING STRUCTURES.

WE HOPE THIS TELEX AND THE PUBLICATIONS MAILED INFORM YOU SUFFICIENTLY FOR THE TIME BEING.
IF YOU NEED MORE INFORMATION PLEASE DO NOT HESITATE TO CONTACT US.

REGARDS,
45148C NSMB NL
166299 B R MAR

0455 08/12
VIA TRT

Shell Development Company
A Division of Shell Oil Company

Bellaire Research Center
P. O. Box 481
Houston, Texas 77001

3737 Bellaire Boulevard
Houston, Texas 77025

May 30, 1984

Dr. F. Rajabi
Brown & Root Development, Inc.
P. O. Box 1051
Houston, TX 77251

Dear Dr. Rajabi:

Enclosed is Shell's response to your survey regarding available software for motion and structural analysis of semisubmersibles and tension leg platforms. We have only completed Tables I and III, which reflect our existing capabilities.

We are presently developing a new suite of computer programs for the dynamic analysis of compliant offshore structures. In these programs, the motion response of the coupled system is evaluated in both the frequency and time domains. Since we have not yet finalized the specific features of the diffraction theory to be incorporated in the programs, we are unable to respond to the questions in Tables II and IV at this time.

Very truly yours,

F. W. Boye, Manager
Production Operations
Research Department

Enclosure

Shell Development Company
A Division of Shell Oil Company

Bellaire Research Center
P. O. Box 481
Houston, Texas 77001

3737 Bellaire Boulevard
Houston, Texas 77025

October 25, 1983

Dr. Farhad Rajabi
Brown and Root, Inc.
Building 29, Room 1021
P. O. Box 4302
Houston, TX 77210

Dear Dr. Rajabi:

ABSTRACTS OF COMPUTER PROGRAMS MOSAS/TLP, MOMOP, MOPOP AND TLPIDO

In response to your request for information regarding Shell's computer programs for motion and structural analysis of semisubmersibles and tension leg platforms, brief descriptions of the programs MOSAS/TLP, MOMOP, MOPOP and TLPIDO are attached.

These programs are available for licensing. For further information regarding acquisition, please contact

Patents and Licensing
Shell Development Company
P. O. Box 2463
Houston, TX 77001

The programs are not available through computer bureaus, and cannot be made available to an engineering contractor retained by NCEL to design a tension leg platform.

Very truly yours,

F. W. Boye, Manager
Production Operations
Research Department

Enclosures

JOHN E. HALKYARD & COMPANY
OCEAN ENGINEERING CONSULTANTS

May 29, 1984 ref. 84-52

Dr. F. Rajabi
Brown & Root Development Inc.
P. O. Box 1051
Houston, TX 77251

Dear Farhad:

Enclosed is a completed copy of your questionaire (Table IV) requested in your letter of April 5. I'm sorry for the delay and hope that this information may be useful in your study.

Best regards,

John E. Halkyard

JEH:bt

enclosure

2949 EPAULETTE STREET • SAN DIEGO, CALIFORNIA 92123 • USA

PHONE (619) 569-6083 • TWX 910-322-1356

Rcv: @1IM/2.05781 Line: 24

B R INC HOU

B R SAN FELIPE
MSG LEH411
Rcv: @1IM/1.00787 Line: 1

B R INC HOU

MAR EMG HOU

EASYLINK 2790494001 13FEB84 19:24/19:28 EST
FROM: TLX 799517 ENJOY CALIF
ENJOY CALIF ENTERPRISES
TO: 794502

FEB. 13, 1984

TO: DR. FARHAD RAJABI (03) 615
BROWN AND ROOT INC.
(713) 676-8610

RE: TLP MOTION ANALYSIS PROGRAMS

RE YOUR TELEX OF TODAY, WE ARE CURRENTLY DEVELOPING SOFTWARE FOR TLP AND SEMISUBMERSIBLE ANALYSIS BUT IT ISN'T READY FOR COMMERCIAL DISTRIBUTION YET. WE ANTICIPATE MAKING PROGRAMS AVAILABLE FOR MICROCOMPUTER USERS (IBM AND/OR CPM OPERATING SYSTEMS) WITHIN THE NEXT 6 - 12 MONTHS. THE INITIAL PROGRAM WILL INCLUDE:

1. 3 DOF (SURGE, PITCH, HEAVE) RIGID BODY MOTIONS OF MOORED SEMI/TLP.
2. MOORING LOADS.
3. LINEAR AND NONLINEAR OPTIONS
A) LINEAR BASED ON AIRY WAVE AND LINEARIZED MORISON EQUATION
B) DIFFRACTION EFFECTS FOR COLUMNS
C) NONLINEAR TIME DOMAIN SOLUTION BASED ON NONLINEAR MORISON EQUATION MODIFIED TO INCLUDE AN EXTENSION OF LINEAR DIFFRACTION EFFECTS AND STRETCHED AIRY OR STOKES FIFTH ORDER WAVE THEORY .
4. FOURIER POST PROCESSING OF OUTPUT TO DETERMINE PRIMARY AND "SPRINGING" RESPONSES (APPLICABLE TO NON-LINEAR CASES ONLY).

CURRENTLY, NONLINEAR MODEL WITH STRETCHED AIRY THEORY HAS BEEN PARTIALLY VALIDATED AGAINST ANOTHER PROGRAM. WE [illegible] PROGRAMS [illegible]

[illegible] BASED DIRECTLY TO [illegible] FUTURE PLANS CALL FOR

DEVELOPING
MICRO BASED RISER ANALYSIS AND COUPLED TLP DYNAMIC ANALYSIS PROGRAMS.

I AM SENDING SEPARATELY A PAPER I PRESENTED WITH SHIN LIN LIU OF
CHEVRON
AT OCEANS '83. THIS COVERS RESULTS OF TLP ANALYSIS USING INTRA-WACS,
A
FINITE ELEMENT PROGRAM DEVELOPED BY PMB AND CHEVRON. INTRA IS
AVAILABLE FOR
LEASE HOWEVER INTRA-WACS (INCLUDING WAVE MODEL) IS PROPRIETARY TO
CHEVRON.
I PRESUME YOU HAVE CONTACTED CHEVRON, PMB, J. R. PAULING, EARL &
WRIGHT AND
OTHERS WHO HAVE SIMILAR PROGRAMS.

LET ME KNOW IF YOU WOULD LIKE FURTHER INFORMATION. I WILL PASS ON
LITERATURE
WHEN THESE PROGRAMS ARE READY FOR COMMERCIAL DISTRIBUTION.

SINCERELY,

JOHN E. HALKYARD
JOHN E. HALKYARD & COMPANY
2949 EPAULETTE STREET
SAN DIEGO, CA 92123
(619) 569-6083
TELEX 759517 OR ESL 62529130 ENJOY CALIF (NOTE NEW TELEX NUMBER)

MMMM

P R INC HOU

MAR RMS HOU

C. J. GARRISON & ASSOCIATES

C. J. GARRISON, Ph. D., P. E.
CONSULTANT IN MARINE HYDRODYNAMICS

3088 Hacienda Drive
Pebble Beach, Ca. 93953

Phone: ~~408-375-2812~~
~~408-646-2632~~
408-373-0313

October 22, 1983

Brown and Root Development, Inc.
P.O. Box 2002
Houston, TX 77001

Attn: Dr. Farhad Rajabi

Dear Dr. Rajabi:

Sorry for the delay in answering your letter of August 11, 1983. I hope it is not too late by now.

I have enclosed a description of a suite of computer programs called MORA which are somewhat general but includes TLP analysis capability. At the present time the time-domain programs NONTID and DRIFT are not yet completed but the rest of the package is available.

MORA is available for $40,000.00 from C.J. GARRRISON and ASSOCIATES and in the very near future can be accessed through the Boeing Computer Service Company.

The most critical part of the computer program package is HYDRAL (formerly known as DYNRES6) and this program has been used in the offshore industry for over 10 years. During that time it has been verified many times by use of experimental data. (Brown and Root is using this program currently.)

On a personal note - greetings from Monterey. I'm glad to see you're in the offshore industry and hope all is going well with you.

Best Regards,

Sincerely,

C. J. Garrison

C.J. Garrison

CJG/jkw
enc.

MCDONNELL DOUGLAS AUTOMATION COMPANY

Box 516, Saint Louis, Missouri 63166

16 August 1983

Brown and Root, Inc.
P.O. Box 4302
Houston, TX 77210

Attn: Mr. Farhad Rajabi, Bldg 29, Room 1021

Dear Mr. Rajabi:

The enclosed package contains the User Manual for McAuto SELOS and various descriptive materials pertaining to the analysis of offshore structures with McAuto proprietary software. The manual contains a theoretical presentation and a list of references.

I believe the SELOS program is capable of handling a variety of problems related to free-floating or tethered structures. The use of Morison's equation based hydrodynamic theory does, however, limit the solution applicability to open framework lattice type structures whose maximum member diameters are less than 20% of the wavelength being examined. I have recently used SELOS for a determination of the fatigue characteristics of Conoco's Hutton tension leg platform.

We have been unable to obtain well-documented experimental data on tension leg platforms. The data generated on such structures is generally proprietary and what is available in the public domain does not provide enough descriptive material to permit a duplicate analytical simulation. Some years ago, McAuto participated in a study of a 'test' bottom supported structure. The study was organized by Det Norske Veritas. SELOS results were comparable to the results obtained with the other 11 programs considered by the study.

Access to McAuto OFFSHORE (the capabilities contained within SELOS and STRUDL) is available on a service bureau basis through McAuto or our agents abroad; or the programs can be licensed on IBM or VAX hardware.

Please feel free to contact me if you need further information.

Sincerely,

MCDONNELL DOUGLAS AUTOMATION COMPANY

H. Peter Kappus

H. Peter Kappus, Senior Consultant
Structural Engineering
(314) 232-2108

HPK:jks

Enclosure

American Bureau of Shipping
Sixty-five Broadway
New York, N. Y. 10006

DL/HHC/
Refer to
File Ref: RD-1

29 September 1983

Dr. Farhad Rajabi
P.O. Box 4302
Brown & Root, Inc.
Building 29 - Room 1021
Houston, TX 77210

Subject: ABS/SEMISUBMERSIBLE Computer Program

Dear Dr. Rajabi:

In response to Mr. Hervey's telex of 14 September 1983, we are forwarding herewith a general description of our semisubmersible computer program. The enclosed information of our computer program contains a brief discussion on its application and a list of references which describe the pertaining theory employed and the correlations with published model test data.

The subject computer program has been satisfactorily applied to evaluate the dynamic characteristics of a number of semi-submersible drilling rigs. However, reports for these studies are proprietary, and are not included in the list of references mentioned above.

The ABS/SEMISUBMERSIBLE program can be made available for use by others by special arrangement.

We trust that the above information will assist you with your survey being conducted for the U.S. Naval Civil Engineering Laboratory on the computer programs available for motion analysis of semi-submersibles and tension-leg platforms. In submitting information on our computer program, we would appreciate receiving a copy of the final survey report, when completed.

Should you have any questions regarding our computer program, please do not hesitate to contact the undersigned or Dr. H. H. Chen at (212) 440-0466 .

Very truly yours,

AMERICAN BUREAU OF SHIPPING

S. G. STIANSEN
Vice President

By: Donald Liu
Donald Liu
Assistant Vice President

Encl.

BRIAN WATT ASSOC.

Rcv: @1IM/1.00060 Line: 1

MAR EMG HOU

BWA HOU

SEPTEMBER 2, 1983

FM: RICHARD AY, BWA, HOUSTON

TO: F. RAJABI, B&R, HOUSTON

IN RESPONSE TO YOUR TELEX, WE SUBMIT THE FOLLOWING:

1) WE HAVE TWO MAIN PROGRAMS WHICH ARE SUPPORTED BY A SUITE OF PRE AND POST PROCESSORS. GENERAL INFORMATION ON THESE TWO PROGRAMS IS LISTED BELOW.

