Environmental
Studies
Revolving
Funds

019 Oil in Ice Computer Model

Canadä

December 1985

Environmental Studies Revolving Funds
Report No. 019

December 1985

OIL IN ICE COMPUTER MODEL

P. Wotherspoon

J. Swiss

R. Kowalchuk

J. Armstrong

Dome Petroleum Limited
Box 200
Calgary, Alberta
T2P 2H8

Scientific Adviser: D. Lawrence

The correct citation for this report is:

Wotherspoon, P., J. Swiss, R. Kowalchuk, and J. Armstrong. 1985. Oil in ice computer model. Environmental Studies Revolving Funds Report No. 012.Ottawa. 129p.

Published under the auspices
of the Environmental Studies
Revolving Funds
ISBN 0-920783-18-x

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TERMS USED IN EQUATIONS

Symbol	Definition	Units
A_s	Area of slick without current	m^2
A'_s	Area of slick with current	m^2
C_D	Roughness form drag coefficient C_D = 1.98 for rectangular prism C_D = 1.55 for triangular prism	Dimen- sionless
δ	Local slick thickness	cm
δ_{eq}	Equilibrium oil slick thickness beneath smooth ice	cm
$\delta_{stagnation}$	Thickness of slick in a cavity at the end of the vortex zone	cm
δ_{tail}	Thickness of contained slick at the downstream cavity wall	cm
D_{vortex}	Vortex zone offset into a cavity	cm
D_{cavity}	Ice roughness height or cavity depth	cm
F_δ	Densimetric Froude number $F_\delta = S_w/\sqrt{(\Delta g \delta)}$ For this case, $\delta = \delta_{eq}$	Dimen- sionless
f_s	Oil/Water interfacial friction factor Empirically ≃ 0.016	Dimen- sionless
g	Gravitational acceleration	cm/sec^2
K	Ice friction amplification factor	Dimen- sionless
L_{shear}	Length of the shear-dominated portion of the oil in a cavity	cm
L_{vortex}	Length of vortex cell	cm
L_{cavity}	Cavity length	cm
μ_o	Viscosity of oil	g/cm-sec

(Terms continued)

Symbol	Definition	Units
Δ	Relative density ratio $\Delta = (\rho_w - \rho_o)/\rho_w$	Dimensionless
ρ_o	Density of oil	g/cm^3
ρ_w	Density of water	g/cm^3
$\sigma_{o/w}$	Interfacial tension between oil and water, typically 30 - 35 dynes/cm for crude oils	dynes/cm
R_s	Rate of spill	m^3/hour
S_e	Speed of edge of slick	cm/sec
S_{fail}	Current speed for containment failure	cm/sec
S_s	Oil slick speed	cm/sec
S_{th}	Threshold current speed for slick movement	cm/sec
S_w	Water current speed	cm/sec
T	Time	hours
T_{end}	Duration of spill	hours
V_s	Volume of slick	m^3
V_{area}	Volume per unit area without current	m^3
V'_{area}	Volume per unit area with current	m^3
V_{width}	Approximate volume of oil trapped per unit width of cavity	cm^3/cm
W_s	Width of slick	m

ACKNOWLEDGEMENTS

The key project managers for this study were Mr. Paul Wotherspoon and Mr. Jim Swiss of Dome Petroleum Limited, Calgary.

The project managers wish to thank Mr. Rick Kowalchuk and Mr. Jon Armstrong of Dome Petroleum's Frontier Computer Systems for their efforts in developing the model.

Appreciation is also due to the study's Scientific Advisor, Mr. Don Lawrence of the Bedford Institute of Oceanography. The study was financed by the Environmental Studies Revolving Fund, administered by the Northern Affairs Program, Department of Indian Affairs and Northern Development, Government of Canada, Ottawa.

SUMMARY

This report documents a computer simulation program that depicts the behaviour and distribution of oil spilled in or under sea ice. The program combines mathematical models developed in previous studies to describe the motion of oil in or under the ice surface. By inputting or estimating such key parameters as oil type, spill duration, flow rate under ice, current speeds and direction, under ice roughness, shoreline, and ice boundaries, a time series of plots are generated showing the distribution of the spilled oil. The simulation plots the position of the oil with respect to a particular ice sheet, however, it does not include the subsequent movement of oil contaminated ice.

Although the program concentrates on the prediction of oil movement under a solid ice cover, the effect of oil in broken pack and brash ice can still be simulated by varying the under ice roughness.

The development of the program relied on available work by other authors, which was very limited. Therefore, some of the model's inherent assumptions cannot be fully substantiated. However, the program forms a base from which future developments and modifications can be made.

Model specifications provide details of the mechanics on which the program depends to predict oil movement. Documentation of the model is provided to enable data systems professionals to mount and run the program.

RÉSUMÉ

Ce rapport fournit des renseignements relatifs à un programme de simulation par ordinateur qui décrit le comportement et la répartition du pétrole déversé dans ou sous la glace. Le programme réunit des modèles mathématiques développés lors de précédentes études pour décrire le déplacement du pétrole dans ou sous la glace. En faisant entrer en mémoire ou en estimant des paramètres de base tels que le type de pétrole, la durée de déversement, le débit, la vitesse et la direction des courants, les aspérités sous la glace, la ligne du rivage, les surfaces délimitées de glace, l'on obtient une série chronologique de tracés illustrant la répartition du pétrole déversé. La simulation figure graphiquement la position du pétrole par rapport à une couche particulière de glace, mais ne prend pas en considération le mouvement subséquent de la glace polluée par le pétrole.

Bien que le programme soit consacré à la prévision du mouvement du pétrole sous une épaisse couche de glace, les effect du pétrole sur les embâcles et les débâcles peuvent être également simulés en faisant varier les données ayant trait aux aspérités sous la glace.

L'élaboration du programme dépendait des travaux disponibles d'autres auteurs, lesquels se sont révélés fort limités. De ce fait, certaines hypothèses inhérentes au modèle ne peuvent être complétement démontrées. Néanmoins, le programme peut servir de base aux améliorations futures et aux modifications susceptibles d'être apportées.

Les caractéristiques du modèle fournissent des précisions quant aux mécanismes sur les lesquels se fonde le programme pour prévoir le déplacement du pétrole. La documentation relative au modèle est proposée afin de permettre aux spécialistes en informatique de monter et d'exécuter ce programme.

INTRODUCTION

Although extensive work has been conducted on the behaviour of oil spilled in and under sea ice, its detection using remote sensing techniques is still in the conceptual stages. Some advances have been made in providing an ice surface monitoring tool for on-site detection (Goodman and Fingas 1983). However, this system is site specific and is only useful in determining the under ice area covered by oil at a suspected site.

The purpose of the oil in ice computer model is to predict the motion of oil released into ocean water in the presence of ice. The model described here:

- considers the case of oil released under ice;
- deals with finite and continuous spills;
- allows for the effect of admixed gas on the spreading of the oil;
- includes the effects of ocean current on the net movement of the slick; and
- models the effect of roughness of the undersurface of the ice.

This model assumes that all parameters are constant for the duration of the simulation; thus, to model, for example, a variable water current, successive runs are required, each covering a limited time during which the current velocity is represented by a different constant.

Output from the program is plotted in the form of a map showing the location and size of the oil slick at the end of the prescribed time interval on a latitudinal and longitudinal grid, with an approximate representation of the shoreline where applicable. The resolution of this map is dependent on the precision of the data matrices used for the calculations, but should be in the order of a kilometre for the location of the slick, and perhaps a tenth as large for its size and shape. This map is generated in the form of a file of commands to the TELL-A-GRAF graphics package, to simplify the model while retaining a high degree of transportability (the model itself is programmed in FORTRAN). Also, a tabular format will be provided containing the same information. An overview of the model is shown in Figure 1.

To accomplish these goals, the following input data are required by the program:

- oil properties: viscosity, density, gas-to-oil ratio, interfacial tension, and interfacial friction factor. Sets of values of these properties are stored in a table and accessed by "oil type;"
- spill characteristics: quantity, duration, flow rate, and location;
- water and ice properties: water density, current velocity, ice locations, and ice undersurface roughness. In future versions of the model, it may be possible to include the effect of pressure ridges on the movement of the oil, in which case their location and size must be available to the model; and
- miscellaneous: shoreline locations and ice boundaries.

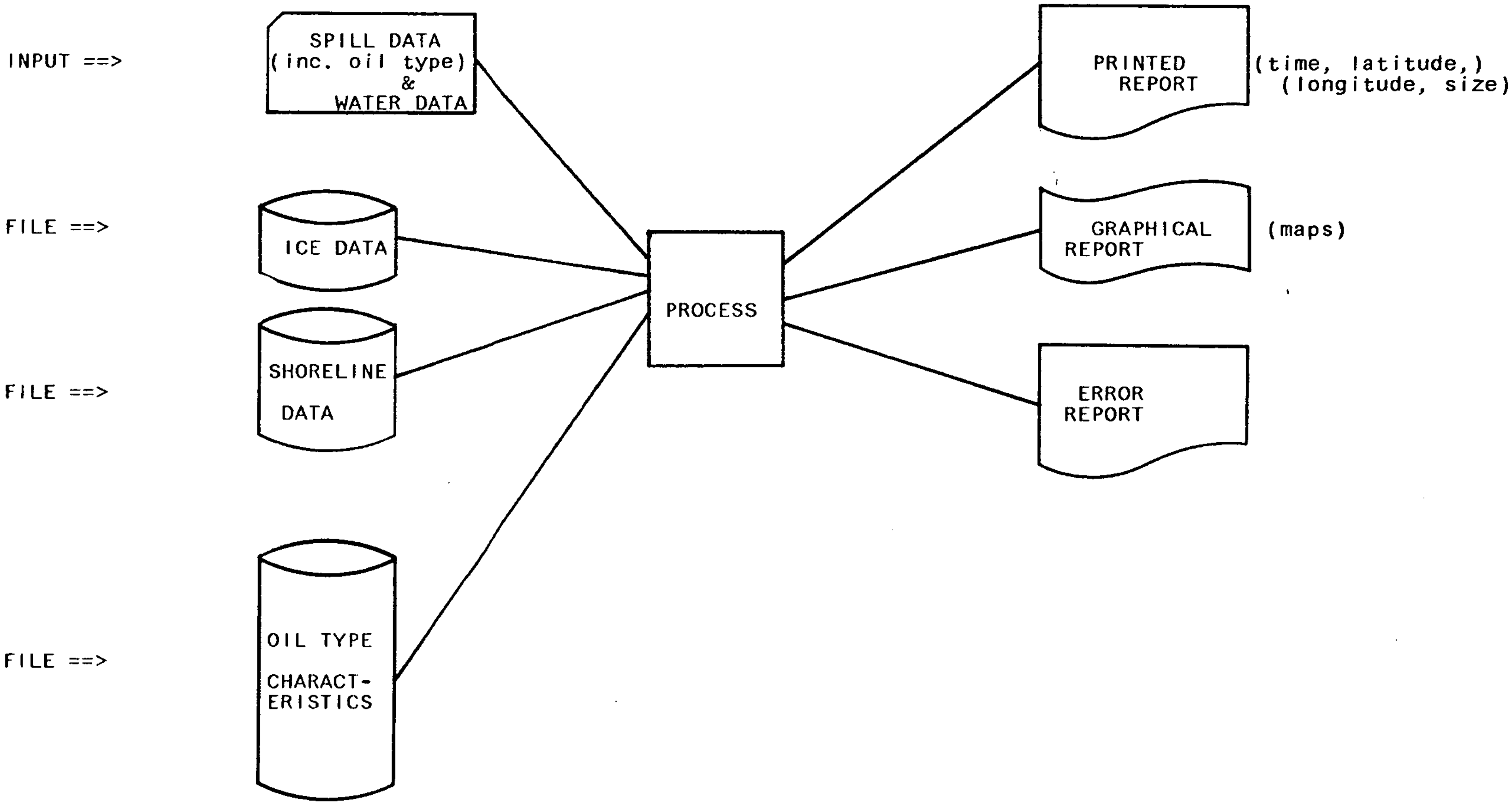


Figure 1. Overview of oil in ice computer model (A fully developed model would extract water and ice data from an environmental database).

Several factors combine to produce independent sub-types of spill:

- with or without current
- with or without gas
- finite or continuous.

For the case of smooth, unbroken ice, the eight possible combinations of these factors have been labelled A through H, listed below, and are described in the section on "Program Logic." For the case of rough ice, a corresponding eight sub-types labelled I through P have been established and are similarly described.

A	No current,	no gas,	finite volume spill
B	No current,	no gas,	continuous spill
C	No current,	gas,	finite
D	No current,	gas,	continuous
E	Current,	no gas,	finite
F	Current,	no gas,	continuous
G	Current,	gas,	finite
H	Current,	gas,	continuous
I	No current,	no gas,	finite
J	No current,	no gas,	continuous
K	No current,	gas,	finite
L	No current,	gas,	continuous
M	Current,	no gas,	finite
N	Current,	no gas,	continuous
O	Current,	gas,	finite
P	Current,	gas,	continuous

Six samples of the outputs are included (see Appendix 7) to illustrate the model's performance. A subsea blowout is assumed with a flow rate of 1,900 m^3/day for 60 days. Input data for the sample run were used only to demonstrate the model and should not be considered as authentic values.

MODEL SPECIFICATIONS

ASSUMPTIONS

Nine assumptions have been made to simplify the model.

a) The presence of gas with the oil is assumed to have no effect beyond initially spreading the oil over a greater area. A gas-to-oil ratio (GOR) is specified in the input, which keys to a table of spreading factors that is maintained within the model. Because of a lack of test or field results on GOR spread factors the initial version of the model only considers a GOR of 200:1, at which level the oil is assumed to be spread over an area seven times larger than would be the case in the absence of gas (Dome Petroleum Limited 1981).

b) A threshold current speed is determined, dependent on the viscosity of the oil (see Equation 2), below which the current is assumed to have no effect on the distribution of the oil. Oil that does not move becomes encapsulated in the ice, thus preventing its movement even if the current increases later.

c) Emulsion formation and diffusion of the oil are ignored. Although these factors might affect the equilibrium thickness and other properties of the oil, their effects are insufficiently well understood to permit modelling them.

d) Oil is assumed not to wet the undersurface of the ice, although friction between the two is calculated (see Equations 2 through 6). (Some portion of the oil may be retained in surface irregularities if the undersurface is characterized as rough, depending on the scale of such roughness and the current speed.)

e) Spills of duration greater than one hour are treated as continuous spills, with oil released at a constant rate until it stops.

f) Each release of oil is assumed to reach equilibrium thickness in less than the model time increment of one hour. Should experience show this not to be the case, and that the rate of spreading is significant in determining the eventual extent or location of the slick, additional equations would need to be added to the program to model the observed situation.

g) For rough ice, the presence of gas is assumed to increase the area covered by oil in the same ratio as for smooth ice.

h) Although the program concentrates on the prediction of oil movement under a continuous and landfast ice cover, the effect of broken ice (>2 m diameter) and brash (<2 m diameter) can still be simulated by varying the under-ice roughness factors.

i) The simulation will plot the position of the oil with respect to a particular ice sheet, however, it does not include allowance for the subsequent movement of the oil-contaminated ice. That complexity is reserved for future models.

INPUT DATA CRITERIA

Oil Type

If the oil is a type not known to the model, the following data must be added to the internal table:

- viscosity
- density
- interfacial tension
- interfacial friction factor.

Spill Data

Time and Date. (Compulsory.) These data should be checked to ensure that the date is within the range for which the model is valid. For example, dates further in the future than environmental data such as current velocities and ice locations can reasonably project should be considered invalid, and should cause the input to be rejected.

Location. (Compulsory.) The program assumes that the location is offshore and in a region of landfast ice. The user may expand the model to handle oil moving amid broken ice.

Quantity or flow rate. (One of these must appear.) If the latter, a duration must appear.

Water and Ice Data

Water density. (Compulsory.) Subject to warning on unreasonable value.

Current velocity. (Compulsory.)

Ice locations. (Compulsory.) This information provides the location of the edge of the ice in the vicinity of the release point.

Ice roughness. (Optional.) If omitted, the model assumes that the ice undersurface is perfectly smooth. The program needs to know the depth, length, width, and spacing of the cavities for the calculation of volume and drag, and also needs a drag coefficient determined by the profile of the cavity walls. (This coefficient will usually be in the range 1.5-2, so could probably be represented by a constant with little loss in accuracy.) The figures for length and width are in relation to the direction of motion of the oil, so orientation of the roughness elements must also be specified. Future versions of the program will probably need to be able to accept multiple inputs to permit the specification of different degrees of roughness at different scales.

Shoreline data. (Obtained from a table.) This information represents the edge of solid ground.

Output Specification

(Compulsory.) This specification establishes the frequency of output required and the total duration to be modelled.

PROGRAM LOGIC

The program logic was designed from a simplistic approach to provide clarity for modification. Sixteen sub-types of spill were developed as a result of a brainstorming session. An analysis of the available references indicated that, with some modifications, the derivations produced by Arctic Incorporated (Cox and Schultz 1981) most aptly satisfied the requirements of the sub-types.

A complete listing of the equations involved is provided, and their use in the calculation procedure is depicted in a flow chart (Figure 2).

Equations

$$\delta_{eq} = 1.67 - 8.50(\rho_w - \rho_o) \qquad (1)$$

$$S_{th} = 305.79/(88.68 - \mu_o) \qquad (2)$$

$$S_s = 0.15S_w - 0.60 \qquad \text{for } S_w < 18 \text{ cm/sec} \qquad (3)$$

$$S_s = S_w - 15.6 \qquad \text{for } S_w > 18 \text{ cm/sec} \qquad (4)$$

$$S_s = S_w(1 - \sqrt{(K/(0.115F_\delta{}^2 + 1.105))}) \qquad (5)$$

$$K \simeq 1 + 1.96(D_{cavity}/L_{cavity}) + 2.22\sqrt{(D_{cavity}/L_{cavity})} \qquad (6)$$

$$D_{vortex} = S_w{}^2/(3.46\Delta g) \qquad (7)$$

$$S_{fail} = 1.5\sqrt{(2((\rho_w + \rho_o)/(\rho_w\rho_o))\sqrt{(\sigma_{o/w}(\rho_w - \rho_o))})} \qquad (8)$$

$$L_{vortex} = 4S_w \qquad (9)$$

$$L_{shear} = 4\Delta g(D_{cavity}{}^2 - (D_{cavity} - D_{vortex}/2)^2)/(f_s S_w{}^2) \qquad (10)$$

$$V_{width} = L_{vortex}(D_{cavity} - D_{vortex}) + (L_{cavity} - L_{vortex})(\delta_{tail} + (D_{cavity} - D_{vortex}/2))/2 \qquad (11)$$

$$\delta_{tail} = \sqrt{(f_s S_w{}^2 (L_{cavity} - L_{vortex})/(4\Delta g) + (D_{cavity} - D_{vortex}/2)^2)} \qquad (12)$$

$$\delta_{stagnation}{}^2 = D_{cavity}{}^2 - f_s S_w{}^2 (L_{cavity} - L_{vortex})/(4pg) \qquad (13)$$

$$V_{width} = (D_{cavity} + S_w{}^2/(4\Delta g))\ (4\Delta g/(f_s S_w{}^2))\ (D_{cavity}{}^2 - (S_w{}^2/(4\Delta g))^2)/2 \qquad (14)$$

$$V_{width} = 6C_D\ D_{cavity} \cdot \delta_{eq} \qquad (15)$$

$$V_{width} = L_{cavity}(D_{cavity} + \sqrt{(D_{cavity}{}^2 - L_{cavity} f_s S_w{}^2/(4\Delta g))})/2 \qquad (16)$$

The program must first determine, by examining the input data, which of the 16 identified sub-types (page 5) is applicable.

Smooth Ice

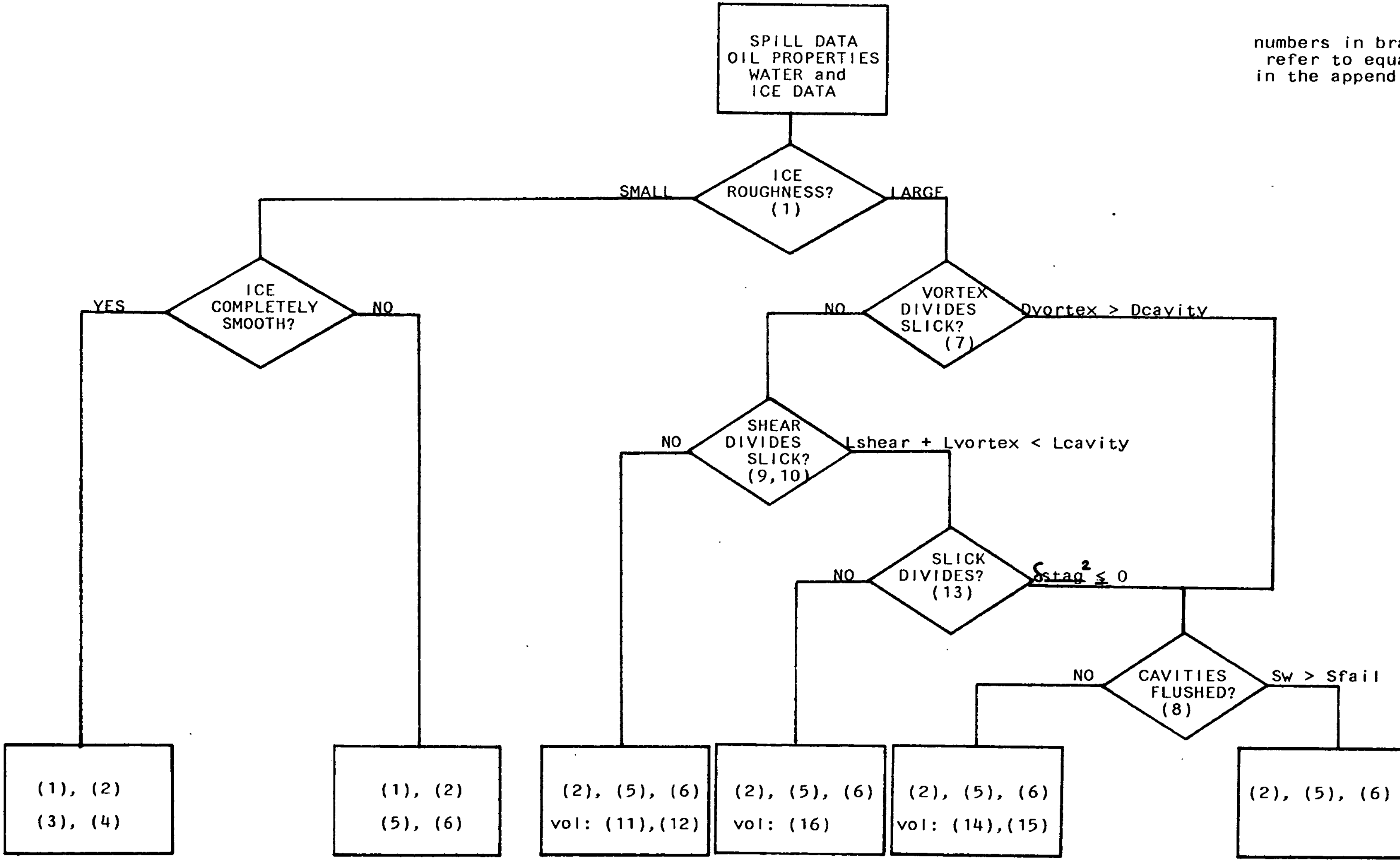
A: <u>No current, no gas, finite spill</u>. Equation 1 is used to obtain the equilibrium thickness, which is combined with the total volume of the spill to derive the area covered. Because there is no current, spreading is assumed to be isotropic, resulting in a circular area of contamination centred on the initial contact point of the oil with the ice.