(A) TIME DOMAIN PROGRAM

- USES MORISON'S EQUATION
- LINEAR AND NONLINEAR WAVE THEORIES
- FULLY NONLINEAR KINEMATICS
- UNLIMITED ROTATIONS AND TRANSLATIONS
- CATENARY AND TENSION LEG MOORINGS
- WIND AND CURRENT LOADING
- FULL NONLINEAR DESCRIPTION OF THE DRAG TERM
- CAPABLE OF DAMAGE ANALYSIS
  - OPERATOR DEFINED
  - SYSTEM RESPONSE DEFINED (E.G. EXCESSIVE MOORING LINE LOAD AND RESULTING LINE LOSS)
- 4TH ORDER RUNGE KUTTA SOLUTION SCHEME

(B) FREQUENCY DOMAIN PROGRAM

- USES MORISON'S EQUATION
- CATENARY AND TENSION LEG MOORINGS
- ITERATIVE LINEAR DESCRIPTION OF THE DRAG TERM
- LINEARIZED MOORING SYSTEM DESCRIPTION

2&3) AT THIS TIME, WE CONSIDER THE THEORETICAL BACKGROUND MANUAL AND THE USER'S MANUAL PROPRIETARY AND ARE UNABLE TO SUBMIT THIS INFORMATION. THIS INFORMATION WILL BE PUBLISHED IN 1984.

4) PRESENTLY, WE ARE PREPARED TO SELL EITHER OF THE ABOVE PROGRAMS. ALTERNATIVELY, WE WILL RUN THESE PROGRAMS FOR A CLIENT.

5) THE PROGRAMS HAVE BEEN VALIDATED AGAINST:
- MODEL TESTS - INCLUDES TWO SEMISUBMERSIBLE MODEL SERIES TESTS.
- OTHER SOFTWARE

6) OUR PROGRAMS ARE EQUALLY APPLICABLE TO SEMISUBMERSIBLES AND TLP'S.

SHOULD YOU REQUIRE FURTHER INFORMATION, WE WOULD BE HAPPY TO RESPOND TO SPECIFIC QUESTIONS.

REGARDS,

RICHARD AY
BRIAN WATT ASSOCIATES, INC.

RA/RT

Time: 13:38 09/02/83 ???
Connect Time : 320 seconds

danish hydraulic institute affiliated to The Danish Academy of Technical Sciences
Agern Allé 5, DK-2970 Horsholm, Denmark · Telephone: 02-86 80 33 · Telegram: Hydroinstitute · Telex: 37402 dhicph dk

Brown & Root Development, Inc.
P.O. Box 1051
Houston
Texas 77251
U.S.A.

May 4, 1984
VJ/BE/B12

Att.: Dr. F. Rajabi

Re.: Questionnaire for Software Capabilities

Dear Sir,

We have examined your questionnaire very thoroughly and have concluded that the format is not relevant for describing the software capabilities available at the Danish Hydraulic Institute. The reason for this is that our programs have been developed and formulated for more general use and exist as individual modules. These modules are then pieced together to form packages for the various specific problems. DHI is at the moment in the process of formulating and developing packages for use in, e.g. pipeline design including environmental conditions, fluid dynamics, and pipeline stability.

The main body of DHI's programs having relation to the objective of the questionnaire comprises the computation of fluid dynamics associated with waves and currents. 2-D and 3-D stochastic as well as deterministic wave theories are available. The interaction between waves and currents can be accounted for and incorporated in the calculation of the fluid dynamics.

These programs can be extended by incorporating the commonly used expressions for predicting hydrodynamic forces on structures. Such analyses have been performed by DHI, e.g. in connection with design of pipelines in the North Sea and the Arabian Gulf.

Furthermore, a programme (DYNPIPE) has been developed for calculating the motion and associated stresses of cylindrical structures exposed to hydrodynamic loading. The Morison equation including the relative kinematics is used to calculate the hydrodynamic forces. Additionally, the forces induced by, e.g. the motion of a laybarge on a pipeline, can be included. The programme uses the finite difference method and works in the time domain. Due to an efficient algorithm the programme is inexpensive to use and has been applied for several problems (pipe laying, tow-out of pipe bundles, bottom tow).

Although DHI is not directly involved in motion and structural analysis of the two types of structures mentioned in your covering letter (semisubs and TLP's), computer programs handling important elements of such analyses are available at DHI.

If you need further information about our capabilities, please do not hesitate to contact us.

Sincerely yours
DANISH HYDRAULIC INSTITUTE

Vagner Jacobsen

EARL AND WRIGHT
CONSULTING ENGINEERS

ONE MARKET PLAZA
SPEAR STREET TOWER
SAN FRANCISCO, CALIFORNIA 94105
415-777-3000

AUSTIN W. EARL
(FEB. 1965)

TELEX
RCA 278484 EANDW UR
WU 34-0502 EANDW SFO

September 15th, 1983

Dr. Farhad Rajabi
P. O. Box 4302
Building 29, Room 1021
Houston, Texas 77210

Dear Dr. Rajabi:

In response to your recent telexes, I have enclosed copies of two Earl and Wright brochures that provide general information concerning Earl and Wright computer programs applicable to tension leg platform, semi-submersibles, and other compliant and/or floating structure motion and structural analysis. Please note that the program name "COSMOS" is for internal Earl and Wright use only; new brochures are being prepared for distribution outside of Earl and Wright. The COSMOS program has now been officially named "EW/ICES" and consists of the following facilities: EW/STRUDL (linear and nonlinear), OFFSHORE, REPORT, GRAPHICS, and NAVAL ARCHITECTURE. The SEADYN, OPUS, IMPRESS, and SMACS programs are being phased out.

Because of the proprietary nature of Earl and Wright software, I am not able to make available to you User's Manuals or Theoretical Manuals. Earl and Wright software is available through standard agreements. All principal Earl and Wright programs are thouroughly validated against analytical checks, against other programs if available, and compared to experimental data if available.

Respectfully,

EARL AND WRIGHT

Bruce E. Bennett, Ph.D.
Supervising Development Engineer

BEB:beb
Encl.

HOUSTON OFFICE: SUITE 200, EAST TOWER, EXECUTIVE PLAZA, 4615 SOUTHWEST FREEWAY, HOUSTON, TEXAS 77027
TELEPHONE 713-966-3100 TELEX 77-3498
A SUBSIDIARY OF SEDCO, INC.

GLOBAL MARINE DEVELOPMENT INC.

P.O. BOX 3010
NEWPORT BEACH, CALIFORNIA 92663

TELEPHONE: 714-752-5050
TELEX: 69-2316
CABLE: GLOMARCO - NpBh
OFFICE: 2302 MARTIN ST.
IRVINE, CA 92715

In reply, refer to:

975-0000
543-83-10-170

10 August 1983

Mr. Farhad Rajabi
Brown & Root, Inc.
P.O. Box 4302
Building 2A, Room 1021
Houston, Texas 77210

Dear Mr. Rajabi:

Thank you for considering Global Marine Development Inc. in your survey. However, due to current work loads, we will not be able to participate in the survey at this time.

Sincerely yours,

GLOBAL MARINE DEVELOPMENT INC.

N. Daoud

N. Daoud, Ph.D.

ND/ln

GLOBAL MARINE DEVELOPMENT INC.

P.O. BOX 3010
NEWPORT BEACH, CALIFORNIA 92663

TELEPHONE: 714-752-5050
TELECOPIER: 714-851-8182
TELEX: 69-2316
CABLE: GLOMARCO - NpBh
OFFICE: 2302 MARTIN ST.
IRVINE, CA 92715

16 September 1983

In reply, refer to:
975/0000
543-83-09-220

Dr. Farhad Rajabi
Brown & Root, Inc.
P.O. Box 4302
Building 29, Room 1021
Houston, Texas 77210

Dear Dr. Rajabi:

Thank you for your telex dated 14 September 1983. A letter was sent in reply to your first telex dated 9 August 1983 (refer to my reference number 543-83-10-170 dated 10 August 1983).

I wish to thank you for considering Global Marine Development Inc. in your survey. However, due to current work loads, we will not be able to participate at this time.

If I may be of further assistance in the future, please do not hesitate to contact me.

Sincerely yours,

GLOBAL MARINE DEVELOPMENT INC.

Nabil Daoud

N. Daoud, Ph.D.

ND/ln

Richard J. Hartman, Ph.D.
Ocean Engineering Consultant

1433 West 13th Avenue
Anchorage, Alaska 99501
(907) 279-8176

530 North Midway Drive, Suite 3
Escondido, California 92027
(~~744~~ 619) 489-9019

February 22, 1984

Dr. Farhad Rajabi
Brown & Root Development, Inc.
P.O. Box 1051
Houston TX 77251

Dear Dr. Rajabi:

Thank you for your interest in SEMISIM. As you will note from the enclosed preliminary promotional material, this program is not expected to be available untill late this year. I am unable, therefore, to provide you with all the material you requested. The following comments correspond to your own itemized list:

1. General... See the enclosed promotional material.

2. Theory... A considerably enhanced Froude-Krylov model which does not account for member interactions. Surface effects of submerged hulls are accounted for approximately by modifications to the hull added masses only. The model is equivalent to a two-dimensional strip theory for the submerged hulls.

3. Users Manual... Unavailable at present.

4. Availability... See enclosed promotional material.

5. Validation... The analytical model was developed in parallel with an intensive program of semisubmersible model testing oriented toward the development of heave, pitch and roll suppression systems for these vessels. There have been, therefore, ample model test comparisons, but unfortunately the test results are proprietary. I expect to chase down some public domain data for comparison and inclusion in the users manual when the microcomputer version of the program is ready.

6. Applicability... The program is specially designed for semisubmersibles in the ballasted (hulls submerged) condition and is not suited for other structures, although it could rather easily be upgraded to incorporate a TLP analysis.

If I can provide further information, please let me know.

Sincerely,

Rich Hart

Richard Hartman
Escondido, California

LIBRARY CONTENTS

The current program library contents follow. Expected release dates of unfinished volumes are indicated in brackets. [A] indicates immediate availability.

- Volume 1: SHIPSIM - simulates motions of and loads on displacement-hull vessels in regular and irregular waves. [A]

- Volume 2: JACKSIM - simulates motions of and loads on jack-up drilling platforms while afloat and during setting-down operations. Computes leg loads incurred during initial bottom contact in a seaway. [August 1984]

- Volume 3: SEMISIM - simulates motions of and loads on semisubmersible platforms in the ballasted condition (displacement hulls submerged). [September 1984]

- Volume 4: DISCSIM - simulates motions of and loads on disc-shaped vessels and buoys which are azimuthally symmetric in plan view. [A]

- Volume 5: TOWSIM - simulates motions of and loads on each of a pair of vessels connected by a towline of arbitrary composition. Computes towline dynamic load variations. [June 1984]

- Volume 6: SALMSIM - simulates the motions of and loads on complex single-point mooring systems with attached storage vessels. [A]

- Volume 7: STATMOOR - computes the lateral static restoring characteristics of complex multileg catenary mooring systems and related single- or multi-line anchoring systems. [A]

- Volume 8: DYNMOOR - computes the wave-frequency load variations in a submerged catenary for arbitrary motions of the upper endpoint. [October 1984]

- Volume 9: STATSALM - computes the lateral static restoring characteristics of articulated single-point mooring systems, including buoyant SALMS and pendulum-type systems. [A]

- Volume 10: DYNSALM - computes the wave-frequency load variations on a submerged, articulated single-point mooring system. [A]

- Volume 11: SLOMOOR - computes the static and low frequency environmental forces on and resulting motions of storage vessels in a single-point moor. [A]

- Volume 12: ARCHIMEDES - computes the hydrostatic and damage stability properties of displacement-hull, semisubmersible, and jack-up vessels. Also computes important dynamic characteristics such as the natural periods of roll, pitch and heave. [July 1984]

- Volume 13: DRAGSIM - computes the combined form drag, skin friction and wave-making drag for a broad spectrum of surface vessels ranging from high speed planing craft to low speed displacement hull vessels. [December 1984]

- UPLOT - a "universal" plotter which produces report-quality x-y engineering plots at a console or on a standard line printer. [A]

Versions of these programs are available to run under most popular micro- and minicomputer and mainframe operating systems, including DEC, H-P, CP/M, MS-DOS, UNIX and others. In addition, SeaSoft will customize any of the library volumes to accommodate special needs or to incorporate unusual or proprietary features and capabilities into the packages.

More detailed descriptions, including user manuals and demonstration diskettes for individual program packages, are available upon request. For further information regarding individual program units or license of library volumes, contact SeaSoft Systems, (619) 489-9019. P.O. Box 271308, Escondido, Ca. 92027.

VESSEL MOTION PACKAGES:

All vessel motion packages include the following REGULAR WAVE capabilities:

- Complete user control over regular wave heights, slopes, periods and directions used in the calculation of regular wave response characteristics (RAO's).

- Complete user control over the regular wave output stream which allows suppression or inclusion of

  * Net Regular Wave Force and/or Torque responses for any or all six degrees of freedom.

  * Regular Wave Motion response for any or all six degrees of freedom.

  * Acceleration, velocity or displacement response characteristics at user-specified points fixed in or on the vessel.

- Complete output of both amplitude and phase of regular wave response characteristics for all requested regular wave conditions and all requested output variables.

All vessel motion packages include the following IRREGULAR WAVE capabilities:

- Complete user specification of wave spectral type, including

  * Pierson-Moskowitz

  * Mean, Sharp and Very Sharp JONSWAP

  * Bretschneider/ISSC

  * User-Specified

- Calculation of significant values, significant rates and characteristic spectral periods of all requested force, torque, acceleration, velocity, displacement or vessel motion variables.

- User specification of the degree of azimuthal spreading of irregular wave energy; i.e., the degree of wave crest shortening due to cross seas. This leads to the faithful simulation of operations in short-crested irregular waves.

- User specification of simultaneous background swell period, height and direction.

Where appropriate, all motions packages produce wave-height dependent RAO's, reflecting important nonlinear effects associated with hydrodynamic damping.

GENERAL FEATURES:

All SeaSoft program packages include the following features and capabilities:

- A data entry and editing program (the "editor") which provides a simplified user interface to the main computational program. This feature permits input files, once created with the editor, to be easily modified to account for major or minor errors or changes. The editor program utilizes an easy-to-use question and answer format for data entry and update. The input files can be archived and reused any number of times. BacKup files are made each time an input file is modified, facilitating the archival process and protecting against inadvertent loss of important data.

- Input/output of data in either English or metric units.

- Complete control over simulation water depth, with full accommodation of all shallow-water wave effects. Most programs based on two- or three-dimensional diffraction theories neglect this important consideration which is essential for many, if not most, offshore applications. For example, shallow water effects will typically begin to become important in 300 feet of water when wave periods exceed 14 seconds or when wind-driven seas exceed a significant wave height of about 30 feet. These conditions are well within the probable scope of any moderately comprehensive vessel motion study. In drilling, jack-up or single point mooring applications, water depths considerably less than 300 feet are extremely commonplace.

- Complete six-degree-of-freedom motion and load analysis and determination of acceleration, velocity or displacement response characteristics at any point on the vessel. The latter ability greatly facilitates many important engineering calculations. For example:

  * dynamic mooring loads due to fairlead motions, velocities and accelerations

  * vessel motions relative to a fixed platform or crane load

  * jacK-up spud can motions relative to the fixed bottom while going on location

- Attractive formatted tabular output is provided on standard 8 1/2 x 11 inch sheets for easy inclusion in reports or other documentation.

- PacKages are written in a transportable high-level language (typically ANSI-standard FORTRAN) which allows the programs to be easily installed on any computer for which a suitable compiler is available. All code has been carefully optimized to execute efficiently on microcomputers.

- Each pacKage features complete output control, allowing user selection of which variables should be output for each run and the specification of output device (console, printer or magnetic disK).

- All pacKages can utilize SeaSoft's universal plotting routine to produce report quality x-y point plots of selected tabular data.

All SeaSoft software is available on a limited license basis which permits unlimited single-CPU use of the pacKages but prohibits resale or transfer. License purchasers are provided bug reports and fixes free of charge for the duration of the license. The signing of a simple license agreement is required prior to license approval.

SEASOFT SYSTEMS' OFFSHORE ENGINEERING COMPUTER PROGRAM LIBRARY:

EXECUTIVE SUMMARY

The SeaSoft family of computer programs comprises a growing group of stand-alone state-of-the-art analysis packages for ocean engineering applications.

AUDIENCE:

The intended audience for the software includes naval architects and marine engineers engaged in offshore operations or design. No special analytical, computational or computer skills are required to make full use of these tools. In particular, user interface to every program employs simple question-and-answer prompting procedures to accomplish data input and program execution.

PHILOSOPHY:

The program library was developed to investigate problems of the type that are commonly studied in model tests; that is, the emphasis is on producing operationally useful data such as motions, accelerations, loads and extensive short- and long-crested irregular wave statistical summaries as opposed to esoteric data of limited operational value such as added-mass and damping matrices.

MICROCOMPUTER EXECUTION ABILITY:

Each program is highly transportable and has been carefully engineered to execute efficiently on the newest generation of portable and desk-top micro- and minicomputers. This means that the same programs used in the office on a multi-user mainframe computer can be executed in the field for on-site operational support. The continuing collapse of microcomputer prices assures that in a very short time, every engineer and naval architect will have on his desktop a powerful, dedicated computer. The family of SeaSoft simulation programs will readily and efficiently execute on this new generation of computer, and will be totally transportable from generation to generation as microcomputer technology matures. It must be emphasized that microcomputer execution ability has been achieved by careful program planning, and not by sacrifice of program capabilities; in every case, the SeaSoft programs are of greater power than comparable codes requiring mainframe computers for their execution. For example, all packages fully incorporate shallow water wave effects on vessel motions which, although extremely important for many offshore applications, are neglected in many mainframe vessel motions programs.

COMPREHENSIVE USER MANUALS:

Each program is supplied with a comprehensive user manual which outlines the use of the program and explains in detail its capabilities. For tutorial purposes, the manuals contain a detailed sample input/output session comprising a realistic application. All manuals contain a table of contents, glossary and index.

CODE COMMONALITY:

All programs share, insofar as possible, the same input/output formats and nomenclature conventions so that the user of any one of the programs will easily be able to use and interpret input procedures for and results from any other program.

AUTHOR QUALIFICATIONS:

The author of the SeaSoft program library holds the Ph.D. degree in theoretical physics from the University of California and post-graduate degrees in aero- and hydrodynamics from the University of Minnesota. He has been directly involved in mathematical and computer analysis and model testing of offshore systems since 1973. The SeaSoft program library is the result of over fifteen years of combined theoretical and model basin experience in hydrodynamics and ocean engineering. The basic theoretical methods employed in the packages have received extensive confirmation in model-scale and full-scale tests during that time.

SEASOFT SYSTEM'S OFFSHORE ENGINEERING COMPUTER PROGRAM LIBRARY:

PROGRAM DESCRIPTIONS AND CAPABILITIES

This material is intended to supplement the EXECUTIVE SUMMARY with some additional details and description of the capabilities of specific volumes in the program library. Unless expected release dates are specified, the programs below are available immediately.

Volume 1: SHIPSIM

SHIPSIM is a general-purpose vessel motions program with specific adaptations to displacement-hull vessels with relatively large block and prismatic coefficients. Vessels in this category include drillships, barges and moored tankers. SHIPSIM produces excellent results for this category of vessels even when length-to-beam ratios are too small to permit the use of strip theory programs for motion analysis. Although designed primarily for the analysis of barge-shaped vessels at zero speed, SHIPSIM is also suitable for simulation of vessels with finer lines and non-zero forward speed.

SHIPSIM utilizes an efficient algorithm for the calculation of wave-frequency forces and torques which allows relatively fast program execution even on microprocessors.

SHIPSIM incorporates an algorithm for the estimation of non-linear effects in roll which leads to realistic nonlinear roll response functions depending upon details of bilge geometry.

An enhanced version of SHIPSIM which simulates the performance of commonly employed anti-roll devices is expected to be available in late 1984.

Volume 2: JACKSIM

JACKSIM is a powerful motion simulator for analysis of motions of jack-up drilling vessels in the floating mode. In addition to the six-degree-of-freedom afloat motions capabilities common to all SeaSoft motion simulations, this package includes:

- A sophisticated analysis of the dynamic leg loads associated with going on location in the presence of waves. This feature includes specification of ocean bottom soil conditions. The leg-load estimation capability provides an important new tool for the operational engineer or marine surveyor. This capability aids in the quantification of the difficult and highly subjective process of evaluating structural risks associated with going on location in marginal sea conditions. The ease of use and the microcomputer execution capability of this program mean that the program load estimates can be obtained in real time, on location, by the engineer or surveyor in charge.

- A novel calculation of leg bending loads incurred going off location in the presence of waves when one or more legs are trapped or otherwise restrained by entrapment in soft bottom materials.

- A nonlinear hull and leg damping algorithm which leads to realistic nonlinear response functions.

- Evaluation of vessel motion characteristics for any position of the legs, from fully raised to fully lowered, and specification of the degree of leg-well blockage by spud can insertion during tow or other legs-elevated operations.

Expected release date: third quarter 1984.

Volume 3: SEMISIM

SEMISIM is a semisubmersible motion simulation package for use in the non-transit, hulls-submerged mode. The computed response characteristics reflect the highly nonlinear nature of motion damping for this type of vessel. Features include simplified input of column and hull forms based on the use of simple geometrical shapes. This permits quick specification and easy modification of the underwater configuration for comparative design and performance analysis and evaluation. Expected release date: third quarter 1984.

Volume 4: DISCSIM

DISCSIM is a complete vessel motion simulation for the special case of azimuthal hull symmetry. This simulation is thus suited for the estimation of buoy motions and loads in single-point mooring applications and for round geometries associated, in particular, with operations in the presence of persistent ice.

Volume 5: TOWSIM

TOWSIM computes the relative wave-frequency motions of a pair of connected vessels for the purpose of calculating wave-frequency loads in the interconnected towline. The characteristics of the towline, including the mass and elastic properties of each element of a multi-element towline, are fully specifiable. The towline load calculation, unlike the quasi-static catenary calculation which is often erroneously applied in this situation, is fully dynamic and utilizes a proprietary algorithm for the fast and efficient calculation of the dynamic plus static loads. Long-period oscillations of the two-vessel system are also characterized and contributions to the long-period motions from low-frequency components of variable wind and wave-drift force are computed. Expected release date: second quarter 1984.

Volume 6: SALMSIM

SALMSIM is a composite of several SeaSoft programs used in design and evaluation of single-point mooring systems with an attached storage vessel. Separate simulation modules compute zero-frequency (static), low-frequency (quasi-static) and wave-frequency (dynamic) properties of the vessel and its associated mooring structure. A typical configuration for SALMSIM consists of STATSALM, SLOMOOR, DYNSALM and SHIPSIM cooperatively and automatically executing to provide motion and load RAOs and low-and high-frequency statistical summaries of motions and loads for an articulated Salm system. Loads are computed at each articulation point; the Salm elements themselves are assumed to be rigid for the purposes of computing motion amplitudes and associated loads. Extensive capabilities for computation of long-period surge of the moored storage vessel and associated Salm loads under the influence of slowly-variable wind, current and wave-drift forces are provided by SLOMOOR. SALMSIM versions accommodating both conventional buoyant Salms and more recent designs based upon pendular masses are available.

Volume 7: STATMOOR

STATMOOR is a comprehensive, state-of-the-art static mooring analysis program for multileg catenary mooring systems. The program overcomes certain analytical shortcomings of existing mooring analysis codes, discussed below, and is used in design and analysis of complex single-vessel multi-point mooring systems.

In developing STATMOOR, special attention was given to several areas in which many well-known mooring codes are deficient. The most notable of these areas is the treatment of elasticity of mooring elements. Many modern mooring materials, in particular the synthetics, are notable in that their gravitational response to imposed loads is smaller than or comparable to their elastic response. In particular, methods employed to approximately account for the small elastic distortion of chain or wire rope under mooring conditions become inadequate in many situations of possible interest, especially when elasticity plays a dominant role. In some cases, commonly-employed approximations to elastic response can result in errors as great as 100% in the predicted line loads and mooring forces.

STATMOOR utilizes a proprietary, analytically exact, solution to the elasto-gravitational static response of mooring line elements; it appears to be the only publicly-available code to do so. In addition, the exact equations employed in the code apply to arbitrary degrees of nonlinearity in the tension-elongation characteristics for the mooring line elements, permitting the analysis of strongly non-linear materials.

STATMOOR provides extensive on-line default values for the weight, strength and elastic properties of steel and synthetic mooring materials to enhance efficiency in preliminary parametric design studies.