B: <u>No current, no gas, continuous spill</u>. Similar to (A), but the calculation is repeated to represent the situation at the end of each hour for the duration of the spill. Depending on the output specification, not all of these representations may need to be displayed, or they may be separated and displayed on more than one plot.

C: <u>No current, gas, finite spill</u>. The calculation procedure is to estimate the equilibrium thickness using Equation 1, as in (A), then to increase the area covered by the gas spread factor to allow for enhanced spreading caused by gas.

D: <u>No current, gas, continuous spill</u>. This situation is similar to (C), however, the calculation is repeated for the amount of oil present at the end of each hour for the duration of the spill.

E: <u>Current, no gas, finite spill</u>. First, the threshold velocity is calculated to determine whether the oil will move or not, using Equation 2. If not, the situation is identical to (A). If the current speed is greater than the threshold level, the entire slick is assumed to move uniformly downstream at a speed given by either Equation 3 or Equation 4, depending on the magnitude of the current.



numbers in brackets refer to equations in the appendix

Figure 2. Flow Chart to determine the calculation regime.

F: Current, no gas, continuous spill. Similar to (E), however, fresh oil is added at each hour. Where the current is high enough to move the slick, the resulting contaminated area will not be circular. The model will represent the shape of the slick as an oval, i.e., a column of uniform width except at the ends, which are semi-circles. The long axis of the oval will be aligned with the direction of the current, and the semi-circular upstream end will be centred on the release point.

For this first sub-type in which the final shape of the slick may be non-circular, a detailed description of the calculation procedure is given:

- calculate equilibrium thickness, δ_{eq}, using Equation 1;

- calculate threshold current speed, S_{th}, Equation 2;

- If water current speed, $S_w > S_{th}$

  calculate slick speed S_s, using Equation 3 or 4

$$W_s = R_s/(S_s \cdot \delta_{eq})$$

where: W_s = width of slick,

R_s = rate of spill, m^3/hour

S_s = speed of slick, m/hour

δ_{eq} = thickness of slick

The slick may then be considered as a rectangle of width (across the current) W_s and length (down-current) $S_s.T$, where T is the time in hours since the beginning of the spill. If the spill ceases after some time T_{end}, the existing rectangle will continue to move downstream as a unit, with speed S_s. The length will be $S_s.T_{end}$, and will not change, nor will the width. The final representation of the slick will be an oval, i.e., the ends of the rectangle will be rounded to more closely approximate reality.

- ELSE (no current) treat as sub-type B, a gradually expanding disk.

G: Current, gas, finite spill. As with (E), the threshold current speed is determined, and the situation is treated as no current for speeds below, and as one of two possible speed regimes for currents above that speed. The effect of the accompanying gas is only to spread the oil thinner.

H: Current, gas, continuous spill. Similar to (E), with the addition of fresh oil each hour, and with the oil distributed further by the gas. As with (F), the final distribution of the oil may be non-circular if the current is above the threshold value.

Rough Ice

Rough ice presents a much more complex situation when the current is high enough to move the oil. The degree to which the oil is affected by the roughness depends not only on the height (depth) of the irregularities in the undersurface of the ice, but also on their separation, and on the interaction of the current speed with both. The situation can be simplified somewhat by classifying the roughness as "small" where the height of the roughness elements is less than the equilibrium thick-

-ness of the oil. When this condition applies, the only difference from the smooth ice case is that the speed of movement of the oil will be somewhat less, and is given by Equation 5. However, for larger-scale roughness, some oil is likely to be retained in cavities even in the presence of above-threshold current. Thus, it is necessary to deduct the appropriate amount from the slick volume at each iteration of the model computations.

As already noted, most of the equations were obtained from Cox and Schultz (1981). Their work consisted of a series of laboratory studies of the motion of oil under ice with and without the presence of roughness elements on the undersurface of the ice. It is important to recognize that this laboratory study was essentially two-dimensional, in that the roughness elements were regular prisms perpendicular to the direction of motion of the oil. In practice, it is to be expected that the equations thus derived will need significant modification in the light of experience, to accommodate the three-dimensional nature of the real world. For the purposes of this specification, the equations are used as presented in the paper (with the exception of Equation 6, which is a quadratic approximation to an empirically derived curve). A schematic illustration of a cavity is shown in Figure 3.

In the course of developing the model, the authors found that Equation 6 yields values of the friction amplification factor that are too great when the ratio of cavity depth to length exceeds the domain originally investigated by Cox and Schultz (1981). To keep the value reasonable, the program developed restricts the value of K to a maximum of 3.0.

I: <u>No current, no gas, finite spill</u>. Because there is no current, this is indistinguishable from the smooth ice situation for small-scale roughness. For large-scale roughness, the volume of the slick will become trapped in the cavities in the ice before it has expanded to the equilibrium thickness area. The program must determine from the cavity dimensions to what extent this will occur.

From roughness data, the cavity volume per unit area of ice and the oil volume per unit area in the equilibrium thickness layer are calculated and added together to give the total volume of oil per unit area, V_{area} (cavities are assumed to be completely filled with oil). Then, assuming the slick to be circular, centred on the release point:

$$A_s = V_s/V_{area}$$

where: A_s = area of slick, m^2

V_s = volume of slick, m^3

V_{area} = volume per unit area, m^3/m^2.

J: <u>No current, no gas, continuous spill</u>. Comments as for (I) apply, but the slick continues to expand as long as the spill continues. However, the area covered will at all times be less than for the smooth ice case, because of the entrapment of oil in the cavities.

K: <u>No current, gas, finite spill</u>. As per assumption (G) in "Model Specifications," the presence of gas with the oil increases the area covered by the oil by the same ratio as in the case of smooth ice. Thus, the area covered will be determined as for (I) above, then increased according to the amount of gas present (i.e., by a factor of seven for a GOR of 200).

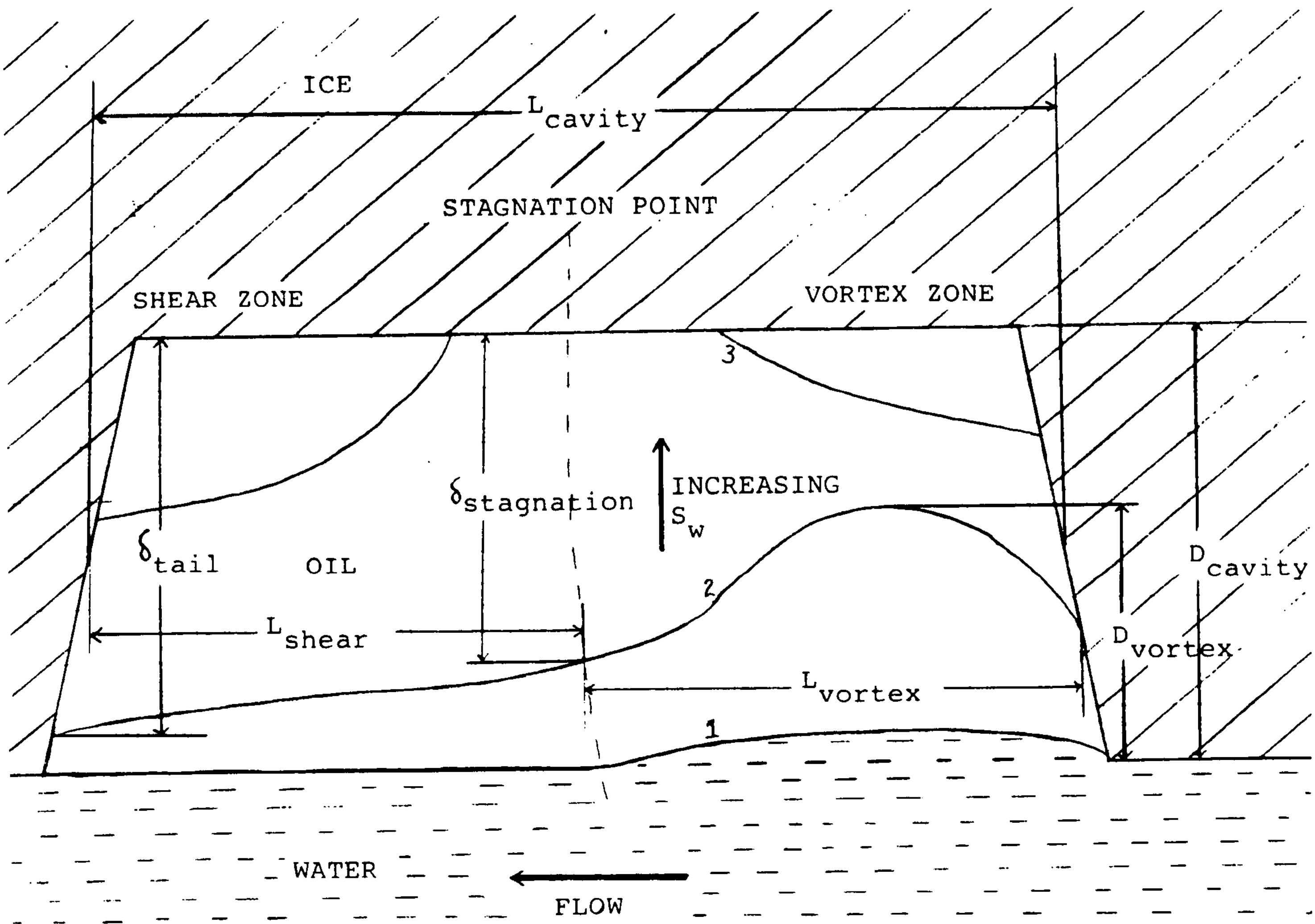


Figure 3. Schematic illustration of the shape taken by oil trapped in a cavity at different current speeds, showing the various parameters used to estimate the trapped volume.

L: No current, gas, continuous spill. Comments as for (K) apply, however, the base situation will be sub-type (J), which will then be expanded in area to reflect the presence of the gas.

M: Current, no gas, finite spill. The threshold velocity for oil movement must be modified from Equation 2, by multiplying by K (Equation 6), the friction amplification factor for rough ice. Currents below the threshold are treated as "no current," i.e., as for (I). For greater currents, small-scale roughness is comparable with smooth ice, but Equation 5 is used to determine the speed of the slick. For large-scale roughness, the amount of oil retained in each cavity is determined using Equations 7 through 16.

The first step in the calculation procedure is to determine the revised threshold current speed by calculating the friction amplification factor K from Equation 6 and multiplying the normal threshold speed by this factor.

a) IF $S_w > S_{th}.K$

- calculate the speed of the slick from Equation 5. (If the resulting speed is negative or zero, branch to the "no current" case.);
- determine the volume of oil per unit area that will be trapped in cavities, using the appropriate equations shown in the calculation regime chart (see Figure 2);
- call this V_{area}, - it should be less than V_{area}, (the no-current figure), and will be zero if Equation 8 shows the current to be greater than, or equal to, the trapping failure speed S_{fail}. Note that V'_{area} does NOT include an allowance for an equilibrium thickness layer of oil, whereas V_{area} does;
- IF $S_w < S_{fail}$, estimate the diameter of the slick as for the no-current situation (I), i.e., calculate V_{area} from the roughness data, and proceed exactly as for sub-type (I), including the equilibrium thickness layer of oil. Now assume that the current stretches the slick downstream into an oval shape. The width is assumed to remain the same, and the length can be determined from the increased area. The area increases because all the oil must be retained only in cavities; the equilibrium layer is moved until it encounters sufficient cavity space to hold it all, and the cavity volume per unit area, V'_{area}, is less than the no-current case.

  When the center of the upstream end is at the release point;

$$A'_s = A_s.V_{area}/V'_{area}$$

  where: A'_s = area of slick with current, m^2

  A_s = area of slick without current, m^2

  V_{area} = volume per unit area, no current, m^3/m^2

  V'_{area} = volume per unit area, in current, m^3/m^2.

- ELSE (cavities flushed) estimate the width as above, and the area as for smooth ice (case 'E'), giving an oval of similar form to the above, however this one will move bodily downstream at a speed given by Equation 5.

b) ELSE (no current) treat as sub-type (I).

N: Current, no gas, continuous spill. Comments as for (J) and (M) apply, however, the front of the slick will advance as long as the spill continues. When significant volumes of oil become trapped in cavities, the result will be a slower net rate of advance.

The calculation procedure for this sub-type is described:

a) IF $S_w > S_{th}.K$

- IF $S_w < S_{fail}$, calculate the width of the slick as for smooth ice i.e., sub-type (F). The slick is then assumed to be in the form of an oval the upstream end of which is centred on the release point, and the downstream edge of which advances continuously at an effective speed

$$S_e = S_s . \delta_{eq} / (\delta_{eq} + V'_{area})$$

where: S_e = speed of edge of slick, m/hr.
S_s = speed of body of slick, m/hr.
δ_{eq} = equilibrium thickness, m
V'_{area} = cavity volume per unit area, m^3/m^2.

Note that V'_{area} is calculated as for sub-type (M), and is the volume trapped per unit area, allowing for the effect of current. It is dimensionally equivalent to a thickness, and represents the average thickness of the trapped oil distributed uniformly over the area.

When the spill ceases, the downstream edge continues to advance at the same effective speed until all the oil in the equilibrium thickness layer is trapped. The final length is then given by:

$$L'_s = L_s(\delta_{eq} + V'_{area})/V'_{area}$$

where: L'_s = length of slick with no equilibrium layer

L_s = length of slick with equilibrium layer

L_s is the length at the instant the spill ceases; L'_s is the final length (these calculations assume a rectangular shape, and the results must be modified for the oval shape actually used in the model output).

- ELSE (cavities flushed) as before, but $S_e = S_s$ (i.e., $V'_{area} = 0$). If the spill ceases, the length remains fixed, but the entire slick moves bodily downstream at S_s.

b) ELSE (no current) treat as sub-type (J).

O: Current, gas, finite spill. Current below threshold reduces this sub-type to (K). Otherwise, the slick should be assumed to progress as for the no-gas situation in sub-type (M), but covering a larger area at each point in time.

P: Current, gas, continuous spill. This sub-type is similar to (N), but, if the current is sufficient to cause the oil to move, the width of the advancing front will be greater in proportion to the increase in area caused by the gas.

MODEL DOCUMENTATION

This section documents the requirements to load and run the program. It should be read thoroughly before attempting to run the program.

PROGRAM SOURCE

The oil in ice model is a computer program that is written in a high level programming language for easy transfer between systems. However, it will still have to be compiled into a workable module at the installation on which the model is to be run on.

This program and all but two explicit subroutines are written for the IBM VS FORTRAN compiler Version 1.3.0 (March 1983). Two PL/I subroutines access system date and time for page headings and plot output labels. The IBM VS FORTRAN is based on the ANSI X3.9-1978 version (a.k.a. FORTRAN 77). IBM has added extensions to the language and this program uses some of these for increased accuracy and readability. The use of the IBM extensions is kept to a minimum, for ease of conversion to another version of FORTRAN, if necessary.

The IBM extensions that are used in this program include:

- specification of storage space during variable definition; and
- use of character and non-character data in the same common block.

PROGRAM STRUCTURE

The model is comprised of a main program and four subroutines. The functions of the components are listed below:

- OILUICE mainline program to drive model
- PLOTIT subroutine to generate printed results and TELL-A-GRAF file
- QCOORD calculates new coordinates given original coordinates, direction and distance
- DATE retrieves system run date
- TIME retrieves system run time.

The list in Table 1 outlines the compile listings of which details are provided in Appendix 10.

TABLE 1

Program compile listings giving functions by statement groups

Program	ISN statements From	To	Function
OILUICE	2	26	Variable definitions
	27	27	Common block definition
	28	55	Variable initialization
	56	195	Run parameter prompting, input and edit routines
	196	207	Parameter verification routines
	208	235	Pick up ice roughness features
	236	240	Write simulation parameters used for the run
	241	253	Variable initialization for each iteration of the model
	257	267	No current, smooth ice, finite or continuous spill
	269	290	Current, smooth ice, finite spill
	291	341	Current, smooth ice, continuous spill
	342	356	Common calculations for rough ice routines
	357	365	No current, rough ice, finite or continuous spill
	368	378	Current, small ice roughness, finite spill
	379	445	Current, large ice roughness, finite spill; uses calculation regime chart
	447	484	Current, small ice roughness, continuous spill
	485	558	Current, large ice roughness, continuous spill; uses calculation regime chart in the program specifications

(Table 1 continued)

Program	ISN statements From	To	Function
	559	560	CALL routine to print and plot results and check if another time frame simulation is to be performed
	562	569	Print oil type table
	570	580	Print ice roughness table
	581	588	Print ice roughness table
	589	589	HALT execution
	590	628	FORMAT statements used in the program
PLOTIT	2	13	Variable definitions
	14	14	Common block definition
	15	210	Generate TELL-A-GRAF statements for the plot file
	211	215	Print hardcopy report of simulation result
	216	216	RETURN to calling program
	217	228	FORMAT statements for outputs
QCOORD	2	4	Variable definitions
	5	10	Variable initialization
	11	30	Compute new latitude
	31	35	Compute new longitude
	36	36	RETURN to calling routines

PROGRAM INPUTS

Five sets of input files must be set up prior to running the model. The other input file is a file of run time parameters that can be input at the time at which the program is run. In this section, the structure of the files are described by their fields, their formats, and the edits performed.

Ice Roughness Table

Each record in this table, (FT01F001), defines the ice roughness characteristics for an area of ice. The first set of latitudes and longitudes (Table 2) identify the northwest and southeast corners of the rectangular area. This is followed by the dimensions, angle, and spacing of the cavities. The drag coefficient is the last field for a complete record. Any number of entries can be made in this file.

The model finds the first table entry which specifies co-ordinate in which the original oil spill occurred. The ice roughness figures are used for the duration of the simulation. A set of sample data is shown in Appendix 1.

TABLE 2

Ice-roughness characteristics for an area of ice

Field		Format
NW latitude	(degrees)	I3
	(minutes)	I2
	(seconds)	I2
NW longitude	(degrees)	I3
	(minutes)	I2
	(seconds)	I2
SE latitude	(degrees)	I3
	(minutes)	I2
	(seconds)	I2
SE longitude	(degrees)	I3
	(minutes)	I2
	(seconds)	I2
Cavity depth	(cm)	F8.3
Cavity length	(cm)	F8.3
Cavity width	(cm)	F8.3
Cavity angle of orientation (degrees from true north)		F9.5
Spacing of cavities lengthwise (cm front-to-front)		F8.3
Spacing of cavities widthwise (cm)		F8.3
Drag coefficient		F7.5

Oil Type Table

This table, (FT02F001), defines the oil type and properties that the model can use (Table 3). The oil type number is used as a key to the table and is matched against the oil type specified in the parameter table. It is only used as a key and is not intended to be a standard oil type identifier. Thus "4" does not necessarily stand for "#4 Fuel Oil." Up to 99 entries can be made in this file, and a set of sample data is shown in Appendix 2.

TABLE 3

Oil type and properties used in the model

Field	Format
Oil type	I2
Viscosity	F6.3
Density	F5.3
Interfacial tension	F5.2
Interfacial friction	F5.3

Land Boundary Coordinates

This file, (FT03F001) of latitudes and longitudes of continuous land points defines the edge of the land region and can extend past the limits of the area to be plotted. Any number of entries can be made in it and its accuracy depends on the number of entries per unit of distance and thus is dependant on the user of the model. A set of sample data is shown in Appendix 4 with a map of the sample area shown in Appendix 3.

Field	Format
North latitude (degrees)	F6.3
West longitude (degrees)	F7.3

Ice Boundary Coordinates

This file, (FT04F001), of latitudes and longitudes of continuous landfast ice points, defines the edge of the landfast ice and can extend past the limits of the area to be plotted. Any number of entries can be made in this file, and its accuracy depends on the number of entries per unit of distance and thus is dependant on the user of the model. A set of sample data is shown in Appendix 5.

Field	Format
North latitude (degrees)	F6.3
West longitude (degrees)	F7.3

Run Time Parameters

This input file, (FT05F001), is used to retrieve all the run time parameters that are necessary to start the simulation(Table 4). The program has been set up as if this file were being entered interactively at a terminal session. If the program is run in batch mode, all input data must be carefully entered, because a reprompt for input to bad data causes the next entry to be read prematurely and unpredictable results to occur. A set of sample input is shown as part of the sample batch run JCL in Appendix 6.

TABLE 4

Run time parameters required to start simulation

Field	Format	Edits
Spill date and hour	I6, 1X, I2	YYMMDD, 0-24
Model duration (hours)	I4	0-4320
Spill latitude (degrees, minutes, seconds)	I2, 1X, I2, 1X, I2	0-90, 0-59, 0-59
Spill longitude (degrees, minutes, seconds)	13, 1X, I2, 1X, I2	0-180, 0-59, 0-59
Plot frequency (hours)	I4	0-4320
West plot longitude (degrees, minutes, seconds)	I3, 1X, I2, 1X, I2	0-180, 0-59, 0-59
East plot longitude (degrees, minutes, seconds)	I3, 1X, I2, 1X, I2	0-180, 0-59, 0-59
Oil type	I2	In oil table
Gas-to-oil ratio	I3	0 or 200
Spill duration (hours)	I4	0-4320
Spill flow (m^3/hour)	F14.5	>0
Spill quantity (m^3)	F14.5	>0
Water density (g/cm^3)	F7.5	>0

(Table 4 continued)

Field	Format	Edits
Current velocity (cm/sec)	F7.4	not negative
Current direction (degrees, minutes, seconds) (ONLY IF VELOCITY >0)	I3, 1X, I2, 1X, I2	0-360, 0-59, 0-59
Verify parameters	A1	Y, N
Reenter parameters	A1	Y, N

Gas-to-oil Ratio Spread Factors

The file, (FT11F001), contains the factors by which the oil slick spreads for various ratios of gas to oil. Up to 999 entries can be made in it using the following structure:

Field	Format
Gas-to-oil ratio	I3
Spread factor	F6.3

In the sample run a spread factor of 7 is used for a GOR of 200 (Dome Petroleum Limited 1981).