STATMOOR is extremely flexible, and is useful in the analysis of virtually any system for which elastic lines or cables play a central role. Examples of non-conventional applications include tension-offset characteristics for composite towlines and for composite rubber hoses used in offshore production facilities, surge and yaw restoring characteristics and tendon tensions for tension leg platforms and guyed towers, and restoring force characteristics for submerged tethered buoys and Salms.

The capabilities of STATMOOR follow:

- Up to twenty-four individual mooring lines can be accommodated (12 mooring lines on some microcomputer versions).

- Each mooring line may consist of up to three independent sublines. Each subline can have specifiable mass characteristics and non-linear elastic characteristics.

- A concentrated weight and/or line support buoy can be specified between appropriate sublines.

- The ocean bottom may be uniformly sloping, or anchor depths may be independently specified.

- Either fairlead pretensions, pretension line angles or horizontal distances to anchors may be specified for a given length of deployed line.

- System and individual line characteristics (net restoring force, line tensions, suspended lengths, etc.) are output in tabular form for horizontal offsets of any magnitude in any direction, and for yaw offsets.

Volume 8: DYNMOOR

DYNMOOR is being developed in response to the extreme need in the offshore industry for a realistic simulation of the dynamic effects arising from wave-frequency motions of the fairleads of a moored vessel. It is clear from an analysis of this problem, as has been verified in model tests, that the dynamic contribution to mooring line loads for a given displacement of a mooring line fairlead at wave frequencies can exceed the level which would be predicted on the basis of a static catenary model of the mooring line by factors of up to ten, and even more in some circumstances.

Previous attempts to quantify this effect have taken the form of a finite-element analysis of an individual mooring line, which analysis is so computationally intensive that little more than one or two cycles of wave-frequency analysis can be carried out in a reasonable amount of time even on a powerful mainframe computer. SeaSoft has solved this problem in a way which allows line loads to be obtained for both regular and irregular waves, even on a microcomputer.

The design of an offshore mooring system is wholly incomplete without a thorough investigation of the level of mooring line loads to be expected in the environmental conditions projected for the application. DYNMOOR provides this capability for wire rope, chain, synthetic and composite mooring lines. Expected release date: third quarter 1984.

Volume 9: STATSALM

STATSALM comprises a powerful design tool which can be used to quickly evaluate a large number of design options in a search for a Salm configuration satisfying the static restoring requirements of a particular project. STATSALM permits specification of Salm geometrical and inertial properties at either of two levels of detail: 1) the input of mass and volumetric variables (mass, buoyancy, centers of gravity and buoyancy, etc.) for an entire Salm articulated member or 2) the specification of those properties for each of a series of rigidly-connected elements, or sub-members, of a single articulated member. In the latter case, STATSALM computes global properties for the entire member from properties of the sub-member elements. STATSALM also provides support for dynamic analysis by evaluating added-mass and other hydrodynamic properties of the articulated members. STATSALM is capable of evaluating the static properties of either buoyant Salm structures or pendular Salm structures which utilize suspended weights, rather than buoyant members, to provide restorative forces.

Volume 10: DYNSALM

DYNSALM computes wave-frequency loads on an articulated Salm, plus inertial, hydrodynamic and quasi-static loads associated with wave-frequency motions of the attached vessel. These loads, and their associated motions, are computed for each rigid member of the Salm and resolved at each articulation point. A version of DYNSALM applicable to recently introduced pendular weight Salm systems is also available.

Volume 11: SLOMOOR

SLOMOOR is a versatile single-point mooring analysis module which computes a moored vessel's static equilibrium configuration and low-frequency, or quasi-static, motions. In this context "low-frequency" refers to motions which occur on a time scale that is very much longer than wave periods (i.e. greater than 20 seconds or so). The natural period of mooring oscillations is computed, as are static and slowly-varying components of forces arising from currents, wind and waves acting on the storage vessel. This information is used to compute equilibrium position and orientation of the vessel relative to the mooring structure in the prescribed environmental conditions and to estimate the amplitude of long-period (low-frequency) motions of the moored vessel in response to slowly-varying forces.

Volume 12: ARCHIMEDES

ARCHIMEDES is a powerful hydrostatics and stability package which has been designed from the outset to meet all the needs of the naval architect and marine engineer. It permits easy preparation of the finite-element gridwork used to define an arbitrary vessel geometry and allows arbitrary changes to be made in the geometry at a later time.

ARCHIMEDES provides the following capabilities:

- Definition of an arbitrary, asymmetrical hull and definition of unusual shapes which facilitate the evaluation of jack-up and semisubmersible vessels in addition to more conventional hull types.
- Simple specification of appendages, open channels and other hull peculiarities.
- Options for output of individual station data, including bonjeans, moments and wetted girth at specified drafts.
- Calculation of hydrostatic curves and cross curves.
- Determination of intact and damaged stability with complete freedom in the selection of flooded compartments.
- User choice of conventional fixed-trim or free-to-trim stability determinations.
- Evaluation of flooded length characteristics.
- Independent specification of free-surface moment permeability and volumetric permeability for flooded compartments.
- Careful handling of end effects when the waterline falls between specified longitudinal sections. This virtually eliminates errors due to large-angle trim conditions or severly tapered (swim) bow/stern configurations.

Expected release date: third quarter 1984.

Volume 13: DRAGSIM

DRAGSIM is a vessel resistance package which spans the range from low-speed displacement-hull vessels to high speed planing craft. Algorithms appropriate to the hull shape/speed combination are selected by the program and speed-power characteristics are output for the requested range of Froude number. The various components of resistance, from skin friction to wave-making, are available as output options. For planing craft, determination of hydrodynamic parameters including trim, wetted length and porpoising stability are available as output options. Expected release date: fourth quarter 1984.

UPLOT

UPLOT is a universal interactive plotting package which provides report-quality computer-independent plotting capabilities. This program can be used with all of the SeaSoft simulation packages. Furthermore, it will accept a formatted input file which can produce plots from any user program, including programs written in FORTRAN, BASIC, PASCAL, C, MODULA 2 or any other language sufficiently sophisticated to produce a formatted disk file. Features of the package include interactive scale manipulation, multiple plots per graph and a sophisticated curve smoothing routine. Plots can be vectored either to the console for viewing or scale modification, or to the line printer.

TYPICAL APPLICATIONS

Some typical applications of the SeaSoft program library follow.

- CONSEQUENCES OF VESSEL RELOCATIONS:

  * A drilling vessel moves from an area, such as the North Sea, where wave spectra are typically sharply peaked to an area, such as offshore Africa, with wave energy generally spread over a larger frequency bandwidth; how will motion-related downtime be affected by the move? [SHIPSIM]

  * A ocean-going barge under tow moves from an area with wave conditions dominated by intense, locally generated wind driven waves into an area with wave conditions dominated by heavy, unidirectional swell from a distant storm. Can towline tension oscillations be reduced by playing out or taking home towline or by a slight temporary alteration in course? [TOWSIM]

  * A jack-up moves from an area subjected to moderate local wind-driven sea conditions but protected from distant swell to a location exposed to long-period swell; what quantitative difference in motion performance afloat and during leg installation can be expected? [JACKSIM]

  * A crane barge moves outside the exposed mouth of a sea-facing channel from inside the channel proper; how will crane motions and accelerations be affected by the deeper water and the increased directional spreading of the seas at the new location? [SHIPSIM]

- PARAMETRIC ANALYSES:

  * Screening of possible SALM designs (i.e., weight and buoyancy distribution) to achive minimal dynamic load variations; perhaps in preparation for a model basin analysis of a single candidate. [SALMSIM]

  * Screening of various combinations of Kevlar, wire rope and chain to achieve, at a minimum materials cost, a prescribed load versus offset curve for a deep water catenary leg mooring system design. [STATMOOR]

  * Screening of CALM buoy designs to achieve minimum average fairlead motions in the presence of persistent eight to ten second swell conditions. [DISCSIM]

The appropriate SeaSoft library programs can quickly evaluate the above situations and provide valuable guidance to system designers, analysts and operations people alike. Vessel performance in the complete range of possible sea conditions for a given site or route can be thoroughly investigated by engineering staff. Parametric studies of the effects on performance of vessel load conditions, irregular wave spectral composition, the effects of cross seas and background swell can be carried out entirely in-house. A single such study, if contracted through an outside consultant, would almost certainly prove to be more costly than the purchase of a single SeaSoft unlimited-use software license.

MISCELLANEOUS

The following pages include miscellaneous material which we hope will provide some further insight into the SeaSoft software library packages.

1. SHIPSIM users manual table of contents.

2. Selected sample SHIPSIM tabular output pages.

3. SALMSIM users manual table of contents.

4. Selected STATMOOR data plotted using UPLOT.

Table of Contents

SeaSoft Systems' Simulation Library

Volume 1:

Barge-Shaped Vessels and Platforms

SERIES 60 VESSEL
TRIAL SIMULATION

Ship Simulator Version 2.10

I. PHYSICAL CHARACTERISTICS SUMMARY

---- SITE CHARACTERISTICS ----

WATER DEPTH	4000.00 FEET
WATER DENSITY	64.00 LBS/CUBIC FOOT

---- VESSEL CHARACTERISTICS ----

DISPLACEMENT	9256.00 K.LBS
VERTICAL (Z) KB	8.00 FEET
VERTICAL (Z) KG	9.00 FEET
LONGITUDINAL GM	476.00 FEET
TRANSVERSE GM	8.60 FEET
PITCH GYRADIUS	79.00 FEET
ROLL GYRADIUS	15.30 FEET
YAW GYRADIUS	81.00 FEET

---- DYNAMICALLY SIMILAR BOX CHARACTERISTICS ----

BOX LENGTH	271.50 FEET
BOX WIDTH	41.50 FEET
BOX DRAFT	12.84 FEET

```
*                                                                        **
**************  II.  UNMOORED VESSEL MOTION CHARACTERISTICS  **************
*                                                                        **
```

---- NATURAL PERIODS AT ZERO SPEED ----

```
NATURAL ROLL PERIOD ....................   7.1 SECONDS
NATURAL PITCH PERIOD ...................   6.1 SECONDS
NATURAL HEAVE PERIOD ...................   6.3 SECONDS
```

---- QUASI-LINEAR ZERO SPEED DAMPING COEFFICIENTS ----

```
NATURAL ROLL DAMPING ...................   5.8 PERCENT
NATURAL PITCH DAMPING ..................  11.8 PERCENT
NATURAL HEAVE DAMPING ..................  14.7 PERCENT
```

```
REGULAR WAVE SLOPE .....................   3.0 DEGREES
WATER DEPTH ...........................4000.0 FEET
```