PROGRAM OUTPUTS

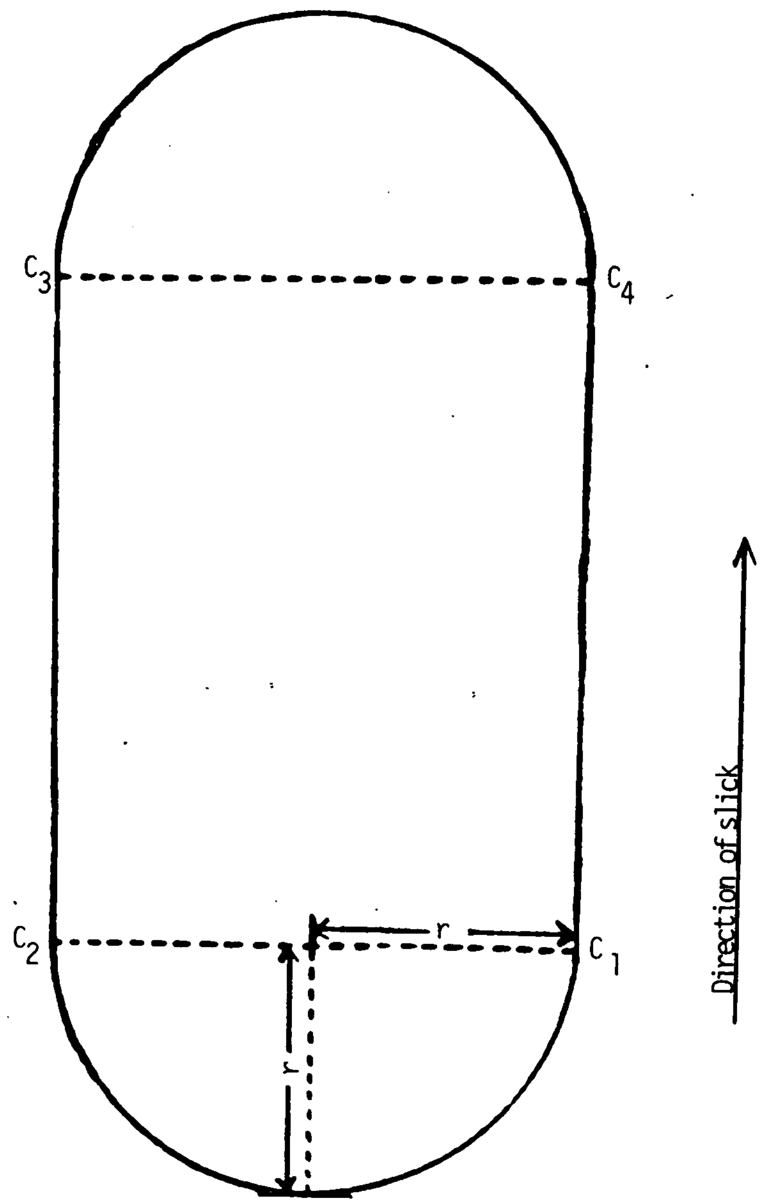
In this section all the outputs produced by this computer model are described and a sample printout for each is provided.

Run Parameter Prompter File

The file (FT06F001) is used in conjunction with the FT05F001 RUN PARAMETER input file. The program uses it to put out the appropriate prompt for input when it requires a run parameter. If an input parameter fails an edit check, the program will put an error message to the file and reprompt for the same parameter. A printout of the oil type table can also be written to this file after the oil type prompt is displayed. A sample output is given in Appendix 7, Sample 1.

Printed Results

There are two parts of this printout file, (FT07F001). The first part is a formatted printout of the parameters that are used in the simulation, which includes the input parameters, oil properties, and ice roughness data (Appendix 7, Sample 2). The second part of the printout is a series of simulation results (Appendix 7, Sample 3). There is one page of results for each plot produced, which is controlled by the input parameter for plot frequency. Each page of simulation results describes the shape, speed, volume, area, dimensions, and location of the oil slick. For circular slicks, the coordinates define the north, east, south, and west edges. For oval slicks, the coordinates define the corners of the rectangular portion of the slick (Figure 4).



r => radius of half circle

C_1 => first coordinate listed on the printout

r = width of slick/2.0

Figure 4. Orientation of printed coordinates for an oval-shaped oil slick.

Arrays Used

The printout that goes to file, (FT08F001), is formatted copies of the oil type (Appendix 7, Sample 4), ice roughness (Appendix 7, Sample 5), and gas-to-oil spread factor tables (Appendix 7, Sample 6) which were used as input into the program.

Error Report

If any errors occur during the course of the simulation, these will be listed on the error report (FT09F001). Examples of errors that can occur are:

- negative calculated slick speed;
- oil equilibrium thickness of less than 0.25 cm; and
- no ice roughness data to match the oil spill coordinates.

TELL-A-GRAF Command and Data File

The program output that is written to this file (FT10F001) is a set of graphic commands and data in a format that the software package called TELL-A-GRAF$_R$ will use to produce graphic illustrations of the simulation results. All data in this file are written from the PLOTIT routine. If TELL-A-GRAF is unavailable at the installation running the model and another graphics method is used, the subroutine PLOTIT will have to be modified to accommodate this; or the plots can be produced manually by transposing the printed results onto a map.

A sample printout of a TELL-A-GRAF file is included in Appendix 8, and sample graphs produced using the TELL-A-GRAF software are reproduced in Appendix 9.

LOADING THE MODEL

The program source will be on a single file on magnetic tape. The file will contain the FORTRAN mainline followed by two FORTRAM subroutines and two small PL/I subroutines. These will be in the same order as the listings in Appendix 10. The tape format is described as follows:

```
UNLABELLED
9 TRACK
1600 BPI
ASCII
FIXED BLOCK
RECORD LENGTH     = 80 BYTES
BLOCK LENGTH      = 80 BYTES
NUMBER OF RECORDS = 1747
1 FILE
```

If the tape is to be loaded onto an IBM system running MVS, the sample JCL in Figure 5 may be used, after slight modification for installation conventions.

Figure 5 IBM MVS source code load JCL.

```
//DSLDRGK  JOB (0844022),'$F11 RGK',TYPRUN=HOLD,
//             CLASS=L,MSGCLASS=N,NOTIFY=DSLDRGK
//* THIS JOB USES TAPE DL5503 AS INPUT (WRITE RING OUT).
/*JOBPARM L=0
//STP1      EXEC PGM=IEBGENER
//SYSIN     DD   DUMMY
//SYSPRINT  DD   SYSOUT=*
//SYSUT1    DD   UNIT=TAPE,VOLUME=SER=DL5503,
//          LABEL=(1,NL),
//          DCB=(RECFM=FB,BLKSIZE=80,LRECL=80,OPTCD=Q,DEN=3),
//          DISP=(,KEEP)
//SYSUT2    DD   UNIT=DISK,DSN=CANS.OILUICE.SRCE,
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=6160),
//          SPACE=(CYL,(2,2),RLSE),
//          DISP=(NEW,CATLG,DELETE)
//
```

RUNNING THE MODEL

Compilation and Link Edit

Once the program source has been loaded onto the system, the PL/I code is split from the FORTRAN code and compiled separately. If PL/I is not available on the installation, new subroutines will have to be written to access the run date and time, or the FORTRAN programs modified to remove the reference to these routines.

The second step is the compilation of the FORTRAN program source and link edit, which creates the workable module. To get the PL/I subroutine linkage to work properly at the DOME installation, the "AMODE=24" had to be specified in the link edit step.

If FORTRAN VS is not available at the installation, the source code will have to be modified for the version of FORTRAN being used, prior to compilation.

If any source code changes are made, the variable VERSNO must be changed accordingly. Internal documentation must also be updated to reflect any changes made to the program source.

File Setup

All program input files must be initialized with valid data in accordance with the structures described in "Program Inputs." It is the end user's responsibility to supply the data for these files.

Run Setup

Once the program is in a load module, it can be run either interactively or in batch mode.

If it is run in batch mode, set up the JOB CONTROL LANGUAGE for all files described in "Program Inputs" and "Program Outputs." A sample of the JCL required to do a batch run is shown in Appendix 6.

If the MODEL is to run interactively, FT05F001 should be allocated to terminal input, and FT06F001 should be assigned to terminal output. Input files will be assigned to the same file as in the batch run. Printed output file assignments are dependant on user requirements.

If TELL-A-GRAF is installed, the TELL-A-GRAF Command and Data File (FT10F001) can be used, after the model has been run, to produce graphic results of the simulation (see Appendix 9).

CONCLUSION

The development of this computer model has relied on a number of assumptions and predictions. However, the program does provide a method by which to define the possible location of oil under or in an ice cover. Whether or not the assumed methodology is proven erroneous by others, the authors feel that the program provides a supportive base from which alterations can be made. The software package has been designed to allow for future alterations.

APPENDICES

APPENDIX 1. SAMPLE ICE ROUGHNESS DATA

Refer to Table 2 in the text for the format

```
70 0 0 135 0 0 69 12 0 133 24 0  7.5 250.0 250.0 90.0  500.0 500.0  1.55
70 30 0 135 24 0 69 12 0 130 0 0  7.5 250.0 250.0 90.0  500.0 500.0  1.98
70 0 0 135 0 0 69 12 0 133 24 0  7.5 3.0 3.0 90.0  5.0 5.0  1.55
70 30 0 133 24 0 69 12 0 130 0 0  7.5 3.0 3.0 90.0  5.0 5.0  1.98
```

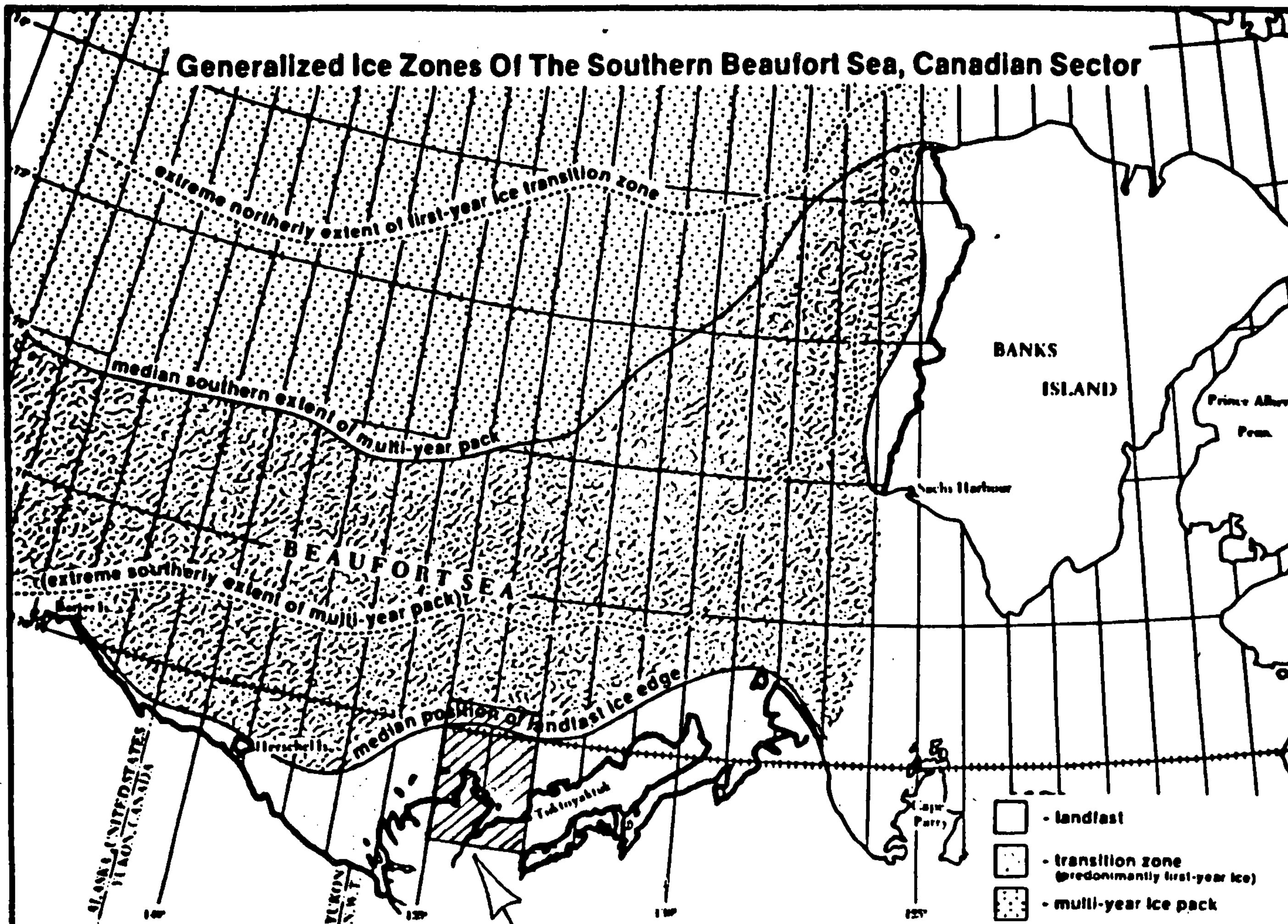
(The sample run's ice roughness data was taken from Danielwicz and Pilkington (1980) and communications with B. Danielwicz, Dome Petroleum).

APPENDIX 2. SAMPLE OIL TYPE ARRAY

Refer to Table 3 in the text for the format.

1	0.15	0.87	30.14	0.016
2	0.50	0.884	30.67	0.016
3	0.57	0.90	30.74	0.016
4	1.50	0.91	31.36	0.016
5	3.0	0.93	32.73	0.016
6	30.0	0.95	34.82	0.016

<u>APPENDIX 3. MAP OF SAMPLE AREA</u>



Area used for land and ice points.

APPENDIX 4. SAMPLE LAND COORDINATES

Refer to "Land Boundary Coordinates" in the text for the format.

69.420	135.0
69.420	134.9
69.460	134.8
69.500	134.7
69.380	134.6
69.600	134.7
69.600	134.6
69.690	134.55
69.800	134.62
69.760	134.5
69.800	134.4
69.730	134.2
69.700	134.3
69.670	134.2
69.640	134.3
69.600	134.2
69.500	134.1
69.480	134.0
69.470	133.8
69.250	134.0
69.180	134.1
69.150	134.1
69.250	133.85
69.260	133.85
69.260	133.7
69.275	133.6
69.280	133.5
69.285	133.4
69.290	133.3
69.295	133.2
69.300	133.1
69.298	132.95
69.305	133.05
69.395	132.95
69.650	133.05
69.730	133.0

APPENDIX 5. SAMPLE LANDFAST ICE COORDINATES

Refer to "Ice Boundary Coordinates" in the text for the format.

70.00	135.0
70.016	134.9
70.031	134.8
70.045	134.7
70.058	134.6
70.060	134.5
70.071	134.4
70.082	134.3
70.090	134.2
70.084	134.1
70.080	134.0
70.075	133.9
70.069	133.8
70.062	133.7
70.054	133.6
70.045	133.5
70.035	133.4
70.025	133.3
70.016	133.2
70.008	133.1
70.0	133.0

APPENDIX 6. SAMPLE RUN JCL (BATCH)

```
//DSLDRGK  JOB (0844022-DSLDRGK),'$F11 RK',MSGCLASS=N,NOTIFY=DSLDRGK,
//         CLASS=E
/*ROUTE PRINT RMT7
//FORT     EXEC PGM=OILUICE
//STEPLIB  DD DSN=SYS1.VFORTLIB,DISP=SHR
//         DD DSN=SYS1.FORTVS,DISP=SHR
//         DD DSN=CANS.TEST.LOAD,DISP=SHR
//FT01F001 DD DSN=CANS.TEST.IRGHTAB,DISP=SHR
//FT02F001 DD DSN=CANS.TEST.OILTAB,DISP=SHR
//FT11F001 DD DSN=CANS.TEST.GORSPR,DISP=SHR
//FT03F001 DD DSN=CANS.TEST.LANDPT,DISP=SHR
//FT04F001 DD DSN=CANS.TEST.ICEPTS,DISP=SHR
//FT05F001 DD *
841218,09
1464
69,55,0
134,12,0
240
134,48,0
133,54,0
2
200
1440
79.16667
1.0049
18.0
315 0 0
N
N
/*
//FT06F001 DD SYSOUT=*
//FT07F001 DD SYSOUT=*
//FT08F001 DD SYSOUT=*
//FT09F001 DD SYSOUT=*
//FT10F001 DD DSN=CANS.TEST.TELAFILE,DISP=OLD
//
```

APPENDIX 7. SAMPLE RUN OUTPUT

Sample 1

```
              D O M E   P E T R O L E U M          85/01/03 11:36:29

              OIL IN ICE COMPUTER MODEL

                     VERSION 1.0

            INPUT PARAMETER SPECIFICATIONS


ENTER SPILL DATE(YYMMDD) AND HOUR
      MODEL DURATION (HOURS)
      SPILL LATITUDE(DEG,MIN,SEC N)
      SPILL LONGITUDE(DEG,MIN,SEC W)
      PLOT FREQUENCY (HOURS)
      WEST PLOT LONGITUDE(DEG,MIN,SEC W)
      EAST PLOT LONGITUDE(DEG,MIN,SEC W)
      OIL TYPE('0' FOR LIST)
      GAS-TO-OIL RATIO(-1 FOR LIST,0 FOR NO GAS)
      SPILL DURATION (HOURS)
      SPILL FLOW(CUBIC METERS/HOUR)
      WATER DENSITY (G/CUBIC CM)
      CURRENT VELOCITY(CM/SEC)
      CURRENT DIRECTION(DEG,MIN,SEC)
VERIFY PARAMETERS? (Y/N)
```

Sample 2

D O M E   P E T R O L E U M   85/01/03 11:36:29

OIL IN ICE COMPUTER MODEL

VERSION 1.0

HARDCOPY SIMULATION RESULTS

SIMULATION PARAMETERS SPECIFIED

SPILL DATE-HOUR	==>	841218- 9
MODEL DURATION	==>	1464 HOURS
SPILL LATITUDE	==>	69 55 0 OR 69.9167 DEG. N
SPILL LONGITUDE	==>	134 12 0 OR 134.2000 DEG. W
PLOT FREQUENCY	==>	240 HOURS
PLOT WEST LONGITUDE	==>	134 48 0 OR 134.8000 DEG. W
PLOT EAST LONGITUDE	==>	133 54 0 OR 133.9000 DEG. W
PLOT NORTH LATITUDE	==>	69.7620 DEG. N
PLOT SOUTH LATITUDE	==>	70.0713 DEG. N
OIL TYPE	==>	2
VISCOSITY	==>	0.5000
DENSITY	==>	0.8840
INTERFACIAL TENSION	==>	30.6700
INTERFACIAL FRICTION	==>	0.0160
GAS-TO-OIL RATIO	==>	0.0
SPILL DURATION	==>	1440 HOURS
SPILL FLOW	==>	79.1667 CUBIC METERS/HOUR
SPILL QUANTITY	==>	114000.0048 CUBIC METERS
WATER DENSITY	==>	1.00490 G/CUBIC CM
CURRENT VELOCITY	==>	18.0000 CM/SEC
CURRENT DIRECTION	==>	315 0 0 OR 315.0000 DEG.

ICE ROUGHNESS CHARACTERICTICS

CAVITY DEPTH (CM.)	===>	7.5000
CAVITY LENGTH (CM.)	===>	250.0000
CAVITY WIDTH (CM.)	===>	250.0000
CAVITY ANGLE (DEG.)	===>	90.0000
CAVITY SPACING(LEN.CM.)	=>	500.0000
CAVITY SPACING(WID.CM.)	=>	500.0000
ROUGHNESS FORM DRAG	===>	1.5500

Sample 3

D O M E   P E T R O L E U M   85/01/03 11:36:29

OIL IN ICE COMPUTER MODEL
VERSION 1.0

SIMULATION RESULTS
84/12/28 9:00

OIL SLICK DATA

```
SHAPE =========> CIRCULAR
SPEED(CM/SEC)==>          0.88517
VOLUME(CU.M.)==>      19000.00080
AREA(SQ.M.) ===>    2044801.08082
LENGTH(M.) ====>       1613.54310
WIDTH(M.) =====>       1613.54310
THICKNESS(CM.)=>          0.64235
COORDINATES====>  69.92900 DEG. N. LAT. 134.21488 DEG. W. LONG.
                  69.92177 DEG. N. LAT. 134.19383 DEG. W. LONG.
                  69.91454 DEG. N. LAT. 134.21488 DEG. W. LONG.
                  69.92177 DEG. N. LAT. 134.23593 DEG. W. LONG.
ANGLE =========> 315.00000 DEG.
```

Sample 3 (con't)

```
                    D O M E   P E T R O L E U M          85/01/03 11:36:29

                    OIL IN ICE COMPUTER MODEL
                           VERSION 1.0

                       SIMULATION RESULTS
                         85/ 1/ 7  9:00

                         OIL SLICK DATA

SHAPE =========> CIRCULAR
SPEED(CM/SEC)==>         0.88517
VOLUME(CU.M.)==>     38000.00160
AREA(SQ.M.) ===>   3810154.84044
LENGTH(M.) ====>      2202.55291
WIDTH(M.) =====>      2202.55291
THICKNESS(CM.)=>         0.64235
COORDINATES====>  69.93351 DEG. N. LAT. 134.22031 DEG. W. LONG.
                  69.92363 DEG. N. LAT. 134.19158 DEG. W. LONG.
                  69.91376 DEG. N. LAT. 134.22031 DEG. W. LONG.
                  69.92363 DEG. N. LAT. 134.24905 DEG. W. LONG.
ANGLE =========> 315.00000 DEG.
```

Sample 3 (con't)

```
D O M E   P E T R O L E U M          85/01/03 11:36:29

OIL IN ICE COMPUTER MODEL
       VERSION 1.0

   SIMULATION RESULTS
     85/ 1/17  9:00

     OIL SLICK DATA

SHAPE =========> CIRCULAR
SPEED(CM/SEC)==>          0.88517
VOLUME(CU.M.)==>      57000.00240
AREA(SQ.M.) ===>    5296061.27886
LENGTH(M.) ====>       2596.75835
WIDTH(M.) =====>       2596.75835
THICKNESS(CM.)=>          0.64235
COORDINATES====>  69.93652 DEG. N. LAT. 134.22395 DEG. W. LONG.
                  69.92488 DEG. N. LAT. 134.19007 DEG. W. LONG.
                  69.91325 DEG. N. LAT. 134.22395 DEG. W. LONG.
                  69.92488 DEG. N. LAT. 134.25783 DEG. W. LONG.
ANGLE =========> 315.00000 DEG.
```

Sample 3 (con't)

```
          D O M E   P E T R O L E U M        85/01/03 11:36:29

          OIL IN ICE COMPUTER MODEL
                 VERSION 1.0

             SIMULATION RESULTS
               85/ 1/27  9:00

               OIL SLICK DATA


SHAPE =========> OVAL
SPEED(CM/SEC)==>         0.88517
VOLUME(CU.M.)==>     76000.00320
AREA(SQ.M.) ===>   7165164.89510
LENGTH(M.) ====>      3227.58980
WIDTH(M.) =====>      2707.31397
THICKNESS(CM.)=>         0.64235
COORDINATES====>  69.93381 DEG. N. LAT. 134.19999 DEG. W. LONG.
                  69.91665 DEG. N. LAT. 134.24994 DEG. W. LONG.
                  69.91995 DEG. N. LAT. 134.25954 DEG. W. LONG.
                  69.93711 DEG. N. LAT. 134.20958 DEG. W. LONG.
ANGLE =========> 315.00000 DEG.
```

Sample 3 (con't).

D O M E   P E T R O L E U M   85/01/03 11:36:29

OIL IN ICE COMPUTER MODEL
VERSION 1.0

SIMULATION RESULTS
85/ 2/ 6 9:00

OIL SLICK DATA

```
SHAPE =========> OVAL
SPEED(CM/SEC)==>         0.88517
VOLUME(CU.M.)==>     95000.00400
AREA(SQ.M.) ===>   9349689.63652
LENGTH(M.) ====>      4034.48725
WIDTH(M.) =====>      2707.31397
THICKNESS(CM.)=>         0.64235
COORDINATES====>  69.93381 DEG. N. LAT. 134.19999 DEG. W. LONG.
                  69.91665 DEG. N. LAT. 134.24994 DEG. W. LONG.
                  69.92506 DEG. N. LAT. 134.27444 DEG. W. LONG.
                  69.94222 DEG. N. LAT. 134.22447 DEG. W. LONG.
ANGLE =========> 315.00000 DEG.
```

Sample 3 (con't)

```
DOME PETROLEUM                  85/01/03 11:36:29

             OIL IN ICE COMPUTER MODEL
                    VERSION 1.0

                SIMULATION RESULTS
                  85/ 2/16  9:00

                  OIL SLICK DATA

SHAPE =========> OVAL
SPEED(CM/SEC)==>         0.88517
VOLUME(CU.M.)==>     114000.00480
AREA(SQ.M.) ===>   11534214.37794
LENGTH(M.) ====>       4841.38470
WIDTH(M.) =====>       2707.31397
THICKNESS(CM.)=>          0.64235
COORDINATES====>  69.93381 DEG. N. LAT. 134.19999 DEG. W. LONG.
                  69.91665 DEG. N. LAT. 134.24994 DEG. W. LONG.
                  69.93017 DEG. N. LAT. 134.28935 DEG. W. LONG.
                  69.94733 DEG. N. LAT. 134.23937 DEG. W. LONG.
ANGLE =========> 315.00000 DEG.
```

Sample 3 (con't)

```
            D O M E   P E T R O L E U M          85/01/03 11:36:29

            OIL IN ICE COMPUTER MODEL
                   VERSION 1.0

               SIMULATION RESULTS
                 85/ 2/26  9:00

                 OIL SLICK DATA

SHAPE =========> OVAL
SPEED(CM/SEC)==>          0.00000
VOLUME(CU.M.)==>     114000.00480
AREA(SQ.M.) ===>   13080208.60102
LENGTH(M.) ====>       5412.42826
WIDTH(M.) =====>       2707.31397
THICKNESS(CM.)=>          0.64235
COORDINATES====>  69.93381 DEG. N. LAT. 134.19999 DEG. W. LONG.
                  69.91665 DEG. N. LAT. 134.24994 DEG. W. LONG.
                  69.93379 DEG. N. LAT. 134.29991 DEG. W. LONG.
                  69.95095 DEG. N. LAT. 134.24992 DEG. W. LONG.
ANGLE =========> 315.00000 DEG.
```

Sample 4.

DOME PETROLEUM 85/01/03 11:36:29

OIL IN ICE COMPUTER MODEL

VERSION 1.0

INPUT TABLE VALUES

OIL TYPE ARRAY

OIL TYPE	VISCOSITY	DENSITY	INTERFACIAL TENSION	INTERFACIAL FRICTION
1	0.1500	0.8700	30.1400	0.0160
2	0.5000	0.8840	30.6700	0.0160
3	0.5700	0.9000	30.7400	0.0160
4	1.5000	0.9100	31.3600	0.0160
5	3.0000	0.9300	32.7300	0.0160
6	30.0000	0.9500	34.8200	0.0160

Sample 5

DOME PETROLEUM 85/01/03 11:36:29

OIL IN ICE COMPUTER MODEL

VERSION 1.0

INPUT TABLE VALUES

ICE ROUGHNESS ARRAY

-----NORTH WEST-----		-----SOUTH EAST-----		CAVITY	CAVITY	CAVITY	CAVITY	LENGTH CAVITY	WIDTH CAVITY	DRAG
LATITUDE	LONGITUDE	LATITUDE	LONGITUDE	DEPTH	LENGTH	WIDTH	ANGLE	SPACING	SPACING	COEFFICIENT
70.00000	135.00000	69.20000	133.39999	7.500	250.000	250.000	90.00000	500.000	500.000	1.55000
70.50000	135.39999	69.20000	130.00000	7.500	250.000	250.000	90.00000	500.000	500.000	1.98000
70.00000	135.00000	69.20000	133.39999	7.500	3.000	3.000	90.00000	5.000	5.000	1.55000
70.50000	133.39999	69.20000	130.00000	7.500	3.000	3.000	90.00000	5.000	5.000	1.98000

Sample 6.

D O M E   P E T R O L E U M   85/01/03 11:36:29

OIL IN ICE COMPUTER MODEL

VERSION 1.0

INPUT TABLE VALUES

GAS-TO-OIL SPREAD FACTORS

GAS-TO-OIL RATIO	SPREAD FACTOR
150	6.300
200	7.000

APPENDIX 8. SAMPLE TELL-A-GRAF FILE

```
GEN A PLOT.
EVERY MESSAGE CONNECT TL.
EVERY MESSAGE STYLE DUPLEX.
EVERY MESSAGE BLANKING OFF.
EVERY CURVE SYMBOL COUNT 0.
EVERY CURVE THICKNESS 3.
LEGEND FRAME ON.
PAGE BORDER OFF.
GRID TEXTURE SOLID.
X GRID ON.
X LENGTH 7.0.
X AXIS TEXT "LONGITUDE".
Y GRID ON.
Y LENGTH 7.0.
Y AXIS TEXT "LATITUDE".
MESSAGE 1 HEIGHT .2,COLOR WHITE.
MESSAGE 1 TEXT "OIL UNDER ICE".
MESSAGE 1 CONNECT BC,X 50,Y 100.
MESSAGE 1 UNITS PLOT-%.
MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.
MESSAGE 2 COLOR WHITE.
MESSAGE 2 TEXT "OILSPILL MODEL".
MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.
MESSAGE 3 COLOR WHITE.
MESSAGE 3 TEXT "VERSION 1.0".
MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.
MESSAGE 4 COLOR WHITE.
MESSAGE 4 TEXT "RUN: 85/01/03 11:36:29".
MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.
MESSAGE 5 COLOR WHITE.
MESSAGE 5 TEXT "SIMULATION: 84/12/28  9:00".
MESSAGE 6 UNITS COORDINATE.
MESSAGE 6 CONNECT BL.
MESSAGE 6 X 133.89999,Y 69.91666,HEIGHT .1.
MESSAGE 6 COLOR WHITE.
MESSAGE 6 TEXT " 1 (KM)".
MESSAGE 6 POINTER UNITS COORDINATE.
MESSAGE 6 POINTER BL 133.87391 69.91666.
MESSAGE 6 STUB 0.
MESSAGE 6 ARROWHEAD 0.
MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.
MESSAGE 7 COLOR WHITE.
MESSAGE 7 TEXT "OIL VOLUME:" "      19000.00080 CU.M.".
MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.
MESSAGE 8 COLOR WHITE.
MESSAGE 8 TEXT "SLICK AREA:" "    2044801.08082 SQ.M.".
MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.
MESSAGE 9 COLOR WHITE.
MESSAGE 9 TEXT "SLICK THICKNESS:" "         0.64235 CM.".
XMIN   134.79999.
XMAX   133.89999.
X STEP   0.10000.
YMIN    69.76201.
YMAX    70.07130.
Y STEP   0.10000.
CURVE 1.
CURVE COLOR GREEN.
CURVE TEXTURE CHAINDASHED.
CURVE 2.
```

```
CURVE COLOR BLUE.
CURVE SHADE COLOR BLUE.
CURVE SHADE PATTERN 135190.
CURVE PAIR 1.
CURVE 3.
CURVE COLOR WHITE.
CURVE SHADE COLOR WHITE.
CURVE SHADE PATTERN 45150.
CURVE SHADE PAIR 3.
CURVE 4.
CURVE SYMBOL COUNT 9999.
CURVE SYMBOL TYPE 4.
CURVE COLOR RED.
INPUT DATA.
"MAINLAND"
135.00000      69.42000
134.90000      69.42000
134.80000      69.46000
134.70000      69.50000
134.60000      69.38000
134.70000      69.60000
134.60000      69.60000
134.55000      69.69000
134.62000      69.80000
134.50000      69.76000
134.40000      69.80000
134.20000      69.73000
134.30000      69.70000
134.20000      69.67000
134.30000      69.64000
134.20000      69.60000
134.10000      69.50000
134.00000      69.48000
133.80000      69.47000
134.00000      69.25000
134.10000      69.18000
134.10000      69.15000
133.85000      69.25000
133.85000      69.26000
133.70000      69.26000
133.60000      69.27500
133.50000      69.28000
133.40000      69.28500
133.30000      69.29000
133.20000      69.29500
133.10000      69.30000
132.95000      69.29800
133.05000      69.30500
132.95000      69.39500
133.05000      69.65000
133.00000      69.73000
"LANDFAST ICE"
135.00000      70.00000
134.90000      70.01600
134.80000      70.03100
134.70000      70.04500
134.60000      70.05800
134.50000      70.06000
134.40000      70.07100
134.30000      70.08200
134.20000      70.09000
134.10000      70.08400
```

```
134.00000       70.08000
133.90000       70.07500
133.80000       70.06900
133.70000       70.06200
133.60000       70.05400
133.50000       70.04500
133.40000       70.03500
133.30000       70.02500
133.20000       70.01600
133.10000       70.00800
133.00000       70.00000
"OIL SLICK AREA"
134.21488       69.92900
134.21122       69.92889
134.20768       69.92856
134.20435       69.92803
134.20135       69.92731
134.19875       69.92642
134.19665       69.92538
134.19510       69.92424
134.19415       69.92302
134.19383       69.92177
134.19415       69.92051
134.19510       69.91929
134.19666       69.91815
134.19876       69.91712
134.20135       69.91623
134.20436       69.91551
134.20768       69.91497
134.21123       69.91465
134.21488       69.91454
134.21853       69.91465
134.22208       69.91497
134.22540       69.91551
134.22841       69.91623
134.23100       69.91712
134.23310       69.91815
134.23466       69.91929
134.23561       69.92051
134.23593       69.92177
134.23561       69.92302
134.23466       69.92424
134.23311       69.92538
134.23101       69.92642
134.22841       69.92731
134.22541       69.92803
134.22208       69.92856
134.21854       69.92889
134.21488       69.92900
"SPILL LOCATION"
134.20000       69.91666
EOD.
SEND.
**FILE**
GEN A PLOT.
EVERY MESSAGE CONNECT TL.
EVERY MESSAGE STYLE DUPLEX.
EVERY MESSAGE BLANKING OFF.
EVERY CURVE SYMBOL COUNT 0.
EVERY CURVE THICKNESS 3.
LEGEND FRAME ON.
PAGE BORDER OFF.
```

```
GRID TEXTURE SOLID.
X GRID ON.
X LENGTH 7.0.
X AXIS TEXT "LONGITUDE".
Y GRID ON.
Y LENGTH 7.0.
Y AXIS TEXT "LATITUDE".
MESSAGE 1 HEIGHT .2,COLOR WHITE.
MESSAGE 1 TEXT "OIL UNDER ICE".
MESSAGE 1 CONNECT BC,X 50,Y 100.
MESSAGE 1 UNITS PLOT-%.
MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.
MESSAGE 2 COLOR WHITE.
MESSAGE 2 TEXT "OILSPILL MODEL".
MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.
MESSAGE 3 COLOR WHITE.
MESSAGE 3 TEXT "VERSION 1.0".
MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.
MESSAGE 4 COLOR WHITE.
MESSAGE 4 TEXT "RUN: 85/01/03 11:36:29".
MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.
MESSAGE 5 COLOR WHITE.
MESSAGE 5 TEXT "SIMULATION: 85/ 1/ 7  9:00".
MESSAGE 6 UNITS COORDINATE.
MESSAGE 6 CONNECT BL.
MESSAGE 6 X 133.89999,Y 69.91666,HEIGHT .1.
MESSAGE 6 COLOR WHITE.
MESSAGE 6 TEXT " 1 (KM)".
MESSAGE 6 POINTER UNITS COORDINATE.
MESSAGE 6 POINTER BL 133.87391 69.91666.
MESSAGE 6 STUB 0.
MESSAGE 6 ARROWHEAD 0.
MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.
MESSAGE 7 COLOR WHITE.
MESSAGE 7 TEXT "OIL VOLUME:" "      38000.00160 CU.M.".
MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.
MESSAGE 8 COLOR WHITE.
MESSAGE 8 TEXT "SLICK AREA:" "    3810154.84044 SQ.M.".
MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.
MESSAGE 9 COLOR WHITE.
MESSAGE 9 TEXT "SLICK THICKNESS:" "         0.64235 CM.".
XMIN   134.79999.
XMAX   133.89999.
X STEP   0.10000.
YMIN    69.76201.
YMAX    70.07130.
Y STEP   0.10000.
CURVE 1.
CURVE COLOR GREEN.
CURVE TEXTURE CHAINDASHED.
CURVE 2.
CURVE COLOR BLUE.
CURVE SHADE COLOR BLUE.
CURVE SHADE PATTERN 135190.
CURVE PAIR 1.
CURVE 3.
CURVE COLOR WHITE.
CURVE SHADE COLOR WHITE.
CURVE SHADE PATTERN 45150.
CURVE SHADE PAIR 3.
CURVE 4.
CURVE SYMBOL COUNT 9999.
```

```
CURVE SYMBOL TYPE 4.
CURVE COLOR RED.
INPUT DATA.
"MAINLAND"
135.00000       69.42000
134.90000       69.42000
134.80000       69.46000
134.70000       69.50000
134.60000       69.38000
134.70000       69.60000
134.60000       69.60000
134.55000       69.69000
134.62000       69.80000
134.50000       69.76000
134.40000       69.80000
134.20000       69.73000
134.30000       69.70000
134.20000       69.67000
134.30000       69.64000
134.20000       69.60000
134.10000       69.50000
134.00000       69.48000
133.80000       69.47000
134.00000       69.25000
134.10000       69.18000
134.10000       69.15000
133.85000       69.25000
133.85000       69.26000
133.70000       69.26000
133.60000       69.27500
133.50000       69.28000
133.40000       69.28500
133.30000       69.29000
133.20000       69.29500
133.10000       69.30000
132.95000       69.29800
133.05000       69.30500
132.95000       69.39500
133.05000       69.65000
133.00000       69.73000
"LANDFAST ICE"
135.00000       70.00000
134.90000       70.01600
134.80000       70.03100
134.70000       70.04500
134.60000       70.05800
134.50000       70.06000
134.40000       70.07100
134.30000       70.08200
134.20000       70.09000
134.10000       70.08400
134.00000       70.08000
133.90000       70.07500
133.80000       70.06900
133.70000       70.06200
133.60000       70.05400
133.50000       70.04500
133.40000       70.03500
133.30000       70.02500
133.20000       70.01600
133.10000       70.00800
133.00000       70.00000
```

```
"OIL SLICK AREA"
134.22031      69.93351
134.21532      69.93336
134.21048      69.93291
134.20594      69.93218
134.20184      69.93120
134.19830      69.92998
134.19542      69.92857
134.19331      69.92701
134.19202      69.92535
134.19158      69.92363
134.19202      69.92192
134.19332      69.92026
134.19544      69.91870
134.19831      69.91729
134.20185      69.91607
134.20595      69.91509
134.21049      69.91436
134.21533      69.91391
134.22031      69.91376
134.22530      69.91391
134.23014      69.91436
134.23467      69.91509
134.23878      69.91607
134.24232      69.91729
134.24519      69.91870
134.24731      69.92026
134.24861      69.92192
134.24905      69.92363
134.24861      69.92535
134.24732      69.92701
134.24520      69.92857
134.24233      69.92998
134.23879      69.93120
134.23469      69.93218
134.23015      69.93291
134.22531      69.93336
134.22031      69.93351
"SPILL LOCATION"
134.20000      69.91666
EOD.
SEND.
**FILE**
GEN A PLOT.
EVERY MESSAGE CONNECT TL.
EVERY MESSAGE STYLE DUPLEX.
EVERY MESSAGE BLANKING OFF.
EVERY CURVE SYMBOL COUNT 0.
EVERY CURVE THICKNESS 3.
LEGEND FRAME ON.
PAGE BORDER OFF.
GRID TEXTURE SOLID.
X GRID ON.
X LENGTH 7.0.
X AXIS TEXT "LONGITUDE".
Y GRID ON.
Y LENGTH 7.0.
Y AXIS TEXT "LATITUDE".
MESSAGE 1 HEIGHT .2,COLOR WHITE.
MESSAGE 1 TEXT "OIL UNDER ICE".
MESSAGE 1 CONNECT BC,X 50,Y 100.
MESSAGE 1 UNITS PLOT-%.
```

```
MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.
MESSAGE 2 COLOR WHITE.
MESSAGE 2 TEXT "OILSPILL MODEL".
MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.
MESSAGE 3 COLOR WHITE.
MESSAGE 3 TEXT "VERSION 1.0".
MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.
MESSAGE 4 COLOR WHITE.
MESSAGE 4 TEXT "RUN: 85/01/03 11:36:29".
MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.
MESSAGE 5 COLOR WHITE.
MESSAGE 5 TEXT "SIMULATION: 85/ 1/17  9:00".
MESSAGE 6 UNITS COORDINATE.
MESSAGE 6 CONNECT BL.
MESSAGE 6 X 133.89999,Y 69.91666,HEIGHT .1.
MESSAGE 6 COLOR WHITE.
MESSAGE 6 TEXT " 1 (KM)".
MESSAGE 6 POINTER UNITS COORDINATE.
MESSAGE 6 POINTER BL 133.87391 69.91666.
MESSAGE 6 STUB 0.
MESSAGE 6 ARROWHEAD 0.
MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.
MESSAGE 7 COLOR WHITE.
MESSAGE 7 TEXT "OIL VOLUME:" "      57000.00240 CU.M.".
MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.
MESSAGE 8 COLOR WHITE.
MESSAGE 8 TEXT "SLICK AREA:" "    5296061.27886 SQ.M.".
MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.
MESSAGE 9 COLOR WHITE.
MESSAGE 9 TEXT "SLICK THICKNESS:" "         0.64235 CM.".
XMIN   134.79999.
XMAX   133.89999.
X STEP   0.10000.
YMIN    69.76201.
YMAX    70.07130.
Y STEP   0.10000.
CURVE 1.
CURVE COLOR GREEN.
CURVE TEXTURE CHAINDASHED.
CURVE 2.
CURVE COLOR BLUE.
CURVE SHADE COLOR BLUE.
CURVE SHADE PATTERN 135190.
CURVE PAIR 1.
CURVE 3.
CURVE COLOR WHITE.
CURVE SHADE COLOR WHITE.
CURVE SHADE PATTERN 45150.
CURVE SHADE PAIR 3.
CURVE 4.
CURVE SYMBOL COUNT 9999.
CURVE SYMBOL TYPE 4.
CURVE COLOR RED.
INPUT DATA.
"MAINLAND"
135.00000      69.42000
134.90000      69.42000
134.80000      69.46000
134.70000      69.50000
134.60000      69.38000
134.70000      69.60000
134.60000      69.60000
```

134.55000	69.69000
134.62000	69.80000
134.50000	69.76000
134.40000	69.80000
134.20000	69.73000
134.30000	69.70000
134.20000	69.67000
134.30000	69.64000
134.20000	69.60000
134.10000	69.50000
134.00000	69.48000
133.80000	69.47000
134.00000	69.25000
134.10000	69.18000
134.10000	69.15000
133.85000	69.25000
133.85000	69.26000
133.70000	69.26000
133.60000	69.27500
133.50000	69.28000
133.40000	69.28500
133.30000	69.29000
133.20000	69.29500
133.10000	69.30000
132.95000	69.29800
133.05000	69.30500
132.95000	69.39500
133.05000	69.65000
133.00000	69.73000
"LANDFAST ICE"	
135.00000	70.00000
134.90000	70.01600
134.80000	70.03100
134.70000	70.04500
134.60000	70.05800
134.50000	70.06000
134.40000	70.07100
134.30000	70.08200
134.20000	70.09000
134.10000	70.08400
134.00000	70.08000
133.90000	70.07500
133.80000	70.06900
133.70000	70.06200
133.60000	70.05400
133.50000	70.04500
133.40000	70.03500
133.30000	70.02500
133.20000	70.01600
133.10000	70.00800
133.00000	70.00000
"OIL SLICK AREA"	
134.22395	69.93652
134.21807	69.93635
134.21236	69.93582
134.20701	69.93496
134.20217	69.93380
134.19799	69.93236
134.19461	69.93070
134.19211	69.92886
134.19059	69.92690
134.19007	69.92488

```
134.19059       69.92286
134.19212       69.92090
134.19462       69.91906
134.19801       69.91740
134.20219       69.91597
134.20702       69.91480
134.21237       69.91395
134.21807       69.91342
134.22395       69.91325
134.22983       69.91342
134.23553       69.91395
134.24088       69.91480
134.24572       69.91597
134.24989       69.91740
134.25328       69.91906
134.25578       69.92090
134.25731       69.92286
134.25783       69.92488
134.25732       69.92690
134.25579       69.92886
134.25330       69.93070
134.24991       69.93236
134.24574       69.93380
134.24090       69.93496
134.23554       69.93582
134.22984       69.93635
134.22395       69.93652
"SPILL LOCATION"
134.20000       69.91666
EOD.
SEND.
**FILE**
GEN A PLOT.
EVERY MESSAGE CONNECT TL.
EVERY MESSAGE STYLE DUPLEX.
EVERY MESSAGE BLANKING OFF.
EVERY CURVE SYMBOL COUNT 0.
EVERY CURVE THICKNESS 3.
LEGEND FRAME ON.
PAGE BORDER OFF.
GRID TEXTURE SOLID.
X GRID ON.
X LENGTH 7.0.
X AXIS TEXT "LONGITUDE".
Y GRID ON.
Y LENGTH 7.0.
Y AXIS TEXT "LATITUDE".
MESSAGE 1 HEIGHT .2,COLOR WHITE.
MESSAGE 1 TEXT "OIL UNDER ICE".
MESSAGE 1 CONNECT BC,X 50,Y 100.
MESSAGE 1 UNITS PLOT-%.
MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.
MESSAGE 2 COLOR WHITE.
MESSAGE 2 TEXT "OILSPILL MODEL".
MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.
MESSAGE 3 COLOR WHITE.
MESSAGE 3 TEXT "VERSION 1.0".
MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.
MESSAGE 4 COLOR WHITE.
MESSAGE 4 TEXT "RUN: 85/01/03 11:36:29".
MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.
MESSAGE 5 COLOR WHITE.
```

```
MESSAGE 5 TEXT "SIMULATION: 85/ 1/27  9:00".
MESSAGE 6 UNITS COORDINATE.
MESSAGE 6 CONNECT BL.
MESSAGE 6 X 133.89999,Y 69.91666,HEIGHT .1.
MESSAGE 6 COLOR WHITE.
MESSAGE 6 TEXT " 1 (KM)".
MESSAGE 6 POINTER UNITS COORDINATE.
MESSAGE 6 POINTER BL 133.87391 69.91666.
MESSAGE 6 STUB 0.
MESSAGE 6 ARROWHEAD 0.
MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.
MESSAGE 7 COLOR WHITE.
MESSAGE 7 TEXT "OIL VOLUME:" "      76000.00320 CU.M.".
MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.
MESSAGE 8 COLOR WHITE.
MESSAGE 8 TEXT "SLICK AREA:" "    7165164.89510 SQ.M.".
MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.
MESSAGE 9 COLOR WHITE.
MESSAGE 9 TEXT "SLICK THICKNESS:" "         0.64235 CM.".
XMIN   134.79999.
XMAX   133.89999.
X STEP   0.10000.
YMIN    69.76201.
YMAX    70.07130.
Y STEP   0.10000.
CURVE 1.
CURVE COLOR GREEN.
CURVE TEXTURE CHAINDASHED.
CURVE 2.
CURVE COLOR BLUE.
CURVE SHADE COLOR BLUE.
CURVE SHADE PATTERN 135190.
CURVE PAIR 1.
CURVE 3.
CURVE COLOR WHITE.
CURVE SHADE COLOR WHITE.
CURVE SHADE PATTERN 45150.
CURVE SHADE PAIR 3.
CURVE 4.
CURVE SYMBOL COUNT 9999.
CURVE SYMBOL TYPE 4.
CURVE COLOR RED.
INPUT DATA.
"MAINLAND"
135.00000      69.42000
134.90000      69.42000
134.80000      69.46000
134.70000      69.50000
134.60000      69.38000
134.70000      69.60000
134.60000      69.60000
134.55000      69.69000
134.62000      69.80000
134.50000      69.76000
134.40000      69.80000
134.20000      69.73000
134.30000      69.70000
134.20000      69.67000
134.30000      69.64000
134.20000      69.60000
134.10000      69.50000
134.00000      69.48000
```