**

*************** II. UNMOORED VESSEL MOTION CHARACTERISTICS **************

**

---- REGULAR WAVE DATA: WAVE HEADING = 150.0 DEG
WAVE SLOPE = 3.0 DEG
FORWARD SPEED = .0 FT/SEC

+++ DIMENSIONLESS DRIVING FORCE/TORQUE RAOS +++

JAVE ERIOD SEC)	WAVE LENGTH (FT)	WAVE HEIGHT (FT)	SURGE AM/PHASE	HEAVE AM/PHASE	ROLL AM/PHASE
4.00	82.0	1.37	.02/ -90.2	.00/ 50.4	.00/ -87.3
4.50	103.8	1.73	.06/ -91.3	.01/ 42.5	.01/ -84.3
5.00	128.1	2.14	.06/ 85.8	.02/-144.5	.01/ 98.1
5.50	155.0	2.58	.16/ 81.0	.06/-150.2	.04/ 99.3
6.00	184.5	3.07	.16/ 74.9	.06/-154.7	.04/ 99.3
6.50	216.5	3.61	.07/ 68.8	.03/-158.3	.02/ 98.6
7.00	251.1	4.19	.06/-116.4	.03/ 18.9	.01/ -82.5
7.50	288.3	4.80	.22/-120.2	.10/ 16.5	.06/ -83.6
8.00	328.0	5.47	.37/-122.8	.18/ 14.6	.12/ -84.7
8.50	370.3	6.17	.50/-124.2	.26/ 12.9	.16/ -85.6
9.00	415.1	6.92	.61/-124.8	.32/ 11.5	.21/ -86.4
9.50	462.5	7.71	.70/-124.6	.38/ 10.2	.24/ -87.1
.00	512.5	8.54	.77/-123.9	.44/ 9.2	.28/ -87.6
..50	565.0	9.42	.83/-122.9	.49/ 8.2	.31/ -88.1
11.00	620.1	10.34	.87/-121.5	.53/ 7.4	.34/ -88.4
11.50	677.8	11.30	.89/-120.0	.57/ 6.6	.36/ -88.7
12.00	738.0	12.30	.91/-118.4	.60/ 6.0	.38/ -88.9
12.50	800.7	13.35	.93/-116.7	.63/ 5.4	.40/ -89.1
13.00	866.1	14.43	.94/-114.9	.66/ 4.9	.41/ -89.3
13.50	934.0	15.57	.95/-113.2	.68/ 4.4	.42/ -89.4
14.00	1004.5	16.74	.95/-111.6	.70/ 4.0	.44/ -89.5
14.50	1077.5	17.96	.96/-110.0	.72/ 3.7	.45/ -89.6
15.00	1153.1	19.22	.96/-108.5	.74/ 3.3	.46/ -89.7
15.50	1231.2	20.52	.96/-107.1	.75/ 3.0	.46/ -89.7
16.00	1311.9	21.87	.97/-105.8	.77/ 2.8	.47/ -89.8
16.50	1395.2	23.25	.97/-104.6	.78/ 2.5	.48/ -89.8
17.00	1481.1	24.68	.97/-103.5	.79/ 2.3	.48/ -89.8
17.50	1569.5	26.16	.97/-102.4	.80/ 2.1	.49/ -89.8
18.00	1660.4	27.67	.97/-101.5	.81/ 1.9	.50/ -89.9
18.50	1754.0	29.23	.98/-100.6	.82/ 1.8	.50/ -89.9

---- REGULAR WAVE FORCE/TORQUE SCALE FACTORS ----

SURGE	....	167.7 KIPS/DEG
SWAY	....	167.7 KIPS/DEG
HEAVE	....	748.8 KIPS/FT
ROLL	....	1442.6 FT-KIPS/DEG
PITCH	....	79847.1 FT-KIPS/DEG
YAW	....	79847.1 FT-KIPS/DEG

**
*************** II. UNMOORED VESSEL MOTION CHARACTERISTICS *************
**

---- REGULAR WAVE DATA: WAVE HEADING = 150.0 DEG
WAVE SLOPE = 3.0 DEG
FORWARD SPEED = .0 FT/SEC

+++ QUASI-LINEAR RESPONSE RAOS (S.A./S.A.) +++

JAVE ERIOD SEC)	WAVE LENGTH (FT)	WAVE HEIGHT (FT)	SURGE (FT./FT.) AM/PHASE	HEAVE (FT./FT.) AM/PHASE	ROLL (DEG/DEG) AM/PHASE
4.00	82.0	1.37	.02/ 89.8	.00/-110.3	.00/ 98.2
4.50	103.8	1.73	.05/ 88.7	.01/-112.1	.00/ 102.8
5.00	128.1	2.14	.05/ -94.2	.02/ 69.8	.01/ -72.6
5.50	155.0	2.58	.14/ -99.0	.13/ 78.4	.06/ -68.0
6.00	184.5	3.07	.13/-105.1	.20/ 96.9	.10/ -61.8
6.50	216.5	3.61	.06/-111.2	.11/ 122.7	.08/ -48.3
7.00	251.1	4.19	.05/ 63.6	.09/ -35.7	.16/ 173.6
7.50	288.3	4.80	.19/ 59.8	.29/ -22.6	.44/-130.0
8.00	328.0	5.47	.31/ 57.2	.44/ -15.0	.49/-110.3
8.50	370.3	6.17	.43/ 55.8	.56/ -10.4	.51/-103.2
9.00	415.1	6.92	.52/ 55.2	.65/ -7.5	.53/ -99.9
9.50	462.5	7.71	.60/ 55.4	.71/ -5.5	.54/ -98.0
00	512.5	8.54	.66/ 56.1	.76/ -4.2	.55/ -96.9
.50	565.0	9.42	.71/ 57.1	.81/ -3.2	.56/ -96.1
11.00	620.1	10.34	.74/ 58.5	.84/ -2.5	.57/ -95.6
11.50	677.8	11.30	.77/ 60.0	.86/ -2.0	.57/ -95.2
12.00	738.0	12.30	.78/ 61.6	.89/ -1.6	.57/ -94.8
12.50	800.7	13.35	.80/ 63.3	.90/ -1.3	.58/ -94.6
13.00	866.1	14.43	.80/ 65.1	.92/ -1.1	.58/ -94.3
13.50	934.0	15.57	.81/ 66.8	.93/ -.9	.58/ -94.1
14.00	1004.5	16.74	.82/ 68.4	.94/ -.7	.58/ -93.9
14.50	1077.5	17.96	.82/ 70.0	.95/ -.6	.58/ -93.8
15.00	1153.1	19.22	.82/ 71.5	.95/ -.5	.58/ -93.6
15.50	1231.2	20.52	.83/ 72.9	.96/ -.4	.58/ -93.5
16.00	1311.9	21.87	.83/ 74.2	.96/ -.4	.58/ -93.3
16.50	1395.2	23.25	.83/ 75.4	.97/ -.3	.58/ -93.2
17.00	1481.1	24.68	.83/ 76.5	.97/ -.3	.58/ -93.1
17.50	1569.5	26.16	.83/ 77.6	.97/ -.2	.58/ -93.0
18.00	1660.4	27.67	.83/ 78.5	.98/ -.2	.58/ -92.9
18.50	1754.0	29.23	.84/ 79.4	.98/ -.2	.58/ -92.8

**

*************** II. UNMOORED VESSEL MOTION CHARACTERISTICS **************

**

---- REGULAR WAVE DATA: WAVE HEADING = 150.0 DEG
WAVE SLOPE = 3.0 DEG
FORWARD SPEED = .0 FT/SEC

+++ ACCELERATION RAOS IN FT/SEC**2 PER UNIT WAVE AMP. (S.A./S.A.) +++

	---- COORDINATES ---- (150.0, .0, 17.0)			---- COORDINATES ---- (-150.0, .0, 17.0)		
VE RIOD EC)	X COMP AM/PHASE	Y COMP AM/PHASE	Z COMP AM/PHASE	X COMP AM/PHASE	Y COMP AM/PHASE	Z COMP AM/PHASE
4.00	.07/ 92	.23/ -11	.08/ -81	.07/ 92	.23/-163	.07/ 104
4.50	.09/ 81	.19/-148	.09/ 127	.09/ 81	.20/ -30	.14/ -76
5.00	.17/ -68	.31/ 161	.44/ 126	.17/ -68	.28/ 14	.40/ -43
5.50	.21/ -81	.26/ 115	.31/ 124	.21/ -81	.22/ 81	.25/ 17
6.00	.30/-142	.23/ 65	.72/ 29	.30/-142	.35/ 131	.68/ 173
6.50	.52/-134	.24/ 10	1.39/ 47	.52/-134	.43/ 152	1.36/-141
7.00	.53/-118	.57/ -16	1.50/ 58	.53/-118	.21/ 158	1.52/-115
7.50	.46/-104	.64/ 10	1.39/ 63	.46/-104	.43/ 108	1.43/ -99
8.00	.38/ -91	.48/ 15	1.22/ 65	.38/ -91	.50/ 121	1.25/ -89
50	.32/ -78	.37/ 14	1.05/ 65	.32/ -78	.48/ 127	1.08/ -81
0	.28/ -68	.29/ 13	.89/ 64	.28/ -68	.43/ 131	.92/ -75
9.50	.24/ -59	.24/ 12	.76/ 62	.24/ -59	.38/ 133	.78/ -70
0.00	.21/ -52	.20/ 12	.65/ 59	.21/ -52	.33/ 136	.67/ -65
0.50	.19/ -46	.16/ 12	.56/ 57	.19/ -46	.28/ 137	.57/ -61
1.00	.16/ -42	.14/ 13	.49/ 54	.16/ -42	.24/ 139	.50/ -57
1.50	.14/ -39	.12/ 15	.43/ 51	.14/ -39	.21/ 140	.44/ -54
2.00	.12/ -36	.10/ 16	.38/ 49	.12/ -36	.18/ 141	.38/ -51
2.50	.11/ -34	.08/ 18	.34/ 46	.11/ -34	.16/ 142	.34/ -48
3.00	.09/ -33	.07/ 20	.30/ 44	.09/ -33	.13/ 143	.31/ -45
3.50	.08/ -32	.06/ 21	.27/ 42	.08/ -32	.12/ 143	.27/ -43
4.00	.07/ -31	.05/ 23	.25/ 39	.07/ -31	.10/ 144	.25/ -40
4.50	.06/ -30	.05/ 25	.23/ 37	.06/ -30	.08/ 144	.23/ -38
5.00	.05/ -30	.04/ 26	.21/ 35	.05/ -30	.07/ 144	.21/ -36
5.50	.04/ -29	.04/ 27	.19/ 33	.04/ -29	.06/ 145	.19/ -34
6.00	.04/ -29	.03/ 28	.18/ 32	.04/ -29	.05/ 145	.18/ -32
6.50	.03/ -29	.03/ 30	.16/ 30	.03/ -29	.05/ 145	.16/ -31
7.00	.03/ -29	.03/ 31	.15/ 29	.03/ -29	.04/ 144	.15/ -29
7.50	.02/ -30	.02/ 32	.14/ 27	.02/ -30	.04/ 144	.14/ -28
8.00	.02/ -30	.02/ 33	.13/ 26	.02/ -30	.03/ 144	.13/ -26
8.50	.02/ -30	.02/ 33	.12/ 25	.02/ -30	.03/ 144	.13/ -25

**
**************** III. IRREGULAR WAVE STATISTICS SUMMARY ***************
**

---- ENVIRONMENTAL CHARACTERISTICS ----

WAVE SPECTRAL TYPE -- BRETSCHNEIDER
: SHORT-CRESTED SEAS

POWER OF COSINE IN SPREADING FACTOR	2.00	
CALCULATED SIGNIFICANT WAVE HEIGHT	6.40	FT
SPECTRUM PEAK PERIOD	6.50	SECONDS
CHARACTERISTIC WIND SPEED	29.21	FT/SECOND
DIRECTION OF MAXIMUM SEAS	150.00	DEGREES

+++ BACKGROUND SWELL DATA +++

CALCULATED SIGNIFICANT SWELL HEIGHT	2.99	FT
SWELL DIRECTION	30.00	DEGREES
SWELL PERIOD	11.00	SECONDS

---- VESSEL DYNAMICS SUMMARY ----

+++ SIGNIFICANT SINGLE AMPLITUDE FORCES/TORQUES +++

	SIGNIFICANT VALUE	SIGNIFICANT RATE	CHARACTERISTIC PERIOD (SEC)
SURGE (K.LBS)	179.17	155.11	7.26
HEAVE (K.LBS)	673.60	454.26	9.32
ROLL (K.LBS-FT.)	1457.78	1534.90	5.97

+++ SIGNIFICANT SINGLE AMPLITUDE MOTIONS +++

	SIGNIFICANT VALUE	SIGNIFICANT RATE	CHARACTERISTIC PERIOD (SEC)
SURGE (FT)	1.12	.71	9.94
HEAVE (FT)	1.79	1.39	8.09
ROLL (DEG)	3.95	3.55	6.98

**
**************** III. IRREGULAR WAVE STATISTICS SUMMARY ***************
** **

---- ENVIRONMENTAL CHARACTERISTICS ----

WAVE SPECTRAL TYPE -- BRETSCHNEIDER
: SHORT-CRESTED SEAS

POWER OF COSINE IN SPREADING FACTOR 2.00
CALCULATED SIGNIFICANT WAVE HEIGHT ..... 6.40 FT
SPECTRUM PEAK PERIOD .... 6.50 SECONDS
CHARACTERISTIC WIND SPEED .... 29.21 FT/SECOND
DIRECTION OF MAXIMUM SEAS .... 150.00 DEGREES