133.80000	69.47000
134.00000	69.25000
134.10000	69.18000
134.10000	69.15000
133.85000	69.25000
133.85000	69.26000
133.70000	69.26000
133.60000	69.27500
133.50000	69.28000
133.40000	69.28500
133.30000	69.29000
133.20000	69.29500
133.10000	69.30000
132.95000	69.29800
133.05000	69.30500
132.95000	69.39500
133.05000	69.65000
133.00000	69.73000
"LANDFAST ICE"	
135.00000	70.00000
134.90000	70.01600
134.80000	70.03100
134.70000	70.04500
134.60000	70.05800
134.50000	70.06000
134.40000	70.07100
134.30000	70.08200
134.20000	70.09000
134.10000	70.08400
134.00000	70.08000
133.90000	70.07500
133.80000	70.06900
133.70000	70.06200
133.60000	70.05400
133.50000	70.04500
133.40000	70.03500
133.30000	70.02500
133.20000	70.01600
133.10000	70.00800
133.00000	70.00000
"OIL SLICK AREA"	
134.19999	69.93381
134.19603	69.93219
134.19295	69.93036
134.19085	69.92837
134.18978	69.92629
134.18979	69.92417
134.19086	69.92209
134.19297	69.92010
134.19605	69.91827
134.20001	69.91665
134.20472	69.91529
134.21005	69.91424
134.21584	69.91351
134.22190	69.91315
134.22805	69.91315
134.23411	69.91351
134.23989	69.91424
134.24522	69.91529
134.24994	69.91665
134.25954	69.91995
134.26350	69.92157

```
134.26658      69.92340
134.26869      69.92539
134.26976      69.92747
134.26977      69.92959
134.26870      69.93167
134.26660      69.93366
134.26352      69.93549
134.25956      69.93711
134.25484      69.93847
134.24951      69.93953
134.24372      69.94025
134.23765      69.94062
134.23149      69.94062
134.22542      69.94025
134.21964      69.93953
134.21430      69.93847
134.20958      69.93711
134.19999      69.93381
"SPILL LOCATION"
134.20000      69.91666
EOD.
SEND.
**FILE**
GEN A PLOT.
EVERY MESSAGE CONNECT TL.
EVERY MESSAGE STYLE DUPLEX.
EVERY MESSAGE BLANKING OFF.
EVERY CURVE SYMBOL COUNT 0.
EVERY CURVE THICKNESS 3.
LEGEND FRAME ON.
PAGE BORDER OFF.
GRID TEXTURE SOLID.
X GRID ON.
X LENGTH 7.0.
X AXIS TEXT "LONGITUDE".
Y GRID ON.
Y LENGTH 7.0.
Y AXIS TEXT "LATITUDE".
MESSAGE 1 HEIGHT .2,COLOR WHITE.
MESSAGE 1 TEXT "OIL UNDER ICE".
MESSAGE 1 CONNECT BC,X 50,Y 100.
MESSAGE 1 UNITS PLOT-%.
MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.
MESSAGE 2 COLOR WHITE.
MESSAGE 2 TEXT "OILSPILL MODEL".
MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.
MESSAGE 3 COLOR WHITE.
MESSAGE 3 TEXT "VERSION 1.0".
MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.
MESSAGE 4 COLOR WHITE.
MESSAGE 4 TEXT "RUN: 85/01/03 11:36:29".
MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.
MESSAGE 5 COLOR WHITE.
MESSAGE 5 TEXT "SIMULATION: 85/ 2/ 6  9:00".
MESSAGE 6 UNITS COORDINATE.
MESSAGE 6 CONNECT BL.
MESSAGE 6 X 133.89999,Y 69.91666,HEIGHT .1.
MESSAGE 6 COLOR WHITE.
MESSAGE 6 TEXT " 1 (KM)".
MESSAGE 6 POINTER UNITS COORDINATE.
MESSAGE 6 POINTER BL 133.87391 69.91666.
MESSAGE 6 STUB 0.
```

```
MESSAGE 6 ARROWHEAD 0.
MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.
MESSAGE 7 COLOR WHITE.
MESSAGE 7 TEXT "OIL VOLUME:" "      95000.00400 CU.M.".
MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.
MESSAGE 8 COLOR WHITE.
MESSAGE 8 TEXT "SLICK AREA:" "    9349689.63652 SQ.M.".
MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.
MESSAGE 9 COLOR WHITE.
MESSAGE 9 TEXT "SLICK THICKNESS:" "          0.64235 CM.".
XMIN   134.79999.
XMAX   133.89999.
X STEP   0.10000.
YMIN    69.76201.
YMAX    70.07130.
Y STEP   0.10000.
CURVE 1.
CURVE COLOR GREEN.
CURVE TEXTURE CHAINDASHED.
CURVE 2.
CURVE COLOR BLUE.
CURVE SHADE COLOR BLUE.
CURVE SHADE PATTERN 135190.
CURVE PAIR 1.
CURVE 3.
CURVE COLOR WHITE.
CURVE SHADE COLOR WHITE.
CURVE SHADE PATTERN 45150.
CURVE SHADE PAIR 3.
CURVE 4.
CURVE SYMBOL COUNT 9999.
CURVE SYMBOL TYPE 4.
CURVE COLOR RED.
INPUT DATA.
"MAINLAND"
135.00000      69.42000
134.90000      69.42000
134.80000      69.46000
134.70000      69.50000
134.60000      69.38000
134.70000      69.60000
134.60000      69.60000
134.55000      69.69000
134.62000      69.80000
134.50000      69.76000
134.40000      69.80000
134.20000      69.73000
134.30000      69.70000
134.20000      69.67000
134.30000      69.64000
134.20000      69.60000
134.10000      69.50000
134.00000      69.48000
133.80000      69.47000
134.00000      69.25000
134.10000      69.18000
134.10000      69.15000
133.85000      69.25000
133.85000      69.26000
133.70000      69.26000
133.60000      69.27500
133.50000      69.28000
```

133.40000	69.28500
133.30000	69.29000
133.20000	69.29500
133.10000	69.30000
132.95000	69.29800
133.05000	69.30500
132.95000	69.39500
133.05000	69.65000
133.00000	69.73000
"LANDFAST ICE"	
135.00000	70.00000
134.90000	70.01600
134.80000	70.03100
134.70000	70.04500
134.60000	70.05800
134.50000	70.06000
134.40000	70.07100
134.30000	70.08200
134.20000	70.09000
134.10000	70.08400
134.00000	70.08000
133.90000	70.07500
133.80000	70.06900
133.70000	70.06200
133.60000	70.05400
133.50000	70.04500
133.40000	70.03500
133.30000	70.02500
133.20000	70.01600
133.10000	70.00800
133.00000	70.00000
"OIL SLICK AREA"	
134.19999	69.93381
134.19603	69.93219
134.19295	69.93036
134.19085	69.92837
134.18978	69.92629
134.18979	69.92417
134.19086	69.92209
134.19297	69.92010
134.19605	69.91827
134.20001	69.91665
134.20472	69.91529
134.21005	69.91424
134.21584	69.91351
134.22190	69.91315
134.22805	69.91315
134.23411	69.91351
134.23989	69.91424
134.24522	69.91529
134.24994	69.91665
134.27444	69.92506
134.27840	69.92668
134.28149	69.92851
134.28359	69.93050
134.28467	69.93258
134.28467	69.93470
134.28360	69.93678
134.28150	69.93877
134.27842	69.94060
134.27446	69.94222
134.26975	69.94358

```
134.26441      69.94464
134.25862      69.94536
134.25255      69.94573
134.24639      69.94573
134.24032      69.94536
134.23453      69.94464
134.22919      69.94358
134.22447      69.94222
134.19999      69.93381
"SPILL LOCATION"
134.20000      69.91666
EOD.
SEND.
**FILE**
GEN A PLOT.
EVERY MESSAGE CONNECT TL.
EVERY MESSAGE STYLE DUPLEX.
EVERY MESSAGE BLANKING OFF.
EVERY CURVE SYMBOL COUNT 0.
EVERY CURVE THICKNESS 3.
LEGEND FRAME ON.
PAGE BORDER OFF.
GRID TEXTURE SOLID.
X GRID ON.
X LENGTH 7.0.
X AXIS TEXT "LONGITUDE".
Y GRID ON.
Y LENGTH 7.0.
Y AXIS TEXT "LATITUDE".
MESSAGE 1 HEIGHT .2,COLOR WHITE.
MESSAGE 1 TEXT "OIL UNDER ICE".
MESSAGE 1 CONNECT BC,X 50,Y 100.
MESSAGE 1 UNITS PLOT-%.
MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.
MESSAGE 2 COLOR WHITE.
MESSAGE 2 TEXT "OILSPILL MODEL".
MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.
MESSAGE 3 COLOR WHITE.
MESSAGE 3 TEXT "VERSION 1.0".
MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.
MESSAGE 4 COLOR WHITE.
MESSAGE 4 TEXT "RUN: 85/01/03 11:36:29".
MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.
MESSAGE 5 COLOR WHITE.
MESSAGE 5 TEXT "SIMULATION: 85/ 2/16  9:00".
MESSAGE 6 UNITS COORDINATE.
MESSAGE 6 CONNECT BL.
MESSAGE 6 X 133.89999,Y 69.91666,HEIGHT .1.
MESSAGE 6 COLOR WHITE.
MESSAGE 6 TEXT " 1 (KM)".
MESSAGE 6 POINTER UNITS COORDINATE.
MESSAGE 6 POINTER BL 133.87391 69.91666.
MESSAGE 6 STUB 0.
MESSAGE 6 ARROWHEAD 0.
MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.
MESSAGE 7 COLOR WHITE.
MESSAGE 7 TEXT "OIL VOLUME:" "      114000.00480 CU.M.".
MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.
MESSAGE 8 COLOR WHITE.
MESSAGE 8 TEXT "SLICK AREA:" "   11534214.37794 SQ.M.".
MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.
MESSAGE 9 COLOR WHITE.
```

```
MESSAGE 9 TEXT "SLICK THICKNESS:" "          0.64235 CM.".
XMIN   134.79999.
XMAX   133.89999.
X STEP   0.10000.
YMIN    69.76201.
YMAX    70.07130.
Y STEP   0.10000.
CURVE 1.
CURVE COLOR GREEN.
CURVE TEXTURE CHAINDASHED.
CURVE 2.
CURVE COLOR BLUE.
CURVE SHADE COLOR BLUE.
CURVE SHADE PATTERN 135190.
CURVE PAIR 1.
CURVE 3.
CURVE COLOR WHITE.
CURVE SHADE COLOR WHITE.
CURVE SHADE PATTERN 45150.
CURVE SHADE PAIR 3.
CURVE 4.
CURVE SYMBOL COUNT 9999.
CURVE SYMBOL TYPE 4.
CURVE COLOR RED.
INPUT DATA.
"MAINLAND"
135.00000      69.42000
134.90000      69.42000
134.80000      69.46000
134.70000      69.50000
134.60000      69.38000
134.70000      69.60000
134.60000      69.60000
134.55000      69.69000
134.62000      69.80000
134.50000      69.76000
134.40000      69.80000
134.20000      69.73000
134.30000      69.70000
134.20000      69.67000
134.30000      69.64000
134.20000      69.60000
134.10000      69.50000
134.00000      69.48000
133.80000      69.47000
134.00000      69.25000
134.10000      69.18000
134.10000      69.15000
133.85000      69.25000
133.85000      69.26000
133.70000      69.26000
133.60000      69.27500
133.50000      69.28000
133.40000      69.28500
133.30000      69.29000
133.20000      69.29500
133.10000      69.30000
132.95000      69.29800
133.05000      69.30500
132.95000      69.39500
133.05000      69.65000
133.00000      69.73000
```

"LANDFAST ICE"

135.00000	70.00000
134.90000	70.01600
134.80000	70.03100
134.70000	70.04500
134.60000	70.05800
134.50000	70.06000
134.40000	70.07100
134.30000	70.08200
134.20000	70.09000
134.10000	70.08400
134.00000	70.08000
133.90000	70.07500
133.80000	70.06900
133.70000	70.06200
133.60000	70.05400
133.50000	70.04500
133.40000	70.03500
133.30000	70.02500
133.20000	70.01600
133.10000	70.00800
133.00000	70.00000

"OIL SLICK AREA"

134.19999	69.93381
134.19603	69.93219
134.19295	69.93036
134.19085	69.92837
134.18978	69.92629
134.18979	69.92417
134.19086	69.92209
134.19297	69.92010
134.19605	69.91827
134.20001	69.91665
134.20472	69.91529
134.21005	69.91424
134.21584	69.91351
134.22190	69.91315
134.22805	69.91315
134.23411	69.91351
134.23989	69.91424
134.24522	69.91529
134.24994	69.91665
134.28935	69.93017
134.29331	69.93179
134.29640	69.93363
134.29851	69.93561
134.29958	69.93769
134.29958	69.93981
134.29852	69.94189
134.29641	69.94388
134.29333	69.94571
134.28937	69.94733
134.28465	69.94869
134.27932	69.94975
134.27352	69.95048
134.26745	69.95084
134.26129	69.95084
134.25522	69.95048
134.24943	69.94975
134.24409	69.94869
134.23937	69.94733
134.19999	69.93381

```
"SPILL LOCATION"
134.20000      69.91666
EOD.
SEND.
**FILE**
GEN A PLOT.
EVERY MESSAGE CONNECT TL.
EVERY MESSAGE STYLE DUPLEX.
EVERY MESSAGE BLANKING OFF.
EVERY CURVE SYMBOL COUNT 0.
EVERY CURVE THICKNESS 3.
LEGEND FRAME ON.
PAGE BORDER OFF.
GRID TEXTURE SOLID.
X GRID ON.
X LENGTH 7.0.
X AXIS TEXT "LONGITUDE".
Y GRID ON.
Y LENGTH 7.0.
Y AXIS TEXT "LATITUDE".
MESSAGE 1 HEIGHT .2,COLOR WHITE.
MESSAGE 1 TEXT "OIL UNDER ICE".
MESSAGE 1 CONNECT BC,X 50,Y 100.
MESSAGE 1 UNITS PLOT-%.
MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.
MESSAGE 2 COLOR WHITE.
MESSAGE 2 TEXT "OILSPILL MODEL".
MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.
MESSAGE 3 COLOR WHITE.
MESSAGE 3 TEXT "VERSION 1.0".
MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.
MESSAGE 4 COLOR WHITE.
MESSAGE 4 TEXT "RUN: 85/01/03 11:36:29".
MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.
MESSAGE 5 COLOR WHITE.
MESSAGE 5 TEXT "SIMULATION: 85/ 2/26  9:00".
MESSAGE 6 UNITS COORDINATE.
MESSAGE 6 CONNECT BL.
MESSAGE 6 X 133.89999,Y 69.91666,HEIGHT .1.
MESSAGE 6 COLOR WHITE.
MESSAGE 6 TEXT " 1 (KM)".
MESSAGE 6 POINTER UNITS COORDINATE.
MESSAGE 6 POINTER BL 133.87391 69.91666.
MESSAGE 6 STUB 0.
MESSAGE 6 ARROWHEAD 0.
MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.
MESSAGE 7 COLOR WHITE.
MESSAGE 7 TEXT "OIL VOLUME:" "     114000.00480 CU.M.".
MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.
MESSAGE 8 COLOR WHITE.
MESSAGE 8 TEXT "SLICK AREA:" "   13080208.60102 SQ.M.".
MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.
MESSAGE 9 COLOR WHITE.
MESSAGE 9 TEXT "SLICK THICKNESS:" "          0.64235 CM.".
XMIN   134.79999.
XMAX   133.89999.
X STEP   0.10000.
YMIN    69.76201.
YMAX    70.07130.
Y STEP   0.10000.
CURVE 1.
CURVE COLOR GREEN.
```

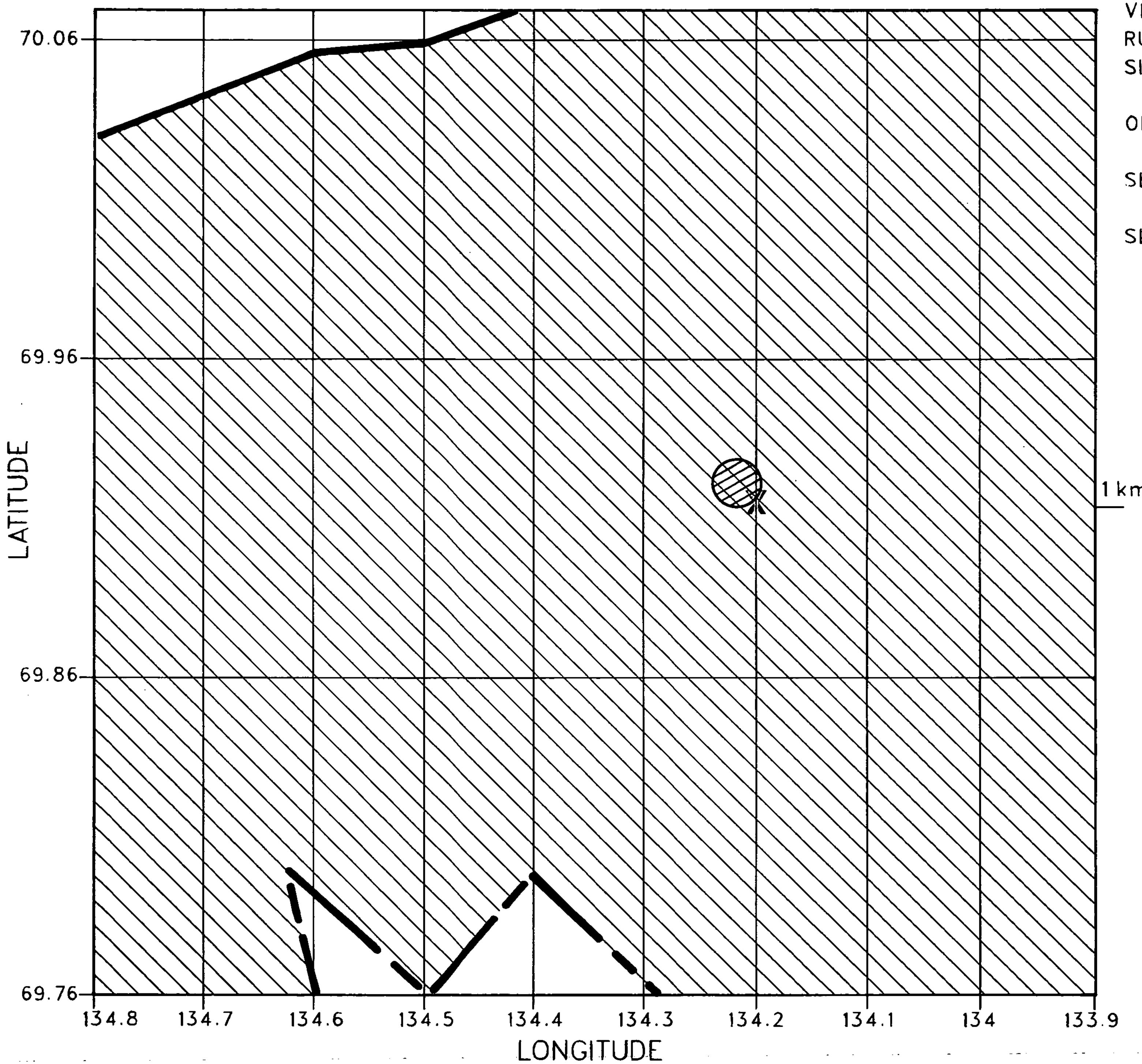
```
CURVE TEXTURE CHAINDASHED.
CURVE 2.
CURVE COLOR BLUE.
CURVE SHADE COLOR BLUE.
CURVE SHADE PATTERN 135190.
CURVE PAIR 1.
CURVE 3.
CURVE COLOR WHITE.
CURVE SHADE COLOR WHITE.
CURVE SHADE PATTERN 45150.
CURVE SHADE PAIR 3.
CURVE 4.
CURVE SYMBOL COUNT 9999.
CURVE SYMBOL TYPE 4.
CURVE COLOR RED.
INPUT DATA.
"MAINLAND"
135.00000      69.42000
134.90000      69.42000
134.80000      69.46000
134.70000      69.50000
134.60000      69.38000
134.70000      69.60000
134.60000      69.60000
134.55000      69.69000
134.62000      69.80000
134.50000      69.76000
134.40000      69.80000
134.20000      69.73000
134.30000      69.70000
134.20000      69.67000
134.30000      69.64000
134.20000      69.60000
134.10000      69.50000
134.00000      69.48000
133.80000      69.47000
134.00000      69.25000
134.10000      69.18000
134.10000      69.15000
133.85000      69.25000
133.85000      69.26000
133.70000      69.26000
133.60000      69.27500
133.50000      69.28000
133.40000      69.28500
133.30000      69.29000
133.20000      69.29500
133.10000      69.30000
132.95000      69.29800
133.05000      69.30500
132.95000      69.39500
133.05000      69.65000
133.00000      69.73000
"LANDFAST ICE"
135.00000      70.00000
134.90000      70.01600
134.80000      70.03100
134.70000      70.04500
134.60000      70.05800
134.50000      70.06000
134.40000      70.07100
134.30000      70.08200
```

```
134.20000        70.09000
134.10000        70.08400
134.00000        70.08000
133.90000        70.07500
133.80000        70.06900
133.70000        70.06200
133.60000        70.05400
133.50000        70.04500
133.40000        70.03500
133.30000        70.02500
133.20000        70.01600
133.10000        70.00800
133.00000        70.00000
"OIL SLICK AREA"
134.19999        69.93381
134.19603        69.93219
134.19295        69.93036
134.19085        69.92837
134.18978        69.92629
134.18979        69.92417
134.19086        69.92209
134.19297        69.92010
134.19605        69.91827
134.20001        69.91665
134.20472        69.91529
134.21005        69.91424
134.21584        69.91351
134.22190        69.91315
134.22805        69.91315
134.23411        69.91351
134.23989        69.91424
134.24522        69.91529
134.24994        69.91665
134.29991        69.93379
134.30387        69.93541
134.30695        69.93724
134.30906        69.93923
134.31014        69.94131
134.31014        69.94343
134.30907        69.94551
134.30697        69.94750
134.30389        69.94933
134.29993        69.95095
134.29521        69.95231
134.28987        69.95337
134.28408        69.95409
134.27801        69.95446
134.27184        69.95446
134.26577        69.95409
134.25998        69.95337
134.25464        69.95231
134.24992        69.95095
134.19999        69.93381
"SPILL LOCATION"
134.20000        69.91666
EOD.
SEND.
**FILE**
```

APPENDIX 9. SAMPLE GRAPHS

The graphs that are presented in this appendix correspond to the hard-copy simulation results shown in Appendix 8. They were produced by the TELL-A-GRAF software package on a Nicolet Zeta 8 pen desk top plotter.

OIL UNDER ICE



OILSPILL MODEL
VERSION 1.0
RUN: 85/01/03 11:36:29
SIMULATION: 84/12/28 9:00

OIL VOLUME:
19000.00080 CU.M.

SLICK AREA:
2044801.08082 SQ.M.

SLICK THICKNESS:
0.64235 CM.

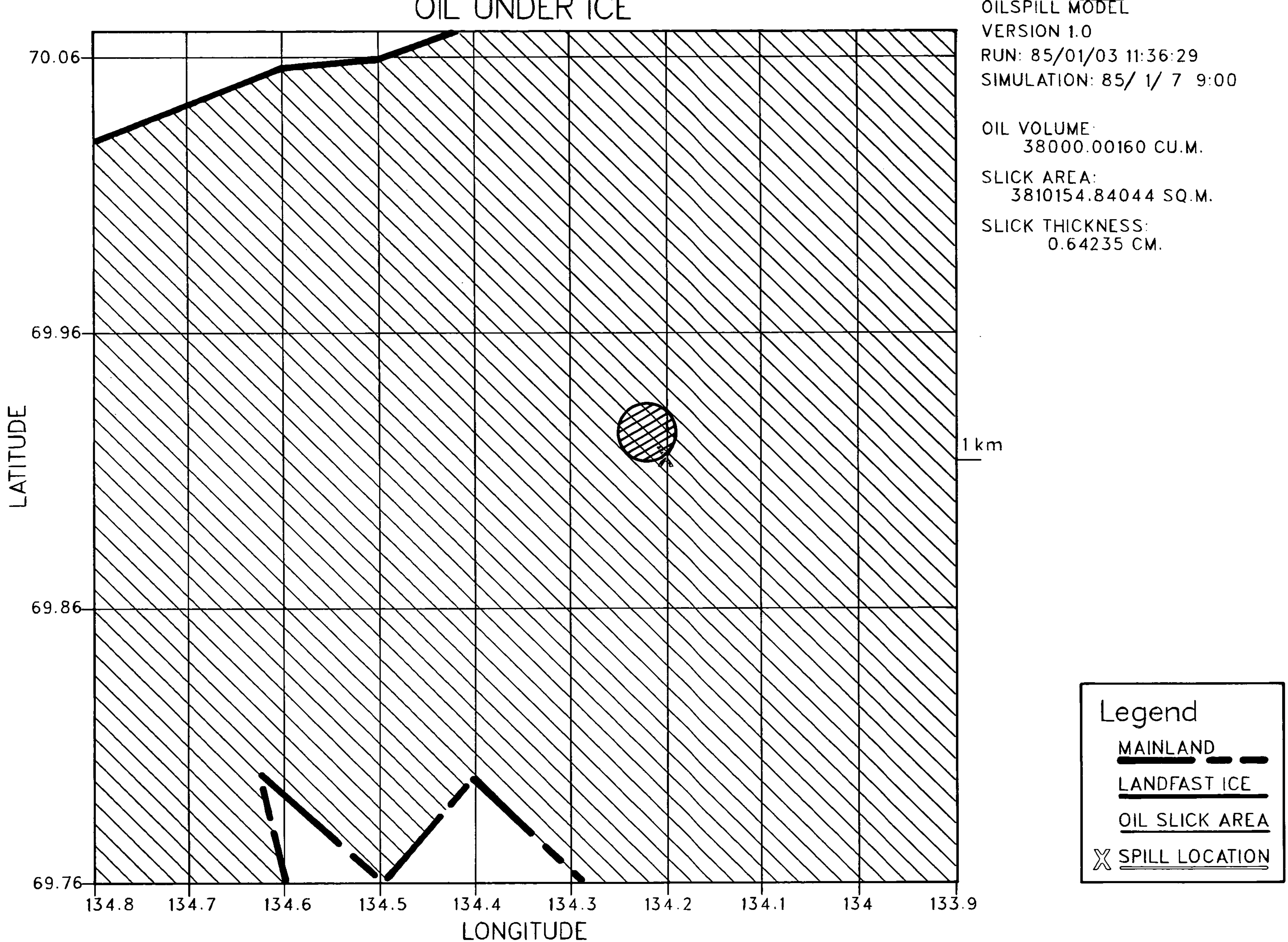
Legend

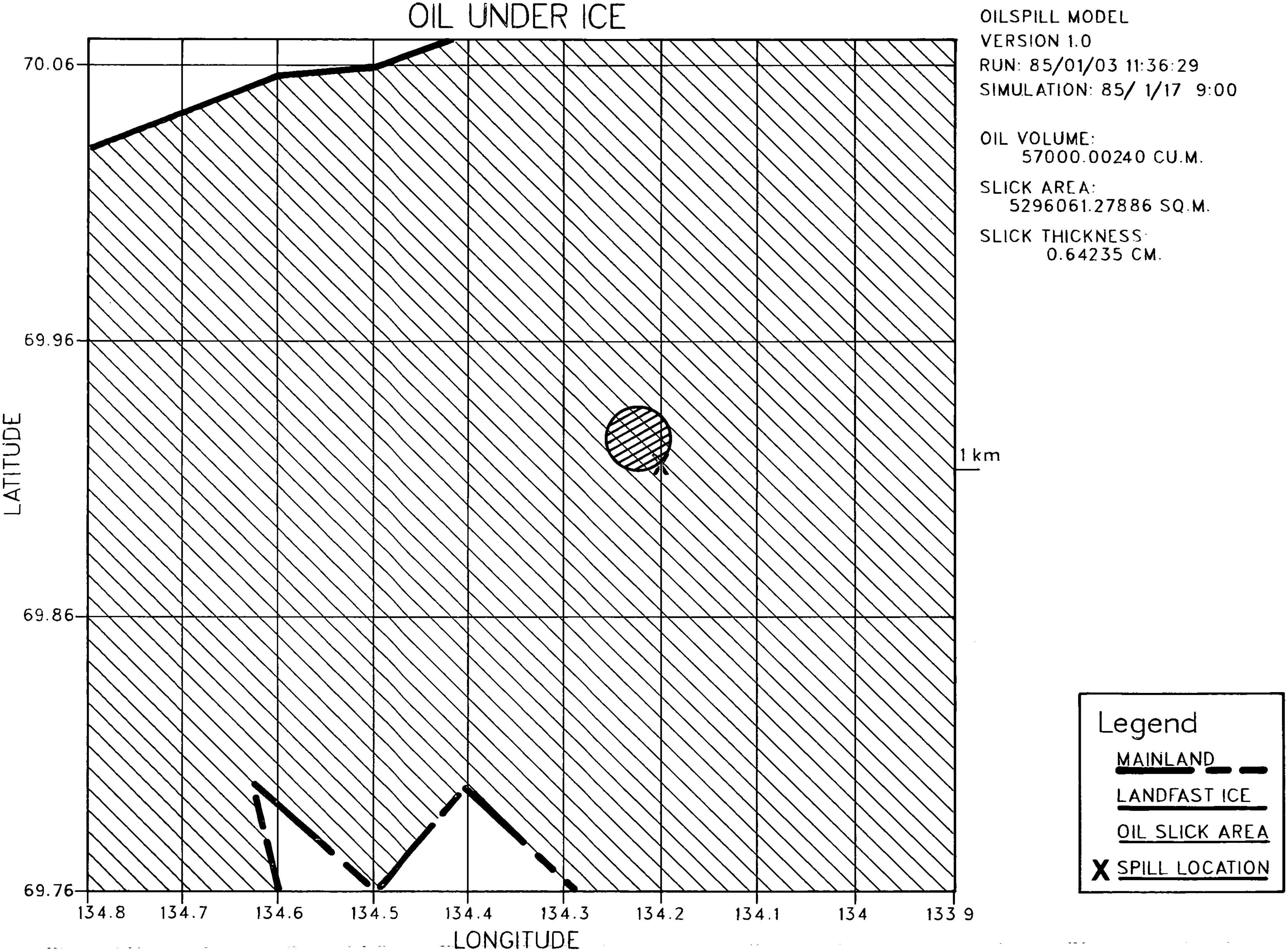
MAINLAND

LANDFAST ICE

OIL SLICK AREA

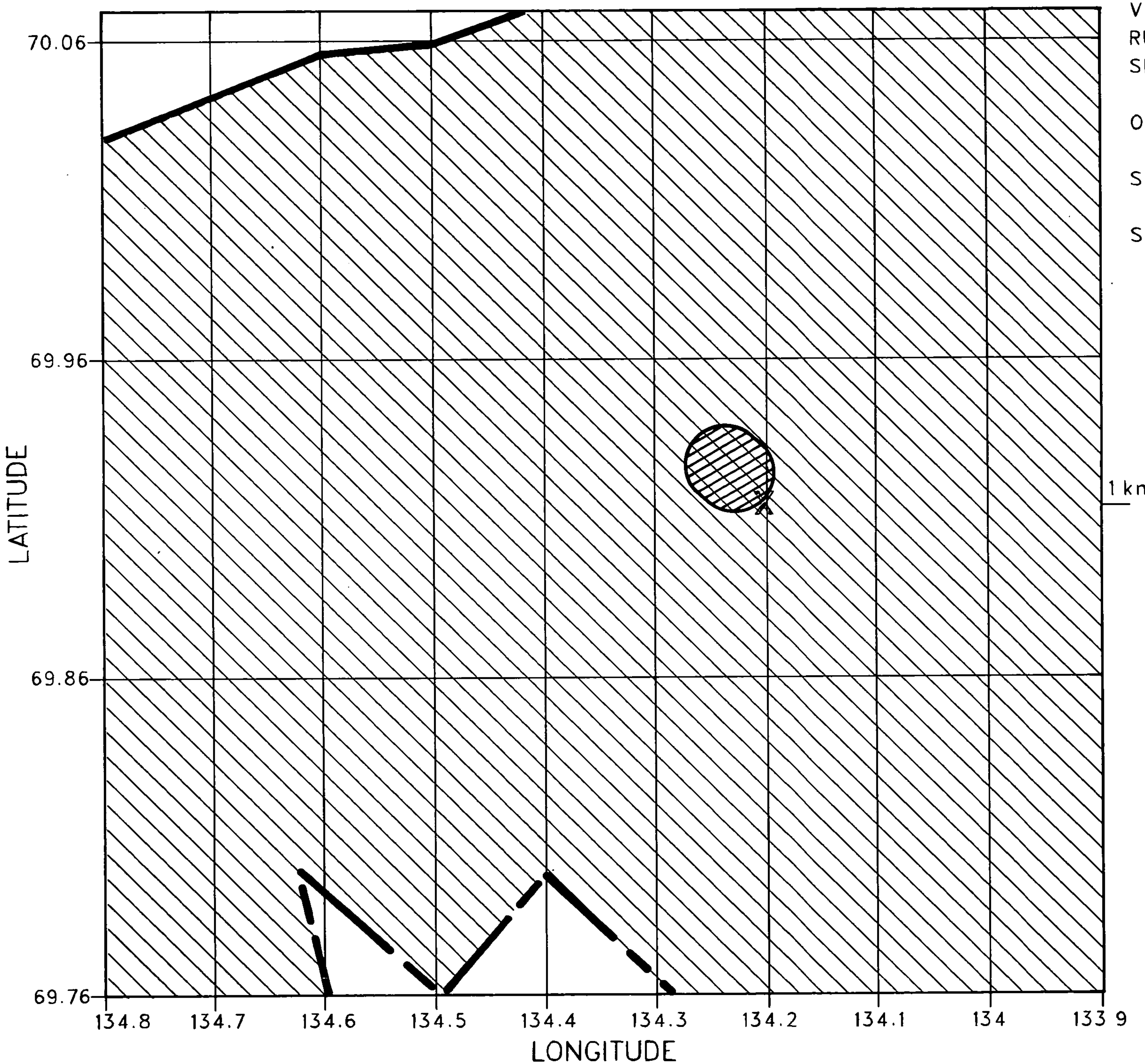
X SPILL LOCATION


OIL UNDER ICE
70.06
69.96
69.86
69.76
LATITUDE
134.8
134.7
134.6
134.5
134.4
134.3
134.2
134.1
134
133.9
LONGITUDE
1 km
OILSPILL MODEL
VERSION 1.0
RUN: 85/01/03 11:36:29
SIMULATION: 85/ 1/ 7 9:00
OIL VOLUME:
38000.00160 CU.M.
SLICK AREA:
3810154.84044 SQ.M.
SLICK THICKNESS:
0.64235 CM.
Legend
MAINLAND
LANDFAST ICE
OIL SLICK AREA
SPILL LOCATION



OIL UNDER ICE
OILSPILL MODEL
VERSION 1.0
RUN: 85/01/03 11:36:29
SIMULATION: 85/ 1/17 9:00
OIL VOLUME:
57000.00240 CU.M.
SLICK AREA:
5296061.27886 SQ.M.
SLICK THICKNESS:
0.64235 CM.
70.06
69.96
69.86
69.76
LATITUDE
1 km
134.8
134.7
134.6
134.5
134.4
134.3
134.2
134.1
134
133 9
LONGITUDE
Legend
MAINLAND
LANDFAST ICE
OIL SLICK AREA
X SPILL LOCATION

OIL UNDER ICE

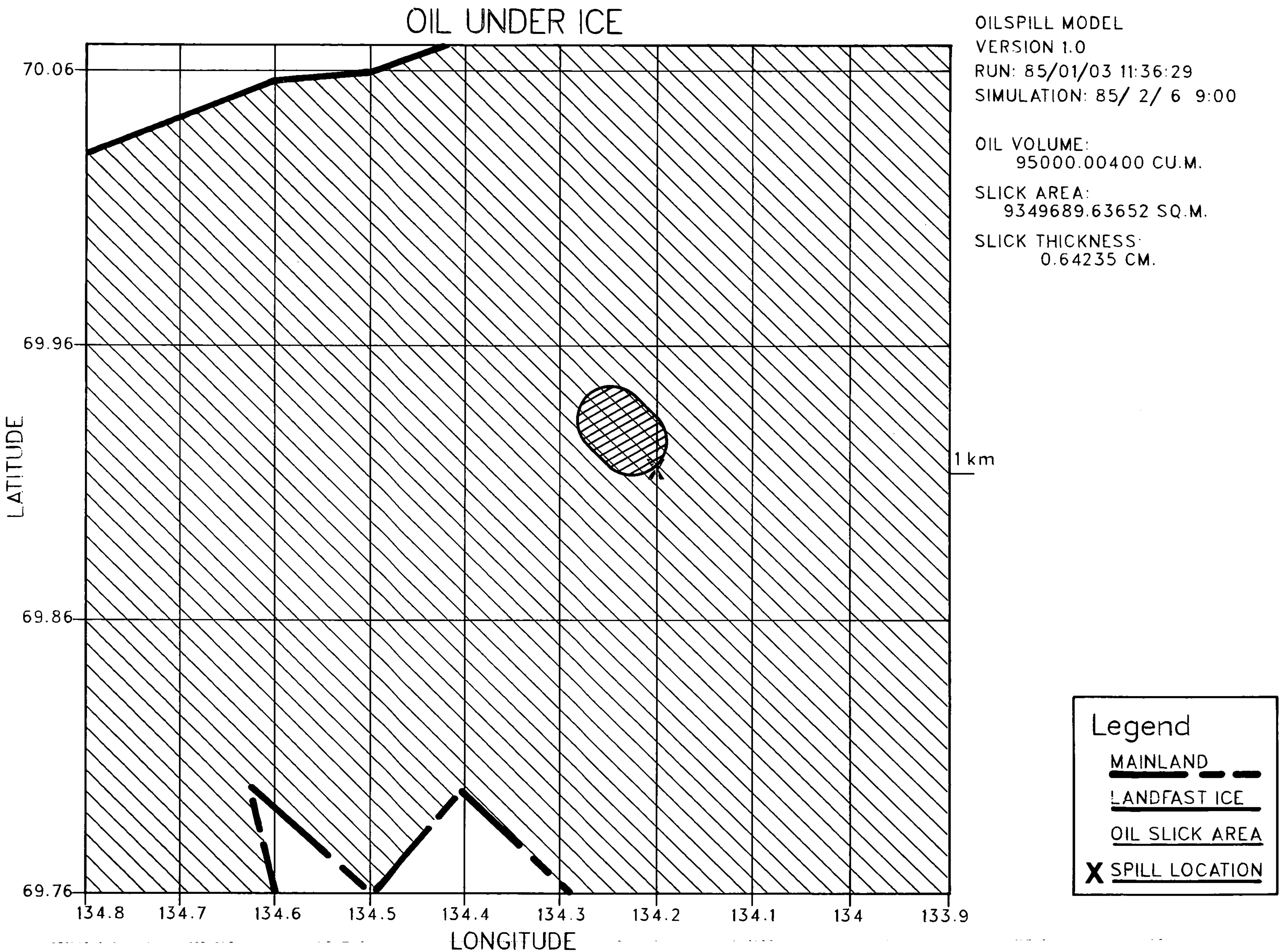


OILSPILL MODEL
VERSION 1.0
RUN: 85/01/03 11:36:29
SIMULATION: 85/ 1/27 9:00

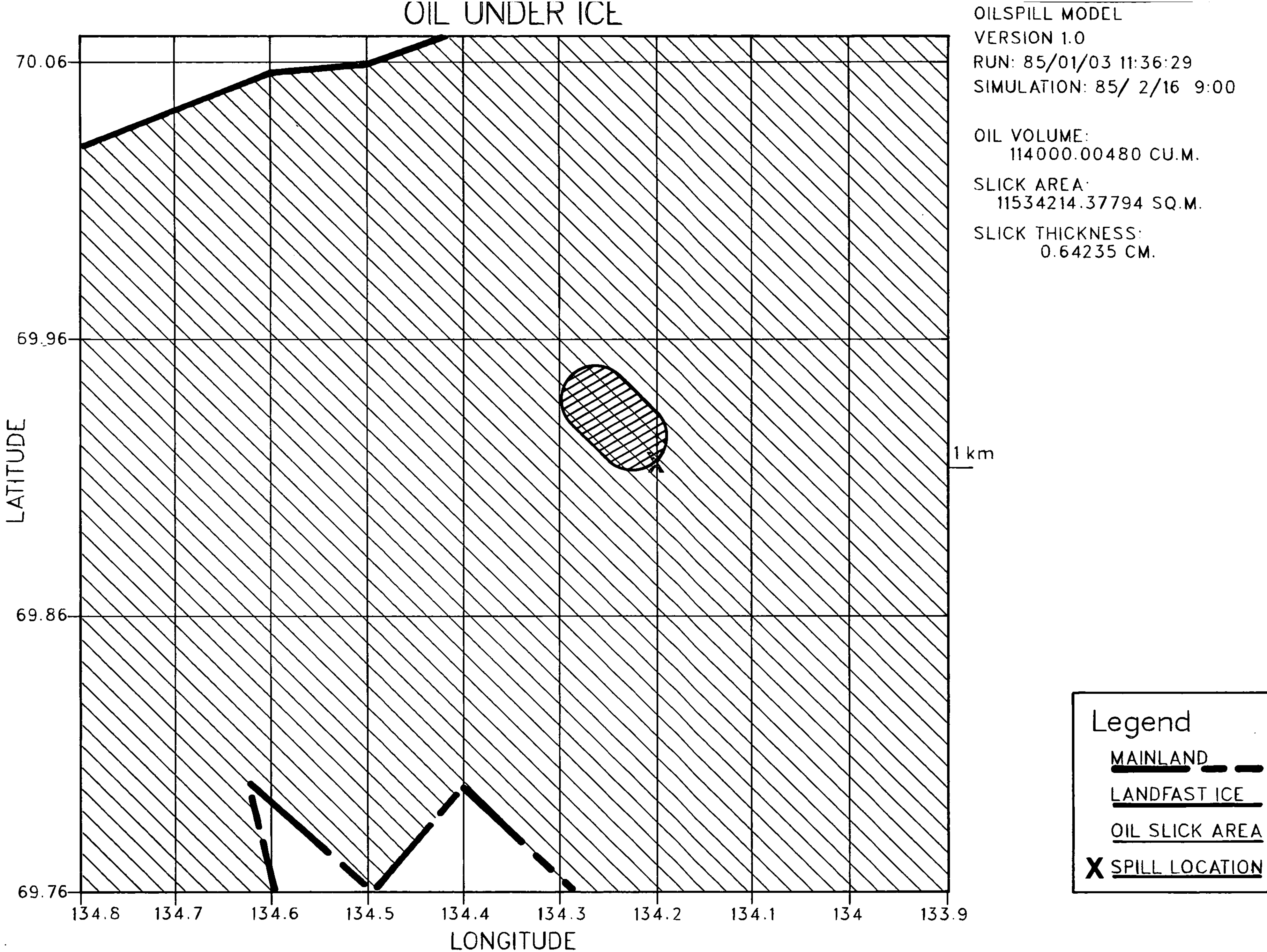
OIL VOLUME:
76000.00320 CU.M.