+++ BACKGROUND SWELL DATA +++

CALCULATED SIGNIFICANT SWELL HEIGHT .... 2.99 FT
SWELL DIRECTION .... 30.00 DEGREES
SWELL PERIOD .... 11.00 SECONDS

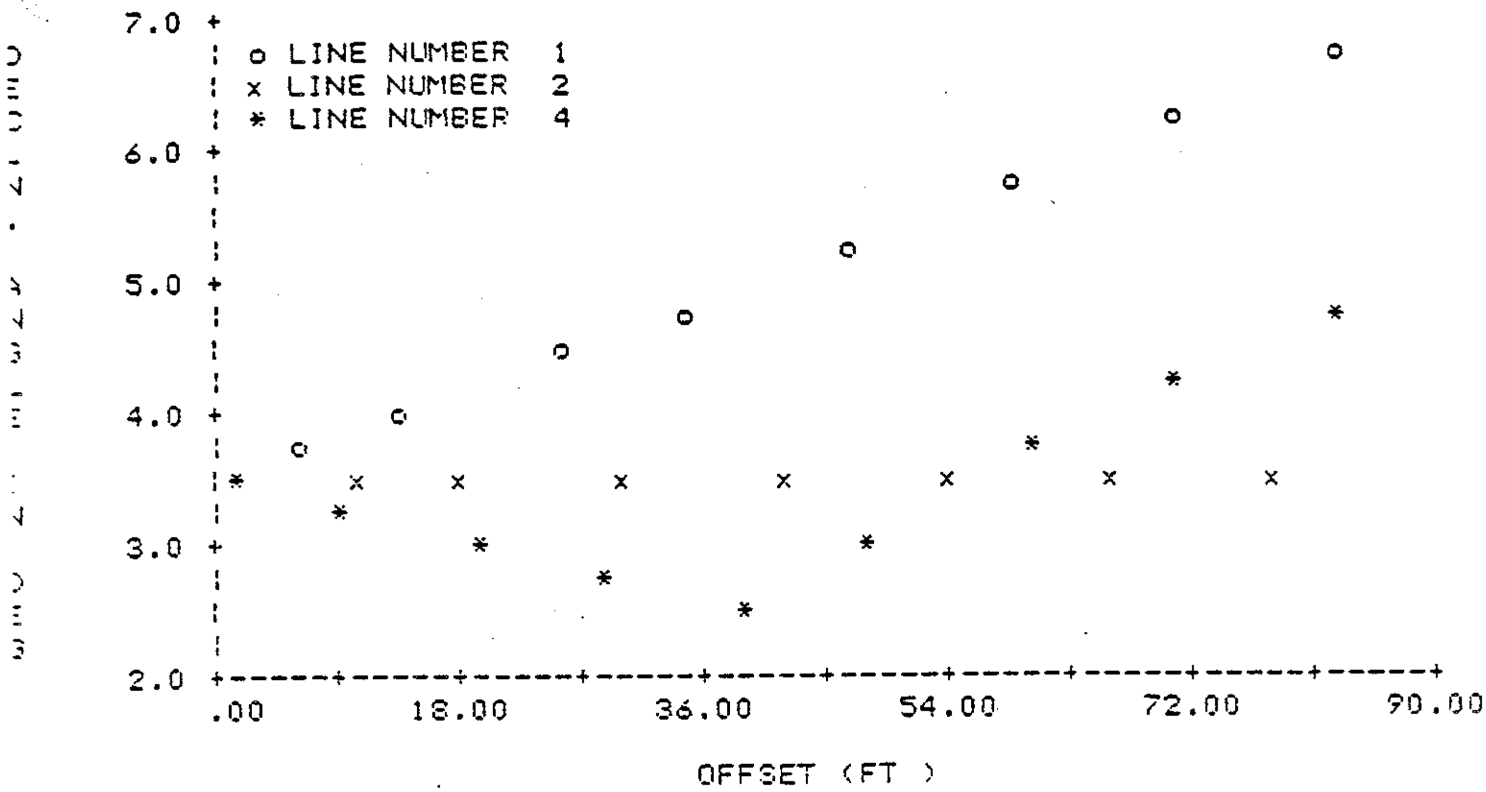
---- LOCAL MOTION SUMMARIES: SELECTED POINTS ----

+++ SIGNIFICANT SINGLE AMP. ACCELERATIONS +++

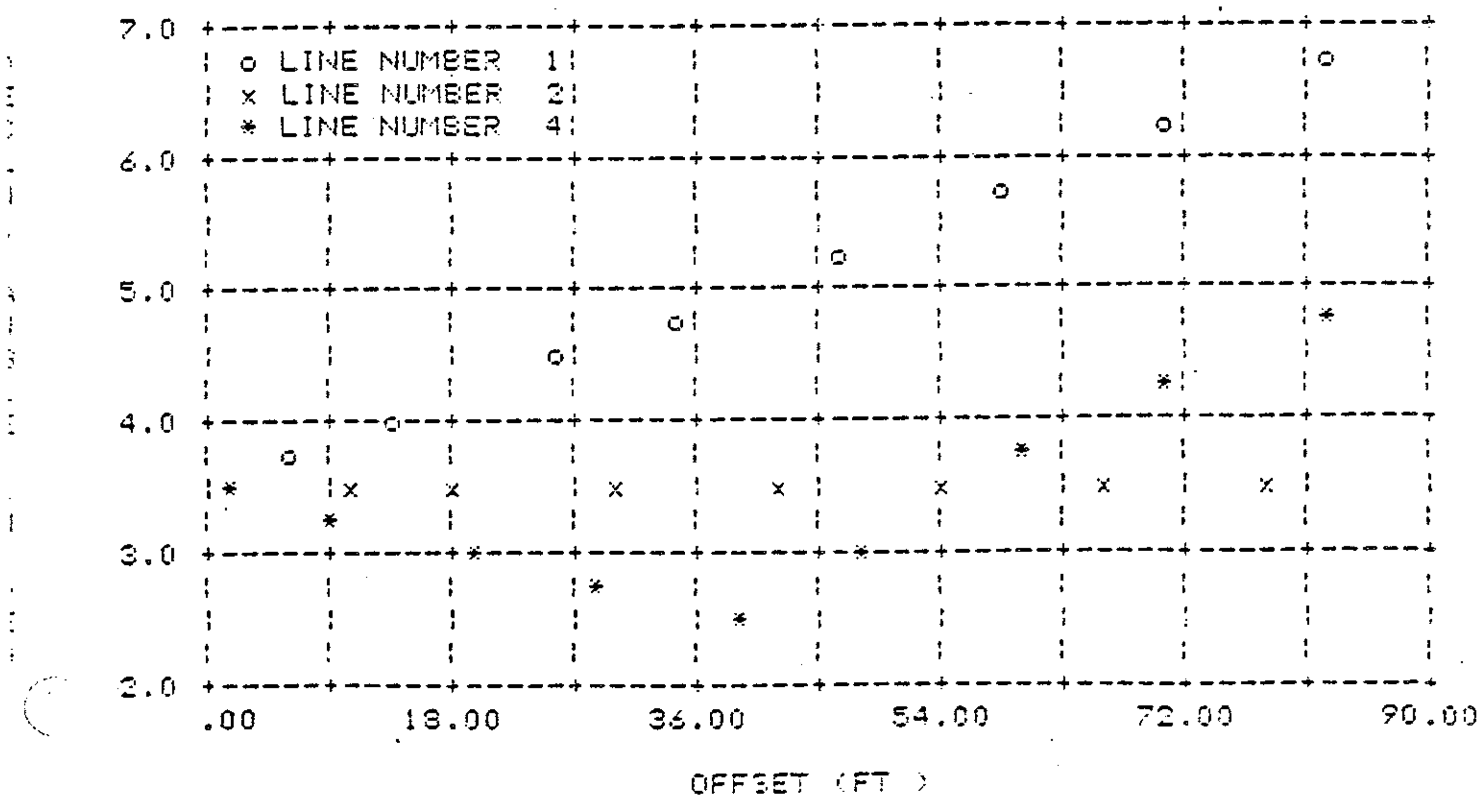
INT COORDINATES (X, Y, Z)			X COMP	Y COMP	Z COMP
150.0,	.0,	17.0)	1.04	3.79	3.32
-150.0,	.0,	17.0)	1.04	3.39	3.37