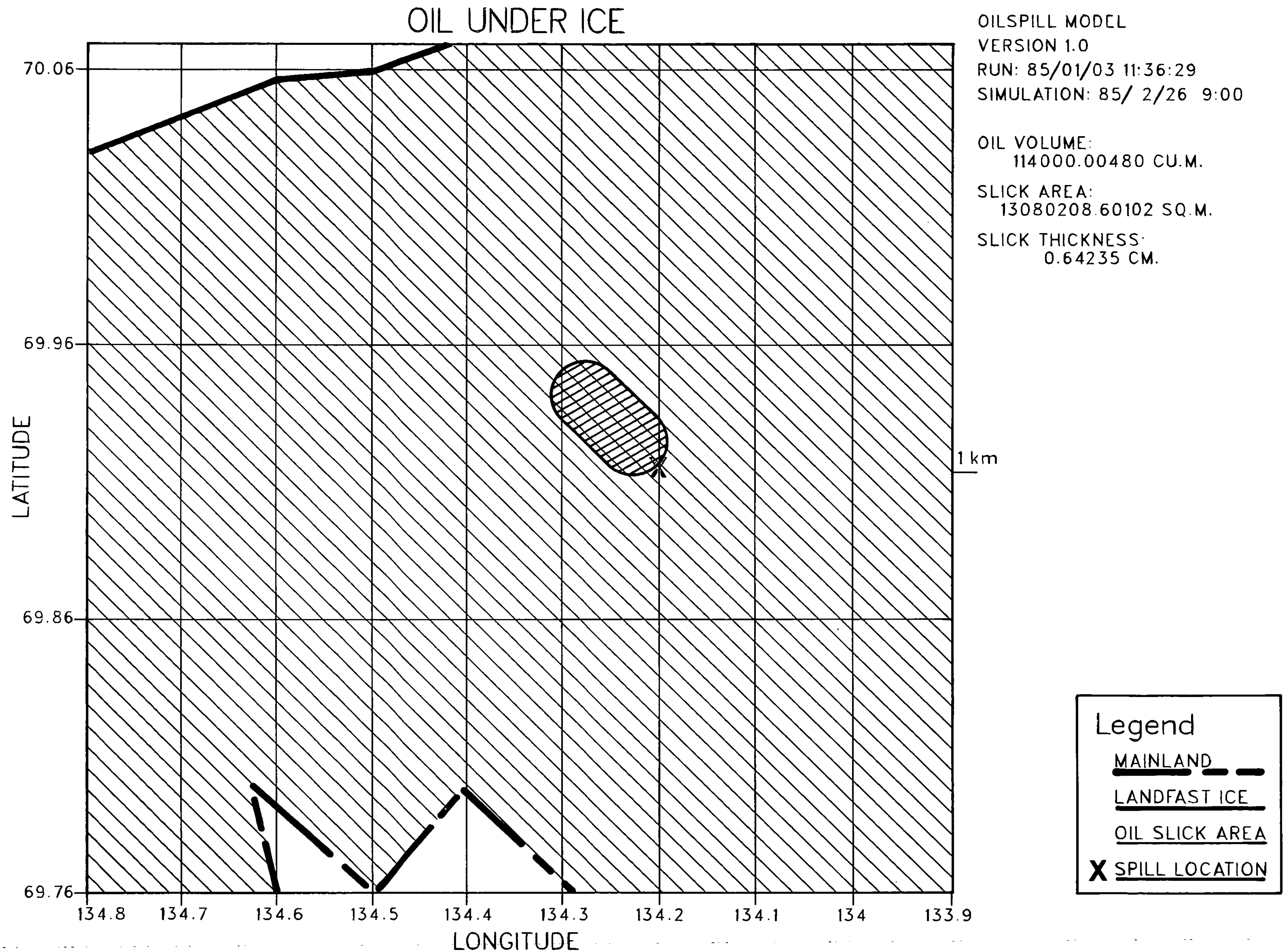
SLICK AREA:
7165164.89510 SQ.M.

SLICK THICKNESS:
0.64235 CM.



OIL UNDER ICE
OILSPILL MODEL
VERSION 1.0
RUN: 85/01/03 11:36:29
SIMULATION: 85/ 2/ 6 9:00
OIL VOLUME:
95000.00400 CU.M.
SLICK AREA:
9349689.63652 SQ.M.
SLICK THICKNESS:
0.64235 CM.
70.06
69.96
69.86
69.76
LATITUDE
1 km
134.8
134.7
134.6
134.5
134.4
134.3
134.2
134.1
134
133.9
LONGITUDE
Legend
MAINLAND
LANDFAST ICE
OIL SLICK AREA
X SPILL LOCATION


OIL UNDER ICE
70.06
69.96
69.86
69.76
LATITUDE
134.8
134.7
134.6
134.5
134.4
134.3
134.2
134.1
134
133.9
LONGITUDE
1 km
OILSPILL MODEL
VERSION 1.0
RUN: 85/01/03 11:36:29
SIMULATION: 85/ 2/16 9:00
OIL VOLUME:
114000.00480 CU.M.
SLICK AREA:
11534214.37794 SQ.M.
SLICK THICKNESS:
0.64235 CM.
Legend
MAINLAND
LANDFAST ICE
OIL SLICK AREA
X SPILL LOCATION


OIL UNDER ICE
OILSPILL MODEL
VERSION 1.0
RUN: 85/01/03 11:36:29
SIMULATION: 85/ 2/26 9:00
OIL VOLUME:
114000.00480 CU.M.
SLICK AREA:
13080208.60102 SQ.M.
SLICK THICKNESS:
0.64235 CM.
LATITUDE
70.06
69.96
69.86
69.76
1 km
LONGITUDE
134.8
134.7
134.6
134.5
134.4
134.3
134.2
134.1
134
133.9
Legend
MAINLAND
LANDFAST ICE
OIL SLICK AREA
X SPILL LOCATION