Table of Contents

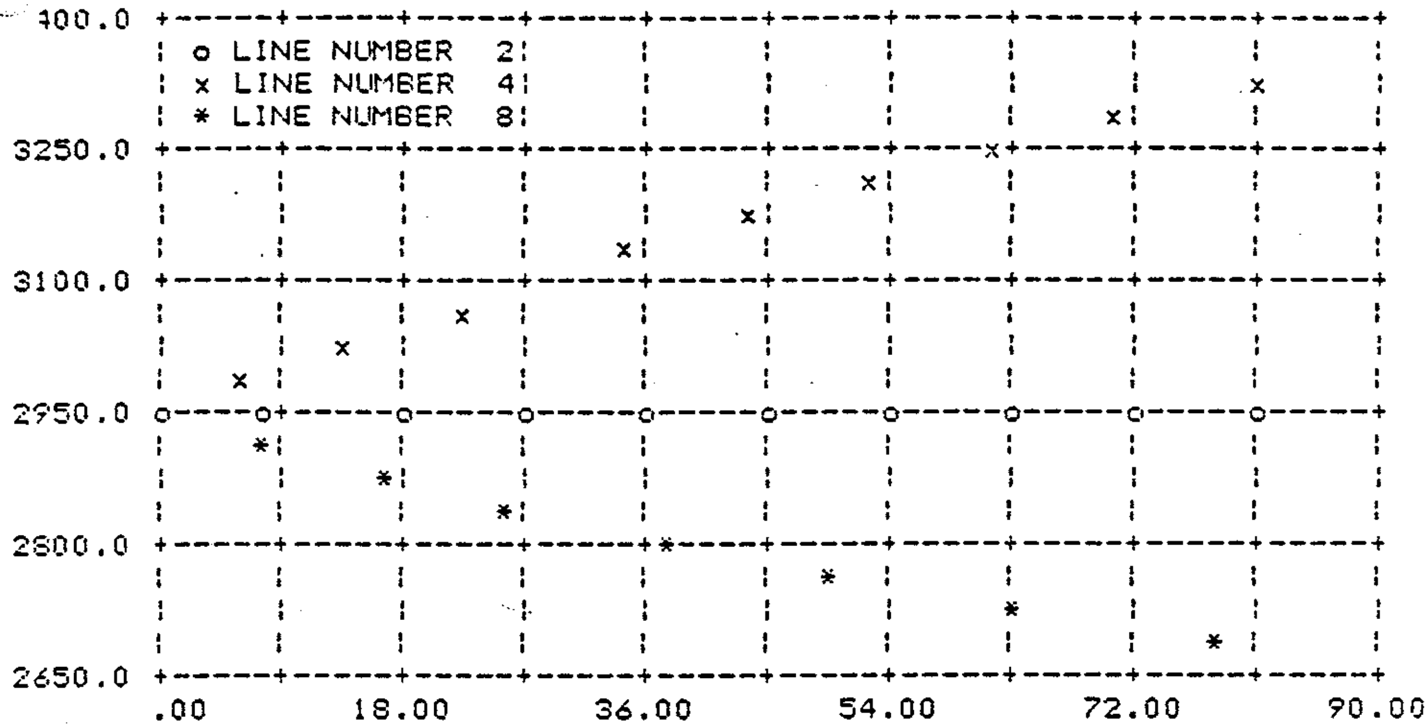
DECLINATION ANGLE AT FAIRLEAD, OFFSET DIRECTION = .0 DEG



DECLINATION ANGLE AT FAIRLEAD, OFFSET DIRECTION = .0 DEG

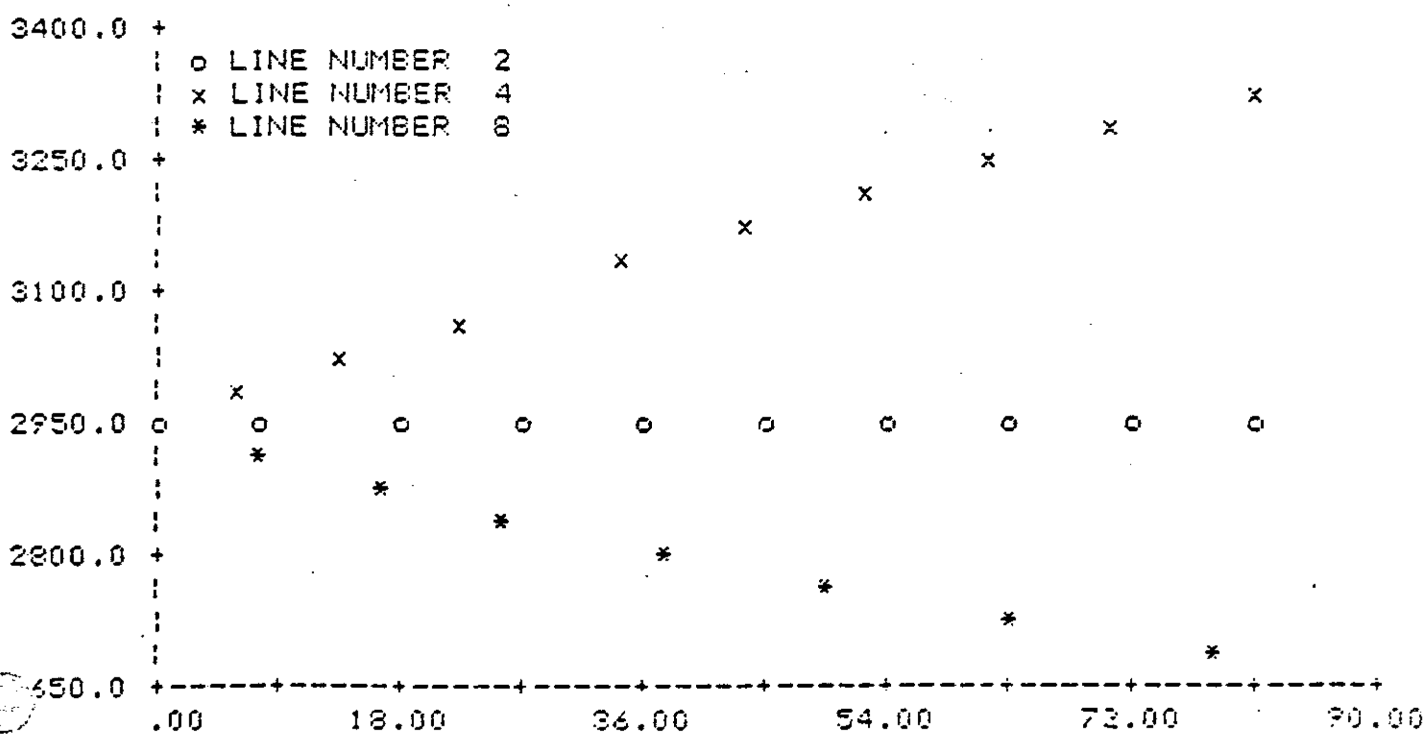


USPENDED LINE LENGTH, OFFSET DIRECTION = .0 DEG



OFFSET (FT)

USPENDED LINE LENGTH, OFFSET DIRECTION = .0 DEG



OFFSET (FT)

SEASOFT SYSTEMS' COMPUTER PROGRAM LIBRARY:

LICENSE PRICING SCHEDULE

gle-program pricing is according to the number of simultaneous users within a particular engineering anizational entity that can be accommodated at one time by the central processing unit to be licensed.

PROGRAM UNIT	1 USER	2-6 USERS	>6 USERS	
Volume 1: SHIPSIM [A]	$7,500	$11,250	$15,000	
Volume 2: JACKSIM	$10,000	$15,000	$20,000	
Volume 3: SEMISIM	$7,500	$11,250	$15,000	
Volume 4: DISCSIM [A]	$5,000	$7,500	$10,000	
Volume 5: TOWSIM	$10,000	$15,000	$20,000	
Volume 6: SALMSIM [A]	$20,000	$30,000	$40,000	(See note 3)
Volume 7: STATMOOR [A]	$7,500	$11,250	$15,000	
Volume 8: DYNMOOR	$8,000	$12,000	$16,000	
Volume 9: STATSALM [A]	$6,000	$9,000	$12,000	
Volume 10: DYNSALM [A]	$6,000	$9,000	$12,000	
Volume 11: SLOMOOR [A]	$6,000	$9,000	$12,000	
Volume 12: ARCHIMEDES	$7,000	$10,500	$14,000	
Volume 13: DRAGSIM	$4,000	$6,000	$8,000	
Volume 14: UPLOT [A]	$3,000	$4,500	$6,000	

NOTES

1. Multiple-user or multiple-program license prices will generally be influenced by specific circumstances; Contact SeaSoft for quotes in specific cases. Generally speaking, Multiple licenses of the same program unit purchased at the same time for use on separate identical computers are priced according to the following guidelines:

   - Additional licenses to run on computers at the same physical plant location are reduced 70% for the first additional license, %80 percent for subsequent licenses.

   - Additional licenses to run on computers of the same engineering organizational entity at different physical plant locations are reduced 30% for the first additional license, 50% for subsequent licenses.

2. Multiple licenses of different program units obtained at the same time to be used on the same computer will be reduced in price according to the number and type of programs licensed. Contact SeaSoft for quotes on any specific subset of library volumes or for other special circumstances not covered in this schedule.

3. SALMSIM comprises an integrated package containing SHIPSIM, STATSALM, DYNSALM, and SLOMOOR, each of which may also be utilized independently.

4. Prices are subject to change without notice. Units flagged with [A] are currently available, others to become available during 1984. Contact SeaSoft Systems, P.O. Box 271308, Escondido, CA 92027. Tel. (619) 489-9019

LLOYD'S

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888379 LR LON G

11/8/83 UR

TO : BROWN + ROOT
HOUSTON
OUR REF : OSG 1000/840/003014
SUBJECT : SURVEY OF TLP COMPUTER PROGRAMS

1) ATTENTION: FARHAD RAJABI 29-1021 671-1058

2) REFERENCE YOUR TELEX DATED 8 AUGUST 1983 WE COMMENT AS FOLLOWS:-

3) IT IS THE POLICY OF THE OFFSHORE SERVICES GROUP WITHIN LLOYD'S REGISTER NOT TO SELL OR LEASE IN-HOUSE SOFTWARE. THE USE OF SUCH PROGRAMS ARE AVAILABLE ONLY AS PART OF OUR ENGINEERING CONSULTANCY, CERTIFICATION AND CLASSIFICATION SERVICES.

4) IN REPLY TO YOUR ENQUIRIES WITH REGARD TO TLP MOTION AND STRUCTURAL ANALZSIS, WE ARE FORWARDING BY AIR MAIL TODAY, TWO PAPERS COVERING OUR DESIGN APPRAISAL CAPABILITY WITH PARTICULAR REFERENCE TO THE RECENT INDEPENDENT DESIGN APPRAISAL OF THE CONOCO HUTTON TLP PROJECT.

5) WITH REGARD TO MOTION ANALYSIS, TWO PACKAGES ARE AVAILABLE:-

A. L.O.T.S. - A FREQUENCY DOMAIN ANALYSIS TO COMPUTE OVERALL BEHAVIOUR AND STRENGTH OF A TLP. THE DETERMINATION OF THE RIG MOTION IN ITS 6 DEGREES OF FREEDOM, PROVIDES THE AMPLITUDES OF MOTION, AS WELL AS LOADS MADE UP OF THE HYDRODYNAMIC,

#6

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ROSTATIC, DIFFERENTIAL GRAVITY, INERTIA AND MOORING FORCES.

B. L.A.M.S. FOR ALL TYPES OF COMPLIANT STRUCTURES. BASED ON A FINITE ELEMENT NON-LINEAR ANALYSIS PACKAGE. IT IS A TIME DOMAIN NALYSIS USING A DIRECT SOLUTION TO THE COUPLED DIFFERENTIAL EQUATIONS OF MOTION. ELEMENTS HAVE LINEAR AND NON-LINEAR ELASTIC AND ELASO-PLASTIC CAPABILITIES.

6. MODEL TEST DATA AND OTHER ANALYSIS PROGRAS HAVE BEEN USED FOR PROGRAM VERIFICATION.

LR LONDON
PL+

888379 LR LON G
166299 B R MAR

McDermott Marine Construction

Research & Development

1010 Common Street
P. O. Box 60035
New Orleans, Louisiana 70160
(504) 587-4411

September 2, 1983

Naval Civil Engineering Laboratory
Port Hueneme, California 93043

Attn: Dr. William Nordell

Re: NCEL Contract-"Engineering Services for Conceptual Formulation and Design, Feasibility Studies, and Development of Design Criteria for Fixed and Moored Ocean Structures"

Gentlemen:

McDermott Engineering recently received a request from Brown and Root Development Inc. to provide detailed information about computer programs related to tension leg platform applications. Evidently this request results from the referenced contract. A copy of our reply to this request is attached.

We are writing to you directly to clarify that McDermott does in fact have internally generated computer codes that may indeed be of interest to NCEL. Our reluctance to provide this information directly to Brown and Root centers around 2 factors, namely:

1. Brown and Root is a direct competitor of McDermott, both in engineering and construction. For competitive reasons, we prefer not to provide them with any information that might damage our relative position.

2. All of the computer code in question was internally generated for usage by McDermott engineers during studies and detailed designs. The code has never been described in external technical publications or the trade press.

Realizing the above, I believe you can understand our definite reluctance to provide Brown and Root Development with the requested data.

We would be pleased to provide NCEL, at your convenience, with appropriate summarizations of our computer codes relating to TLP applications. Should you be interested in receiving these summarizations, please contact our Dr. Robert Gair at (713) 870-5000 or myself at (504) 587-4411. Should there be sufficient interest, key members of our technical staff, including Drs. Demos Angelides, Carlos Llorente, and Cheng-Yo Chen, can be made available for detailed discussions at NCEL.

Sincerely yours,

Lawrence A. Boston
Division Manager
Research & Development

LAB:jct

Attachment

cc: Brown & Root Development Co.
Attn: Mr. Farhad Rajabi
Robin Stagg
Bob Gair
Demos Angelides
Steve Will

HUDSON ENGINEERING CORPORATION
SUBSIDIARY OF McDERMOTT INC.
1010 COMMON STREET P.O. BOX 60035 NEW ORLEANS, LA 70160 AREA CODE 504/587-4411 TELEX: 587-412

August 18, 1983

Brown & Root Development, Inc.
P.O. Box 4302, Building 29
Room 1021
Houston, Texas 77210

Attn: Mr. Farhad Rajabi

Re: Your telex to Dr. Demos
Angelides dated 9 Aug. 83
(TLP-related Programs)

Sir:

We have reviewed the several computer programs we have available for tension leg platform analysis work and have concluded that we have none that meets the requirements set forth in your telex.

McDermott appreciates being included in your survey.

Sincerely yours,

McDERMOTT RESEARCH & DEVELOPMENT
a division of
Hudson Engineering Corporation

Lawrence A. Boston
Division Manager

LAB:js
cc: R. Stagg
D. Angelides
S. Will
B. Gair
M. Marcus

Rcv: @1IN/3.00216 Line: 3

166299 B R MAR

TLX 9/20/83
TO DR FARHAD RAJABI, BROWN AND ROOT
FROM T MATSUBARA, GENERAL MANAGER, APPLIED SYSTEMS DEPT, MITSUBISHI
RESEARCH INST, TKY, JPN

RE YOUR TLX OF 9/14/83

WE USE GENERAL PURPOSE PROGRAMS SUCH AS MSC NASTRAN TO SOLVE HYDRO ELASTICITY PROBLEMS ARISING IN SUBMERSIBLE STRUCTURE ANALYSIS. WE FEEL WE WILL NOT BE ABLE TO PROVIDE SUPPORTED SPECIALIZED SOFTWARES ADEQUATE TO YOUR SURVEY.

BEST RGDS,

166299 B R MAR
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0740 09/20
VIA TRT

Time: 06:37 09/20/83 CDT
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TRONDHEIM, 1983.09.19

AT/KB

TO BROWN AND ROOT INC. HOUSTON

ATT.: DR. FARHAD RAJABI.

REFERENCE IS MADE TO YOUR TELEX OF 14 SEPTEMBER 1983, INQUIERING ABOUT COMPUTER PROGRAMS FOR SEMISUBS AND TLP.

WITH RESPECT TO TENSION LEG PLATFORM WE HAVE TOGETHER WITH OTHER INSTITUTIONS IN TRONDHEIM DEVELOPED A COMPUTER PROGRAM, TERRICA TO CALCULATE MOTIONS, TETHERFORCES AND RISER STRESSES. THE PROGRAM IS DEVELOPED FOR THE OIL COMPANY COLOCO. WE CAN DO SERVICES FOR THIRD PARTIES WITH THE PROGRAM, BUT ANY SALE OF THE PROGRAM WILL BE A MATTER BETWEEN CONOCO AND A POTENTIAL CLIENT. THE PROGRAM HAS BEEN VALIDITATED BY MODEL TESTS.

WITH RESPECT TO SEMISUBS WE HAVE A COMPUTER PROGRAM, WAMOF, TO CALCULATE TRANSFER FUNCTIONS AND DRIFT FORCES. THE PRECENT POLICY IS TO DO SERVICES WITH THE PROGRAM AND LEASE THE PROGRAM TO POTENSIAL USERS, BUT NOT TO SELL THE PROGRAM.

THE METHODS USED ARE THE FOLLOWING:

PONTOONS: FRANK- CLOSEFIT METHOD.
COLUMNS: MC CARNY AND FUCHS
BRACINGS: MORISON INERTIA TERM.
FORTINGS INPUT COEFFISIENTS.

THE SEMISUB PROGRAM WILL BE COMPARED WITH OTHER PROGRAMS IN AN EXERCISE UNDERTAKEN BY INTERNATIONAL TOWING TANK CONFERENCES COMMITTEE ON OCEAN ENGINEERING.

SINCERELY YOURS
FOR NORWEGIAN HYDRODYNAMIC LABORATORIES
SHIP AND OCEAN LABORATORY
ALF TOERUM

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VIA TRT

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Stevens Institute of Technology Castle Point, Hoboken, New Jersey 07030

Department of Civil and Ocean Engineering
201 • 420 • 5344

September 20, 1983

Dr. Farhad Rajabi
Brown and Root, Inc.
P.O. Box 4302
Building 29, Room 1021
Houston, TX 77210

Subject: Survey of Semisubmersible Programs

Dear Dr. Rajabi:

Thank you for your advice to participate in the survey program concerning the availability of computer programs of semisubmersible motions and loads.

Since we have two sets of programs, we designate them by Programs A and B.

1) Program A can compute heave, pitch and roll motions of a semisubmersible in head and beam regular waves of deep water. The program does not include the hydrodynamic interaction effects due to the presence of multi-members. Program B can compute heave, pitch, sway, roll and yaw motions and loads of a semisubmersible as well as twin hull ships running in oblique seas. The program can evaluate the effect of the hydrodynamic interaction between two horizontal sections.

   The computations is based on a strip method and two-dimensional source distribution procedure.

Program A:

"Motions of a Semisubmersible Drilling Platform in Head Seas", Report SIT-OE-71-8, December 1971, (with F. Chou) also in <u>Marine Technology</u> Vol. 10, No. 2, April 1973, (by C. H. Kim).

"On the Motions of a Multi-Member Supported Semisubmersible in Seas", paper presented at the International Conference on Marine Sciences and Ocean Engineering, Hamburg, Germany, Sept. 24-25, 1980, (by C. H. Kim).

2) The theoretical background and validation of the analytical methods are given in the following references:

Program B:

"Motions and Loads of a Catamaran Ship of Arbitrary Shape in a Seaway", SIT-DL-74-Report 1750, July 1974. Also published in Journal of Hydronautics, Vol. 10, No. 1, Jan. 1976, (by C. H. Kim).

"The Hydrodynamic Interaction between Two Cylindrical Bodies Floating in Beam Seas", SIT Report OE-72-10, June 1972, (by C. H. KIM).

3) User's manuals are in incomplete forms.

4) Purchasable.

5) As described in the foregoing 2), the calculation of motions and loads were validated by comparing the analytical results with available experimental and analytical data.

Hoping that the foregoing information will be of help in your survey, I am -

Sincerely yours,

C. H. Kim

C. H. Kim, Professor
of Civil and Ocean
Engineering

CHK:ag

Rrv: @1IM/1.00046 Line: 1

MAR EMG HOU

SANTA FE ORGE
MSG 0001

KKKKK
5663006112
BROWN AND ROOT
HOUSTON, TEXAS
794508 MAR EMG HOU
8-30-83
ATTN FARHAD RAJABI
EDS-045-83
SUBJ: TLP COMPUTER PROGRAM SURVEYS
IN RESPONDING TO YOUR TELEX DATED AUG. 9, 1983, SANTA FE IS VERY ACTIVE IN THE DESIGN AND ANALYSIS OF OFFSHORE STRUCTURES INCLUDING TENSION LEG PLATFORMS. WE HAVE A COMPLETE SET OF COMPUTER PROGRAMS FOR MOTION AND STRUCTURAL ANALYSES OF TLP'S. OUR COMPUTER CAPABILITIES ARE ALREADY ON FILE WITH NCEL AS A RESULT OF OUR PRESENTATION TO THEM ON MAY 18. PLEASE REFER TO THAT DOCUMENT FOR YOUR SURVEY. LET US KNOW IF YOU HAVE ANY PROBLEM.
BOB CHOU
SF ORANGE

SANTA FE ORGE
X
Time: 22:32 08/30/83 ???
Connect Time :   150 seconds

SWAN WOOSTER
ENGINEERING CO. LTD.

1190 HORNBY STREET, VANCOUVER, B.C., CANADA, V6Z 2H6 TELEPHONE (604) 684-9311, TELEX 04-51275, CABLE "SWANCO"

1984 05 22

Brown & Root Development Inc.
P.O. Box 1051
Houston, Texas 77251

Attention: Dr. F. Rajabi

Subject: Ship Motions Computer Program

Dear Sirs:

In your letter of April 5, 1984 you requested information on Swan Wooster's capabilities for analyzing motions and structural analysis for semisubmersibles and tension leg platforms. We have a program available which we call SHPDYN which is intended to evaluate the motions and forces of a ship moored at an open pile dock. The program would be applicable to analyzing ship type sections at spread moorings or tension leg moorings as long yaw displacements are "small" as, at the present time, forces are not calculated as a function of changing orientation of the ship.

The program presents a time history solution to the motion and forces in six degrees of freedom incorporating non-linear mooring systems. Wave forces are calculated using strip theory following the work of Muga and Wilson (1970). Added mass and damping coefficients are input based on model test results for prismatic bodies.

We have not completed any of the questionnaire tables as they are not directly applicable to our program. The program is only available for use on a consultancy basis.

Yours very truly

SWAN WOOSTER ENGINEERING CO. LTD.

C.S. Birt, P. Eng.

cc: K.J. Charpentier - Swan Wooster, Houston

Rcv: @1IM/3.00229 Line: 3

166299 B R MAR

77380 YARD G 21/9/83

TO: BROWN AND ROOT HOUSTON

ATTN: DR. FARHAD RAJABI 29-1021 071-1053

WAVE MOTIONS

1. THANK YOU FOR REVISED TELEX. I BELIEVE THAT MOST POINTS RELATING TO SEMI-SUBMERSIBLE DESIGN WERE COVERED IN OUR PREVIOUS DISPATCH TO YOU. HOWEVER, THE CALCULATION OF WAVE FORCE INPUT TO TLP SIMULATION MODEL AND CALCULATION OF SEMI-SUB RESPONSE CAN BE MADE BY YARD USING EITHER:

   A. DIFFERACTION PROGRAM - NMI WAVE. THIS MAJOR WAVE RESPONSE PROGRAM IS AVAILABLE EITHER DIRECTLY FROM NMI LTD OR THROUGH SIA COMPUTER BUREAUX. REFERENCES TO NMI WAVE ARE NUMEROUS EG. NMI WAVE USER MANUAL 1978 AND HOGBEN N AND STANDING R G, 1974, 'WAVE LOADS ON LARGE BODIES': PROC. SYMP. DYN. MAR. VEHICLES STRUCT. IN WAVES, INST. MECH. ENGRS. LONDON, PP. 258-277.

   B. FIRST ORDER (MORRISON EQUATION) PROGRAM DEVELOPED BY GLASGOW UNIVERSITY AND VALIDATED AGAINST EXTENSIVE TANK TESTS. THIS PROGRAM IS VERY MUCH CHEAPER TO RUN AND WILL GIVE SATISFACTORY RESULTS IN MANY CONDITIONS. REF: K.M.OO AND N.S. MILLER RINA 1976

MOORING AND DYNAMICS

2. FOR SEMI-SUBMERSIBLES THE MOORING FORCES ARE OFTEN DERIVED FROM QUASI-STATIC CONSIDERATIONS. THIS MAY BE SATISFACTORY FOR CONVENTIONAL MOORINGS BUT FOR NOVEL CONDITIONS OR MOORING DESIGNS THE ANALYSIS SHOULD BE EXTENDED TO COVER THE SLOW DRIFT DYNAMICS. YARD SIMULATION MODEL DEVELOPED FOR A TANKER AT A SINGLE POINT MOORING IS IDEAL FOR THIS TASK. DETAILS OF THE MODEL AND ITS VALIDATION WERE INCLUDED IN THE PREVIOUS PACKAGE.

3. I TRUST THAT THE FOREGOING IS OF INTEREST AND WOULD BE PLEASED TO DISCUSS ANY POINT IN MORE DETAIL.

BEST REGARDS

C.J. EDMONDS (DR.)
SENIOR CONSULTANT
YARD LTD.

++++

77380 YARD G   L.D.R.

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A

77380 YARD G 30.8.83

TO: BROWN + ROOT, HOUSTON, USA

ATTN: FARHAD RAJABI ; 29-1021 671-1058

TLP COMPUTER PROGRAM SURVEY

1. THANK YOU FOR YOUR ENQUIRY DATED 08/09/83 AND OUR APOLOGIES FOR DELAY IN REPLYING.

2. WE DO NOT HAVE SOFTWARE FOR TLP MOTIONS WHICH IS COMMERCIALLY AVAILABLE.

3. OUR TLP WORK HAS BEEN BASED ON HYBRID COMPUTER SIMULATION OF TLP MOTIONS. THE WORK HAS CONCENTRATED ON NON-LINEAR SUBHARMONIC MOTIONS AND HAS BEEN VALIDATED AGAINST EXTENSIVE TANK TESTS.

4. I HAVE DESPATCHED A COPY OF REPORT TO YOU BUT THE IMPORTANT FEATURES OF THIS WORK ARE:

- LARGE SUBHARMONIC MOTIONS CAN OCCUR IN RANDOM SEAS:
- SIGNIFICANT SUBHARMONICS MAY OCCUR DUE TO DIFFERENT FREQUENCY EFFECTS IN SPREAD SEAS.
- THE INCLUSION OF COUPLED NON-LINEAR DRAG IS VITAL TO CORRECT PREDICTION OF THESE MOTIONS. LINEARIZATION OF THE DRAG CAN IN SOME CASES SIGNIFICANTLY UNDERESTIMATE MOTION.
- THE WORK SUGGESTS THAT TLPS WITH LARGE VERTICAL BUOYANCY MEMBERS ARE LESS LIKELY TO BE AFFECTED BY SUCH MOTIONS THAN THOSE WITH LARGE HORIZONTAL ONES, PARTICULARLY IF THEY JAVE SMALL CROSS MEMBERS GIVING HIGH HORIZONTAL DRAG.

5. WE WOULD CERTAINLY BE INTEREESTED IN CONTRIBUTING TO ANY TLP STUDY, BUT OUR INPUT WOULD HAVE TO BE EITHER:

- CONSULTANCY USING OUR OWN IN-HOUSE MODEL
- TRANSLATING THE EXISTING HYBRID MODEL TO A TRANSPORTABLE DIGITAL MODEL WHICH COULD BE AVAILABLE ON A LEASE SALE OR BUREAU BASIS.

6. OBVIOUSLY NEITHER FIT YOUR EXACT REQUEST BUT IF YOU ARE INTERESTED IN DISCUSSING THIS SUBJECT FURTHER WE WOULD BE PLEASED TO DO SO.

BEST REGARDS

CHRIS EDMONDS
YARD LTD

+++

77380 YARD G

166299 B R MAR

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VIA TRT

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Time: 10:55 08/30/83 ???