APPENDIX 10. SOURCE CODE LISTINGS

This appendix contains a sample compile listings of the FORTRAN mainline program and two subroutines. It also contains the PL/I source code listings for the DATE and TIME subroutines.

```
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09       TIME: 16:42:09                      PAGE:     1
REQUESTED OPTIONS (EXECUTE): NODECK,OPTIMIZE(0),GOSTMT,MAP
OPTIONS IN EFFECT:  NOLIST   MAP NOXREF   GOSTMT NODECK   SOURCE NOTERM   OBJECT FIXED  NOTEST NOTRMFLG    SRCFLG NOSYM
                    OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(64)      CHARLEN(500)      SDUMP
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       1         PROGRAM OILICE
              C
              C     *****************************************************************
              C     *                                                               *
              C     *   PROGRAM: OILUICE                                            *
              C     *                                                               *
              C     *   VERSION: 1.0 - DEC 1984                                     *
              C     *                                                               *
              C     *   AUTHOR : RICK KOWALCHUK                                     *
              C     *            DOME PETROLEUM LTD                                 *
              C     *            BOX 200                                            *
              C     *            CALGARY,ALTA T2P 2H8                               *
              C     *                                                               *
              C     *   GENERAL:INTERACTIVE FORTRAN PROGRAM TO MODEL THE MOTION OF  *
              C     *      OIL RELEASED INTO OCEAN WATER IN THE PRESENCE OF ICE.    *
              C     *      A TELAGRAF FILE WILL BE PRODUCED THAT WILL DRAW AN AREA  *
              C     *      MAP AND LOCATE THE SIZE AND SHAPE OF THE SLICK AT VARIOUS*
              C     *      TIMES IN THE SIMULATION.                                 *
              C     *                                                               *
              C     *****************************************************************
              C
ISN       2         REAL*16      PLFRLO,PLTOLO,PLFRLA,PLTOLA,PDIR,PDIST,OSLAT,OSLONG
ISN       3         REAL*16      CURDIR,SPLAT,SPLONG,PLAT1,PLONG1,PLAT2,PLONG2
ISN       4         REAL*16      OSRAD
ISN       5         REAL*8       ISPQTY,ISPRTE,IWDENS,SW,LALRAT,GSPFAC
ISN       6         REAL*8       CD,DELTA,THCKLO,THCKEQ,THCKST,THCKTL,DVORT,DCAV
ISN       7         REAL*8       FTHCK,FS,GRAV,K,LSHEAR,LVORT,LCAV,VISOIL,DENOIL
ISN       8         REAL*8       DENWAT,ITENS,SFAIL,SSLICK,STH,VWIDTH,AS,VS,VAREA
ISN       9         REAL*8       VCAV,LS,WS,ANGSL,TEMP,OFFSET,SEDGE
ISN      10         REAL*8       ICERGH(2,2)
ISN      11         REAL*8       SPCAVL,SPCAVW,WCAV,ANGCAV,ANGDIF,LREC
ISN      12         REAL*8       VERSNO
ISN      13         INTEGER*4    ICEARR,OILARR,LANDPT,ICEPTS,READER
ISN      14         INTEGER*4    PROMPT,PRESLT,PARRS,PERRS,PTELAG,GORSPR
ISN      15         INTEGER*4    IDATE,ITIME,IDUR,IPLFRQ,ILATD,ILATM,ILATS
ISN      16         INTEGER*4    IPLODF,IPLOMF,IPLOSF,IPLODT,IPLOMT,IPLOST
ISN      17         INTEGER*4    ILONGD,ILONGM,ILONGS,IOILTP,ISPDUR
ISN      18         INTEGER*4    ICURD,ICURM,ICURS,MHOUR,IGOR,TABGOR
ISN      19         INTEGER*4    OTTYPE
ISN      20         INTEGER*4    I,J
ISN      21         INTEGER*4    COORD(2,6)
ISN      22         LOGICAL*4    RNDSP
ISN      23         INTEGER*4    LEAP
ISN      24         INTEGER*2    MODAYS(12)
ISN      25         CHARACTER*8  RDATE,RTIME
ISN      26         CHARACTER*1  IVERFY,IREENT
              C
ISN      27         COMMON       PLFRLO,PLTOLO,PLFRLA,PLTOLA,PDIR,PDIST,
                   *             SPLAT,SPLONG,PLAT1,PLONG1,PLAT2,PLONG2,OSLAT,OSLONG,
```

```
     *              THCKLO,SSLICK,AS,VS,LS,WS,ANGSL,VERSNO,LREC,
     *              LANDPT,ICEPTS,PRESLT,PTELAG,IDATE,ITIME,MHOUR,
     *              RNDSP,
     *              MODAYS,
     *              RDATE,RTIME
C
```



```
*....*...1.........2.........3.........4.........5.........6.........7.*.......8
C       ***************************************************************
C       *                                                             *
C       * FILE IDENTIFIERS:                                           *
C       *                                                             *
C       *     ICEARR =>UNIT 1 - FILE OF ICE ROUGHNESS CHARACTERISTICS *
C       *     OILARR =>UNIT 2 - FILE OF OIL TYPES AND PROPERTIES      *
C       *     LANDPT =>UNIT 3 - FILE OF LAND BOUNDARY COORDINATES     *
C       *     ICEPTS =>UNIT 4 - FILE OF LANDFAST ICE COORDINATES      *
C       *     READER =>UNIT 5 - INPUT FOR RUN PARAMETERS              *
C       *     PROMPT =>UNIT 6 - PROMPT FILE FOR RUN PARAMETERS        *
C       *     PRESLT =>UNIT 7 - PRINTED RESULTS OF SIMULATION         *
C       *     PARRS ==>UNIT 8 - PRINTOUT OF ARRAYS USED FOR THE RUN   *
C       *     PERRS ==>UNIT 9 - PARAMETER AND RUNTIME ERROR PRINTOUT  *
C       *     PTELAG =>UNIT 10- TELAGRAF COMMAND AND DATA FILE        *
C       *     GORSPR =>UNIT 11- GAS TO OIL SPREAD FACTORS             *
C       *                                                             *
C       * PARAMETER INPUT FIELDS:                                     *
C       *                                                             *
C       *     IDATE ==> SPILL DATE                                    *
C       *     ITIME ==> SPILL TIME                                    *
C       *     IDUR ===> MODEL DURATION IN HOURS                       *
C       *     IPLFRQ => PLOT FREQUENCY IN HOURS (E.G. PLOT EVERY X HOURS)
C       *     IPLODF => PLOT WESTERN LONGITUDE DEGREES                *
C       *     IPLOMF => PLOT WESTERN LONGITUDE MINUTES                *
C       *     IPLOSF => PLOT WESTERN LONGITUDE SECONDS                *
C       *     IPLODT => PLOT EASTERN LONGITUDE DEGREES                *
C       *     IPLOMT => PLOT EASTERN LONGITUDE MINUTES                *
C       *     IPLOST => PLOT EASTERN LONGITUDE SECONDS                *
C       *     ILATD ==> SPILL LATITUDE DEGREES                        *
C       *     ILATM ==> SPILL LATITUDE MINUTES                        *
C       *     ILATS ==> SPILL LATITUDE SECONDS                        *
C       *     ILONGD==> SPILL LONGITUDE DEGREES                       *
C       *     ILONGM==> SPILL LONGITUDE MINUTES                       *
C       *     ILONGS==> SPILL LONGITUDE SECONDS                       *
C       *     IOILTP => TYPE OF OIL - USED TO SEARCH OIL TYPE FILE    *
C       *     IGOR ===> GAS TO OIL RATIO                              *
C       *     ISPDUR => DURATION OF SPILL                             *
C       *     ICURD ==> WATER CURRENT DIRECTION DEGREES               *
C       *     ICURM ==> WATER CURRENT DIRECTION MINUTES               *
C       *     ICURS ==> WATER CURRENT DIRECTION SECONDS               *
C       *     ISPQTY => SPILL QUANTITY - FOR FINITE SPILLS ONLY       *
C       *     ISPRTE => SPILL RATE - FOR CONTINUOUS SPILLS ONLY       *
C       *     IWDENS => WATER DENSITY                                 *
C       *     SW =====> WATER CURRENT SPEED                           *
C       *     IVERFY => INPUT PARAMETER VERIFICATION ANSWER           *
C       *     IREENT => REENTER INPUT PROMPT ANSWER                   *
C       *                                                             *
C       * WORK AND STORAGE FIELDS:                                    *
C       *                                                             *
C       *     RDATE  => RUN DATE IN YY/MM/DD FORMAT                   *
```

```
C       *     RTIME  => RUN TIME IN HH:MM FORMAT                    *
C       *     VERSNO => CURRENT PROGRAM VERSION NUMBER                 *
C       *     MHOUR  => CURRENT MODEL HOUR FROM START OF SIMULATION    *
C       *     CURDIR => CURRENT DIRECTION DECIMAL DEGREES              *
C       *     SPLAT  => SPILL LATITUDE IN DECIMAL DEGREES              *
C       *     SPLONG => SPILL LONGITUDE IN DECIMAL DEGREES             *
C       *     OSLAT  => OIL SLICK LATITUDE IN DECIMAL DEGREES          *
C       *     OSLONG => OIL SLICK LONGITUDE IN DECIMAL DEGREES         *
C       *     OSRAD  => OIL SLICK RADIUS IN METERS FOR CIRCULAR SLICKS *
C       *     LREC   => LENGTH OF RECTANGULAR PORTION OF OVAL SLICKS   *
```



```
*....*...1.........2.........3.........4.........5.........6.........7.*.......8
C       *     LALRAT => DISTANCE RATIO OF LATITUDE TO LONGITUDE AT SPILL
C       *     GSPFAC => SPREAD FACTOR INCREASE FROM THE GAS TO OIL RATIO
C       *     PLAT1  => TEMPORARY FIELD FOR RATIO CALC IN PLOT EXTENTS *
C       *     PLONG1 => TEMPORARY FIELD FOR RATIO CALC IN PLOT EXTENTS *
C       *     PLAT2  => TEMPORARY FIELD FOR RATIO CALC IN PLOT EXTENTS *
C       *     PLONG2 => TEMPORARY FIELD FOR RATIO CALC IN PLOT EXTENTS *
C       *     PDIR   => PARAMETER DIRECTION FIELD FOR SUBROUTINE QCOORD*
C       *     PDIST  => PARAMETER DISTANCE FIELD FOR SUBROUTINE QCOORD *
C       *     PLFRLO => PLOT WESTERN LONGITUDE IN DECIMAL DEGREES      *
C       *     PLTOLO => PLOT EASTERN LONGITUDE IN DECIMAL DEGREES      *
C       *     PLFRLA => PLOT SOUTHERN LATITUDE IN DECIMAL DEGREES      *
C       *     PLTOLA => PLOT NORTHERN LATITUDE IN DECIMAL DEGREES      *
C       *     SPCAVL => SPACING BETEEN LEADING EDGES OF CAVITIES ALONG *
C       *               THE LENGTHWISE DIRECTION.                      *
C       *     SPCAVW => SPACING BETEEN LEADING EDGES OF CAVITIES ALONG *
C       *               THE WIDTHWISE DIRECTION.                       *
C       *     ANGDIF => DIFFERENCE BETWEEN CURRENT DIRECTION AND       *
C       *               ICE ROUGHNES ORIENTATION.                      *
C       *     OTTYPE => OIL TYPE FROM OILARR                           *
C       *     TABGOR => GAS TO OIL RATIO FROM GORSPR FILE              *
C       *     LEAP   => TEMP VARIABLE FOR LEAP YEAR CALCULATION        *
C       *     MODAYS => MONTH DAY ARRAY                                *
C       *     ICERGH => ICE ROUGHNESS LAT,LONG ARRAY                   *
C       *     COORD  => ICE ROUGHNESS LAT,LONG ARRAY IN D,M,S          *
C       *     RNDSP  => BOOLEAN VARIABLE FOR ROUND OIL SLICK SHAPE     *
C       *                                                              *
C       * FORMULAE FIELDS:                                             *
C       *                                                              *
C       *     CD =====> ROUGHNESS FORM DRAG COEFFICIENT                *
C       *           ==>1.98 FOR RECTANGULAR PRISM                      *
C       *           ==>1.55 FOR TRIANGULAR PRISM                       *
C       *     DELTA ==> RELATIVE DENSITY RATIO                         *
C       *     THCKLO => LOCAL SLICK THICKNESS                          *
C       *     THCKEQ => EQUILIBRIUM OIL SLICK THICKNESS                *
C       *               BENEATH SMOOTH ICE                             *
C       *     THCKST => THICKNESS OF SLICK IN A CAVITY                 *
C       *               AT THE END OF THE VORTEX ZONE                  *
C       *     THCKTL => THICKNESS OF CONTAINED SLICK AT                *
C       *               THE DOWNSTREAM CAVITY WALL                     *
C       *     DVORT ==> VORTEX ZONE OFFSET INTO A CAVITY               *
C       *     DCAV ===> ICE ROUGHNESS HEIGHT OR CAVITY DEPTH           *
C       *     FTHCK ==> DENSIMETRIC FROUDE NUMBER                      *
C       *               FTHCK=SW/(DELTA*GRAV*THCKLO)                   *
C       *               FOR THIS CASE, THCKLO=THCKEQ                   *
C       *     FS =====> OIL/WATER INTERFACIAL FRICTION FACTOR          *
C       *               EMPIRICALLY APROX. 0.016                       *
```

```
C      *      GRAV ===> GRAVITATION ACCELERATION                            *
C      *      K ======> ICE FRICTION AMPLIFICATION FACTOR                   *
C      *      LSHEAR => LENGTH OF SHEAR-DOMINATED PORTION                   *
C      *                OF THE OIL IN A CAVITY                              *
C      *      LVORT ==> LENGTH OF VORTEX CELL                               *
C      *      LCAV ===> LENGTH OF CAVITY                                    *
C      *      VISOIL => VISCOSITY OF THE OIL                                *
C      *      DENOIL => DENSITY OF OIL                                      *
C      *      DENWAT => DENSITY OF WATER                                    *
C      *      ITENS ==> INTERFACIAL TENSION BETWEEN OIL AND WATER           *
C      *                TYPICALLY 30-35 DYNES/CM FOR CRUDE OILS             *
C      *      SFAIL ==> CURRENT SPEED FOR CONTAINMENT FAILURE               *
C      *      SSLICK => OIL SLICK SPEED                                     *
C      *      STH ====> THRESHOLD CURRENT SPEED FOR SLICK MOVEMENT          *
```



```
     *....*...1.........2.........3.........4.........5.........6.........7.*.......8
C      *      SW =====> WATER CURRENT SPEED                                 *
C      *      VWIDTH => APPROXIMATE VOLUME OF OIL TRAPPED PER               *
C      *                UNIT WIDTH OF CAVITY                                *
C      *      OSLAT ==> LATITUDE OF THE ORIGIN POINT OF SLICK               *
C      *      OSLONG => LONGITUDE OF THE ORIGIN POINT OF SLICK              *
C      *      AS =====> AREA OF SLICK                                       *
C      *      VS =====> VOLUME OF SLICK                                     *
C      *      LS =====> LENGTH OF SLICK                                     *
C      *      WS =====> WIDTH OF SLICK                                      *
C      *      ANGSL ==> ANGLE OF ORIENTATION OF SLICK                       *
C      *      VAREA ==> VOLUME PER UNIT AREA                                *
C      *      VCAV  ==> VOLUME OF ICE CAVITY PER UNIT AREA                  *
C      *                                                                    *
C      *                                                                    *
C      **********************************************************************
C
C      **********************************************************************
C      *                                                                    *
C      * -INITIALIZE DAYS IN MONTH ARRAY                                    *
C      *                                                                    *
C      **********************************************************************
C
ISN    28        MODAYS(1)=31
ISN    29        MODAYS(2)=28
ISN    30        MODAYS(3)=31
ISN    31        MODAYS(4)=30
ISN    32        MODAYS(5)=31
ISN    33        MODAYS(6)=30
ISN    34        MODAYS(7)=31
ISN    35        MODAYS(8)=31
ISN    36        MODAYS(9)=30
ISN    37        MODAYS(10)=31
ISN    38        MODAYS(11)=30
ISN    39        MODAYS(12)=31
C
C      **********************************************************************
C      *                                                                    *
C      * -ASSIGN FILE UNIT NUMBERS                                          *
C      *                                                                    *
C      **********************************************************************
C
ISN    40    1   ICEARR=1
```

```
ISN       41            OILARR=2
ISN       42            LANDPT=3
ISN       43            ICEPTS=4
ISN       44            READER=5
ISN       45            PROMPT=6
ISN       46            PRESLT=7
ISN       47            PARRS=8
ISN       48            PERRS=9
ISN       49            PTELAG=10
ISN       50            GORSPR=11
              C
              C         ****************************************************************
              C         *                                                              *
              C         * -ASSIGN PROGRAM VERSION NUMBER                               *
              C         * -INITIALIZATION OF VARIBLES                                  *
              C         *                                                              *
              C         ****************************************************************
              C
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09      NAME: OILICE   PAGE:     5
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       51            VERSNO=1.0
ISN       52            MHOUR=0
ISN       53            CALL DATE(RDATE)
ISN       54            CALL TIME(RTIME)
ISN       55            GRAV=981.0
              C
              C         ****************************************************************
              C         *                                                              *
              C         * -WRITE PROMPT FOR INPUTS                                     *
              C         * -EDIT INPUTS                                                 *
              C         * -WRITE OUT ERROR MESSAGE AND REPROMPT IF INCORRECT           *
              C         *                                                              *
              C         ****************************************************************
              C
ISN       56            WRITE(PROMPT,9000),RDATE,RTIME,VERSNO
ISN       57            GO TO 21
ISN       58       20   WRITE(PROMPT,9015)
ISN       59       21   WRITE(PROMPT,9001)
ISN       60            READ(READER,*)IDATE,ITIME
ISN       61            IF(IDATE.LT.840101.OR.IDATE.GT.940101)GO TO 20
ISN       62            IF(ITIME.LT.0.OR.ITIME.GT.24)GO TO 20
ISN       63            LEAP=MOD(IDATE,40000)
ISN       64            IF(LEAP.LT.10000)MODAYS(2)=29
ISN       66            GO TO 31
ISN       67       30   WRITE(PROMPT,9015)
ISN       68       31   WRITE(PROMPT,9002)
ISN       69            READ(READER,*)IDUR
ISN       70            IF(IDUR.LT.0.OR.IDUR.GT.4320)GO TO 30
ISN       71            GO TO 41
ISN       72       40   WRITE(PROMPT,9015)
ISN       73       41   WRITE(PROMPT,9003)
ISN       74            READ(READER,*)ILATD,ILATM,ILATS
ISN       75            IF(ILATD.LT.0.OR.ILATD.GT.90)GO TO 40
ISN       76            IF(ILATM.LT.0.OR.ILATM.GT.59)GO TO 40
ISN       77            IF(ILATS.LT.0.OR.ILATS.GT.59)GO TO 40
ISN       78            SPLAT = ((ILATD*3600)+(ILATM*60)+ILATS)/3600.
ISN       79            GO TO 51
ISN       80       50   WRITE(PROMPT,9015)
```

```
ISN      81    51    WRITE(PROMPT,9004)
ISN      82          READ(READER,*)ILONGD,ILONGM,ILONGS
ISN      83          IF(ILONGD.LT.0.OR.ILONGD.GT.180)GO TO 50
ISN      84          IF(ILONGM.LT.0.OR.ILONGM.GT.59)GO TO 50
ISN      85          IF(ILONGS.LT.0.OR.ILONGS.GT.59)GO TO 50
ISN      86          SPLONG = ((ILONGD*3600)+(ILONGM*60)+ILONGS)/3600.
ISN      87          GO TO 61
ISN      88    60    WRITE(PROMPT,9015)
ISN      89    61    WRITE(PROMPT,9005)
ISN      90          READ(READER,*)IPLFRQ
ISN      91          IF(IPLFRQ.GT.IDUR)GO TO 60
ISN      92          GO TO 63
ISN      93    62    WRITE(PROMPT,9015)
ISN      94    63    WRITE(PROMPT,9006)
ISN      95          READ(READER,*)IPLODF,IPLOMF,IPLOSF
ISN      96          IF(IPLODF.LT.0.OR.IPLODF.GT.180)GO TO 62
ISN      97          IF(IPLOMF.LT.0.OR.IPLOMF.GT.59)GO TO 62
ISN      98          IF(IPLOSF.LT.0.OR.IPLOSF.GT.59)GO TO 62
ISN      99          PLFRLO = ((IPLODF*3600)+(IPLOMF*60)+IPLOSF)/3600.
ISN     100          IF(PLFRLO.LT.SPLONG)GO TO 62
ISN     101          GO TO 65
ISN     102    64    WRITE(PROMPT,9015)
```



```
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     103    65    WRITE(PROMPT,9007)
ISN     104          READ(READER,*)IPLODT,IPLOMT,IPLOST
ISN     105          IF(IPLODT.LT.0.OR.IPLODT.GT.180)GO TO 64
ISN     106          IF(IPLOMT.LT.0.OR.IPLOMT.GT.59)GO TO 64
ISN     107          IF(IPLOST.LT.0.OR.IPLOST.GT.59)GO TO 64
ISN     108          PLTOLO = ((IPLODT*3600)+(IPLOMT*60)+IPLOST)/3600.
ISN     109          IF(PLTOLO.GT.SPLONG)GO TO 64
ISN     110          IF(PLTOLO.GT.PLFRLO)GO TO 64
              C
              C      *************************************************************
              C      *                                                           *
              C      * -CALCULATE PLOT MIN AND MAX LATITUDES. A SQUARE GRID IS   *
              C      *  ESTABLISHED BY CALCULATING A LATITUDE TO LONGITUDE DISTANCE *
              C      *  RATIO AT THE SPILL COORDINATE AND EXTENDING IT AGAINST THE *
              C      *  INPUT LONGITUDE COORDINATE DIFFERENCE.                   *
              C      *                                                           *
              C      *************************************************************
              C
ISN     111          PDIST=1000.0
ISN     112          PDIR=0.0
ISN     113          CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN     114          PDIR=90.0
ISN     115          CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT2,PLONG2)
ISN     116          LALRAT=(PLAT1-SPLAT)/(SPLONG-PLONG2)
ISN     117          PLAT1=(PLFRLO-PLTOLO)*LALRAT
ISN     118          PLTOLA=SPLAT+(PLAT1/2.0)
ISN     119          PLFRLA=SPLAT-(PLAT1/2.0)
ISN     120    82    WRITE(PROMPT,9008)
ISN     121          READ(READER,*)IOILTP
ISN     122          OPEN(OILARR)
ISN     123          IF(IOILTP.EQ.0)GO TO 84
ISN     124    83    READ(OILARR,*,END=85)OTTYPE,VISOIL,DENOIL,ITENS,FS
ISN     125          IF(IOILTP.NE.OTTYPE)GO TO 83
ISN     126          CLOSE(OILARR)
```

```
ISN      127          GO TO 87
ISN      128    84    READ(OILARR,*,END=85)OTTYPE,VISOIL,DENOIL,ITENS,FS
ISN      129          WRITE(PROMPT,9020),OTTYPE,VISOIL,DENOIL,ITENS,FS
ISN      130          GO TO 84
ISN      131    85    CLOSE(OILARR)
ISN      132          WRITE(PROMPT,9021)
ISN      133          GO TO 82
ISN      134    86    WRITE(PROMPT,9015)
ISN      135    87    WRITE(PROMPT,9019)
ISN      136          READ(READER,*)IGOR
ISN      137          IF(IGOR.EQ.0)GO TO 91
ISN      138          OPEN(GORSPR)
ISN      139          IF(IGOR.EQ.-1)GO TO 89
ISN      140    88    READ(GORSPR,*,END=90)TABGOR,GSPFAC
ISN      141          IF(IGOR.NE.TABGOR)GO TO 88
ISN      142          CLOSE(GORSPR)
ISN      143          GO TO 94
ISN      144    89    READ(GORSPR,*,END=90)TABGOR,GSPFAC
ISN      145          WRITE(PROMPT,9025),TABGOR,GSPFAC
ISN      146          GO TO 89
ISN      147    90    CLOSE(GORSPR)
ISN      148          WRITE(PROMPT,9026)
ISN      149          IF(IGOR.EQ.-1)GO TO 87
ISN      150          GO TO 86
ISN      151    91    GSPFAC=1.0
ISN      152          GO TO 94
LEVEL 1.3.0 (MAY 1983)           VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09      NAME: OILICE   PAGE:     7
                      *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      153    93    WRITE(PROMPT,9015)
ISN      154    94    WRITE(PROMPT,9009)
ISN      155          READ(READER,*)ISPDUR
ISN      156          IF(ISPDUR.GT.IDUR.OR.ISPDUR.LT.1)GO TO 93
ISN      157          IF(ISPDUR.GT.1)GO TO 101
ISN      158          GO TO 96
ISN      159    95    WRITE(PROMPT,9015)
ISN      160    96    WRITE(PROMPT,9010)
ISN      161          READ(READER,*)ISPQTY
ISN      162          IF(ISPQTY.LE.0)GO TO 95
ISN      163          ISPRTE = 0
ISN      164          GO TO 111
ISN      165   100    WRITE(PROMPT,9015)
ISN      166   101    WRITE(PROMPT,9011)
ISN      167          READ(READER,*)ISPRTE
ISN      168          IF(ISPRTE.LE.0)GO TO 100
ISN      169          ISPQTY = ISPRTE*ISPDUR
ISN      170          GO TO 111
ISN      171   110    WRITE(PROMPT,9015)
ISN      172   111    WRITE(PROMPT,9012)
ISN      173          READ(READER,*)IWDENS
ISN      174          IF(IWDENS.LE.0)GO TO 110
ISN      175          GO TO 121
ISN      176   120    WRITE(PROMPT,9015)
ISN      177   121    WRITE(PROMPT,9013)
ISN      178          READ(READER,*)SW
ISN      179          IF(SW.LT.0)GO TO 120
ISN      180          IF(SW.EQ.0)GO TO 135
ISN      181          GO TO 131
ISN      182   130    WRITE(PROMPT,9015)
```

```
ISN     183     131  WRITE(PROMPT,9014)
ISN     184          READ(READER,*)ICURD,ICURM,ICURS
ISN     185          IF(ICURD.LT.0.OR.ICURD.GT.360)GO TO 130
ISN     186          IF(ICURM.LT.0.OR.ICURM.GT.59)GO TO 130
ISN     187          IF(ICURS.LT.0.OR.ICURS.GT.59)GO TO 130
ISN     188          CURDIR = ((ICURD*3600)+(ICURM*60)+ICURS)/3600.
ISN     189          GO TO 141
ISN     190     135  ICURD=0
ISN     191          ICURM=0
ISN     192          ICURS=0
ISN     193          CURDIR=0
ISN     194          GO TO 141
ISN     195     140  WRITE(PROMPT,9015)
              C
              C      **************************************************************
              C      *                                                            *
              C      * -ASK IF THE PARAMETERS NEED TO BE VERIFIED                 *
              C      * -IF NO, START THE MODEL                                    *
              C      * -IF YES, DISPLAY THE PARAMETERS                            *
              C      *                                                            *
              C      **************************************************************
              C
ISN     196     141  WRITE(PROMPT,9016)
ISN     197          READ(READER,9018),IVERFY
ISN     198          IF(IVERFY.NE.'Y'.AND.IVERFY.NE.'N')GO TO 140
ISN     199          IF(IVERFY.NE.'Y')GO TO 160
ISN     200          WRITE(PROMPT,9023),IDATE,ITIME,
                    *                    IDUR,
                    *                    ILATD,ILATM,ILATS,SPLAT,
                    *                    ILONGD,ILONGM,ILONGS,SPLONG,
```



```
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                    *                    IPLFRQ,
                    *                    IPLODF,IPLOMF,IPLOSF,PLFRLO,
                    *                    IPLODT,IPLOMT,IPLOST,PLTOLO,
                    *                    PLFRLA,
                    *                    PLTOLA
ISN     201          WRITE(PROMPT,9024),IOILTP,
                    *                    VISOIL,
                    *                    DENOIL,
                    *                    ITENS,
                    *                    FS,
                    *                    IGOR,
                    *                    ISPDUR,
                    *                    ISPRTE,
                    *                    ISPQTY,
                    *                    IWDENS,
                    *                    SW,
                    *                    ICURD,ICURM,ICURS,CURDIR
ISN     202          GO TO 151
ISN     203     150  WRITE(PROMPT,9015)
              C
              C      **************************************************************
              C      * -ASK IF THE PARAMETERS NEED TO BE REENTERED                *
              C      * -IF YES GO BACK TO REPROMPT FOR ALL THE PARAMETERS         *
              C      **************************************************************
              C
ISN     204     151  WRITE(PROMPT,9017)
```

```
ISN      205            READ(READER,9018),IREENT
ISN      206            IF(IREENT.NE.'Y'.AND.IREENT.NE.'N')GO TO 150
ISN      207            IF(IREENT.EQ.'Y')GO TO 21
               C
               C        ****************************************************************
               C        * -PICK UP ICE ROUGHNESS PARAMETERS FOR THE AREA IN WHICH      *
               C        *  THE SPILL OCCURRED. IF IT ISN'T IN THE ICE ROUGHNESS ARRAY, *
               C        *  ASSUME THAT IT IS SMOOTH ICE AND DISPLAY A MESSAGE.         *
               C        ****************************************************************
               C
ISN      208       160  OPEN(ICEARR)
ISN      209       161  READ(ICEARR,*,END=180),((COORD(I,J),J=1,6),I=1,2),DCAV,LCAV,
                      *                       WCAV,ANGCAV,SPCAVL,SPCAVW,CD
ISN      210            DO 170 I=1,2
ISN      211            ICERGH(I,1)=(COORD(I,1)*3600+COORD(I,2)*60+COORD(I,3))/3600.
ISN      212            ICERGH(I,2)=(COORD(I,4)*3600+COORD(I,5)*60+COORD(I,6))/3600.
ISN      213       170  CONTINUE
               C
               C        ****************************************************************
               C        *                                                              *
               C        *     I=1      ==> N.W. ICE ROUGHNESS AREA BOUNDRY             *
               C        *     I=2      ==> S.E. ICE ROUGHNESS AREA BOUNDRY             *
               C        *    (I,1)     ==> LATITUDE IN DEGREES                         *
               C        *    (I,2)     ==> LONGITUDE IN DEGREES                        *
               C        *                                                              *
               C        ****************************************************************
               C
ISN      214            IF(SPLAT.GT.ICERGH(1,1).OR.SPLONG.GT.ICERGH(1,2))GO TO 161
ISN      215            IF(SPLAT.LT.ICERGH(2,1).OR.SPLONG.LT.ICERGH(2,2))GO TO 161
ISN      216            GO TO 190
ISN      217       180  DCAV=0
ISN      218            LCAV=0
ISN      219            WCAV=0
ISN      220            ANGCAV=0
```

```
ISN      221            SPCAVL=0
ISN      222            SPCAVW=0
ISN      223            CD=0
ISN      224            WRITE(PROMPT,9022)
ISN      225       190  CLOSE(ICEARR)
ISN      226            ANGDIF=CURDIR-ANGCAV
ISN      227            ANGDIF=DABS(ANGDIF)
ISN      228            IF(ANGDIF.LE.45.0.OR.ANGDIF.GE.315.0)GO TO 195
ISN      229            IF(ANGDIF.GE.135.0.AND.ANGDIF.LE.225.0)GO TO 195
ISN      230            TEMP=LCAV
ISN      231            LCAV=WCAV
ISN      232            WCAV=TEMP
ISN      233            TEMP=SPCAVL
ISN      234            SPCAVL=SPCAVW
ISN      235            SPCAVW=TEMP
ISN      236       195  WRITE(PRESLT,9100),RDATE,RTIME,VERSNO
ISN      237            WRITE(PRESLT,9101)
ISN      238            WRITE(PRESLT,9102),IDATE,ITIME,
                      *                  IDUR,
                      *                  ILATD,ILATM,ILATS,SPLAT,
                      *                  ILONGD,ILONGM,ILONGS,SPLONG,
                      *                  IPLFRQ,
```

```
     *                        IPLODF,IPLOMF,IPLOSF,PLFRLO,
     *                        IPLODT,IPLOMT,IPLOST,PLTOLO,
     *                        PLFRLA,
     *                        PLTOLA
ISN    239      WRITE(PRESLT,9103),IOILTP,
     *                        VISOIL,
     *                        DENOIL,
     *                        ITENS,
     *                        FS,
     *                        IGOR,
     *                        ISPDUR,
     *                        ISPRTE,
     *                        ISPQTY,
     *                        IWDENS,
     *                        SW,
     *                        ICURD,ICURM,ICURS,CURDIR
ISN    240      WRITE(PRESLT,9104),DCAV,LCAV,WCAV,ANGCAV,SPCAVL,SPCAVW,CD
      C
      C         ***************************************************************
      C         *                                                             *
      C         *  INITIALIZE VARIABLES FOR CALCULATIONS.                     *
      C         *                                                             *
      C         ***************************************************************
      C
ISN    241      OPEN(PTELAG)
ISN    242  200 MHOUR=MHOUR+IPLFRQ
ISN    243      ANGSL=CURDIR
ISN    244      RNDSP=.TRUE.
ISN    245      SSLICK=0.0
ISN    246      LREC=0.0
ISN    247      OSLAT=SPLAT
ISN    248      OSLONG=SPLONG
ISN    249      DENWAT=IWDENS
ISN    250      IF(ISPRTE.EQ.0.OR.MHOUR.GE.ISPDUR)GO TO 210
ISN    251      VS=ISPRTE*MHOUR
ISN    252      GO TO 220
ISN    253  210 VS=ISPQTY
      C
LEVEL 1.3.0 (MAY 1983)      VS FORTRAN      DATE: 1985 JAN 09    TIME: 16:42:09     NAME: OILICE   PAGE:   10
      *....*...1.........2.........3.........4.........5.........6.........7.*.......8
      C         ***************************************************************
      C         *                                                             *
      C         *  CHECK FOR SMOOTH ICE AND GO TO ROUGH ICE ROUTINES IF A     *
      C         *  POSITIVE CAVITY DEPTH IS FOUND.                            *
      C         *                                                             *
      C         ***************************************************************
      C
ISN    254  220 IF(DCAV.NE.0)GO TO 3000
      C
      C         ***************************************************************
      C         *                                                             *
      C         *  CALCULATE THE CURRENT SPEED NECESSARY TO MOVE THE OIL. IF  *
      C         *  IT IS ENOUGH, GO TO THE CURRENT ROUTINES, OTHERWISE TREAT IT*
      C         *  AS A "NO CURRENT" SITUATION.                               *
      C         *                                                             *
      C         ***************************************************************
      C
ISN    255      STH=305.79/(88.68-VISOIL)
```

```
ISN     256              IF(SW.GT.STH)GO TO 600
                C
                C        *************************************************************
                C        *                                                           *
                C        *  NO CURRENT, SMOOTH ICE, FINITE OR CONTINUOUS SPILL       *
                C        *                                                           *
                C        *************************************************************
                C
ISN     257       500    THCKEQ=1.67-(8.50*(DENWAT-DENOIL))
ISN     258              IF(THCKEQ.GE.0.25)GO TO 510
ISN     259              WRITE(PERRS,*),'***EQUIL. THICKNESS<.25-SUBSTITUTING .25***'
ISN     260              THCKEQ=0.25
ISN     261       510    THCKLO=THCKEQ
ISN     262              SSLICK=0.0
ISN     263              AS=VS/(THCKEQ/100.0)
ISN     264              AS=AS*GSPFAC
ISN     265              LS=2.0*(DSQRT(AS/3.141592654))
ISN     266              WS=LS
ISN     267              GO TO 7000
                C
                C        *************************************************************
                C        *                                                           *
                C        *  CHECK IF FINITE OR CONTINUOUS SPILL FOR SMOOTH ICE; CURRENT.*
                C        *                                                           *
                C        *************************************************************
                C
ISN     268       600    IF(ISPDUR.GT.1)GO TO 800
                C
                C        *************************************************************
                C        *                                                           *
                C        *  CURRENT, SMOOTH ICE, FINITE SPILL                        *
                C        *                                                           *
                C        *************************************************************
                C
ISN     269              IF(SW.GT.18.0)GO TO 610
ISN     270              SSLICK=(0.15*SW)-0.60
ISN     271              GO TO 640
ISN     272       610    SSLICK=SW-15.6
ISN     273       640    IF(SSLICK.GT.0)GO TO 650
ISN     274              WRITE(PERRS,*),'***SLICK SPEED NEGATIVE-SUBSTITUTING ZERO***'
ISN     275              GO TO 500
ISN     276       650    THCKEQ=1.67-(8.50*(DENWAT-DENOIL))
```

```
ISN     277              IF(THCKEQ.GE.0.25)GO TO 660
ISN     278              WRITE(PERRS,*),'***EQUIL. THICKNESS<.25-SUBSTITUTING .25***'
ISN     279              THCKEQ=0.25
ISN     280       660    THCKLO=THCKEQ
ISN     281              AS=VS/(THCKEQ/100.0)
ISN     282              AS=AS*GSPFAC
ISN     283              LS=2.0*(DSQRT(AS/3.141592654))
ISN     284              WS=LS
ISN     285              PDIST=SSLICK*MHOUR*36.0
ISN     286              PDIR=CURDIR
ISN     287              CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN     288              OSLAT=PLAT1
ISN     289              OSLONG=PLONG1
ISN     290              GO TO 7000
```

```
C
C      ****************************************************************
C      *                                                              *
C      *  CURRENT, SMOOTH ICE, CONTINUOUS SPILL                       *
C      *                                                              *
C      ****************************************************************
C
   800 IF(SW.GT.18.0)GO TO 810
       SSLICK=(0.15*SW)-0.60
       GO TO 840
   810 SSLICK=SW-15.6
   840 IF(SSLICK.GT.0)GO TO 845
       WRITE(PERRS,*),'***SLICK SPEED NEGATIVE-SUBSTITUTING ZERO***'
       SSLICK=0.0
       GO TO 500
   845 RNDSP=.FALSE.
       THCKEQ=1.67-(8.50*(DENWAT-DENOIL))
       IF(THCKEQ.GE.0.25)GO TO 847
       WRITE(PERRS,*),'***EQUIL. THICKNESS<.25-SUBSTITUTING .25***'
       THCKEQ=0.25
   847 THCKLO=THCKEQ
       WS=ISPRTE/((SSLICK*36.0)*(THCKEQ*0.01))
       WS=WS*GSPFAC
       AS=VS/(THCKEQ*0.01)
       AS=AS*GSPFAC
       LREC=(AS-(3.141592654*((WS/2.0)**2.0)))/WS
       LS=LREC+WS
       OFFSET=SSLICK*36.0*MHOUR
       IF(OFFSET.GT.WS/2.0)OFFSET=WS/2.0
       IF(MHOUR.LE.ISPDUR)GO TO 850
       PDIST=OFFSET+(SSLICK*36.0*(MHOUR-ISPDUR))
       PDIR=CURDIR
       CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
       OSLAT=PLAT1
       OSLONG=PLONG1
       GO TO 890
   850 PDIST=OFFSET
       PDIR=CURDIR
       CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
       OSLAT=PLAT1
       OSLONG=PLONG1
C
C      ****************************************************************
C      *                                                              *
C      *  IF THE CALCULATED LENGTH IS LESS THAN THE CALCULATED WIDTH  *
C      *  OF THE SLICK, RECALCULATE TO BE A DISPLACED CIRCULAR SLICK. *
```



```
C      *                                                              *
C      ****************************************************************
C
   890 IF(WS.LE.LS)GO TO 7000
       RNDSP=.TRUE.
       LREC=0.0
       AS=VS/(THCKEQ/100.0)
       AS=AS*GSPFAC
       LS=2.0*(DSQRT(AS/3.141592654))
       WS=LS
```

```
ISN     333          OSRAD=LS/2.0
ISN     334          PDIST=SSLICK*36.0*MHOUR
ISN     335          IF(PDIST.GT.OSRAD.AND.ISPDUR.GE.MHOUR)PDIST=OSRAD
ISN     337          PDIR=CURDIR
ISN     338          CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN     339          OSLAT=PLAT1
ISN     340          OSLONG=PLONG1
ISN     341          GO TO 7000
              C
              C      ****************************************************************
              C      *                                                              *
              C      *  ROUGH ICE ROUTINES.                                         *
              C      *                                                              *
              C      ****************************************************************
              C
              C
              C      ****************************************************************
              C      *                                                              *
              C      *  CALCULATE THE CURRENT SPEED NECESSARY TO MOVE THE OIL. IF   *
              C      *  IT IS ENOUGH, GO TO THE CURRENT ROUTINES, OTHERWISE TREAT IT*
              C      *  AS A "NO CURRENT" SITUATION.                                *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     342     3000 K=1.0+(1.96*(DCAV/LCAV))+(2.22*DSQRT(DCAV/LCAV))
ISN     343          IF(K.GT.3.0)K=3.0
ISN     345          THCKEQ=1.67-(8.50*(DENWAT-DENOIL))
ISN     346          IF(THCKEQ.GE.0.25)GO TO 3010
ISN     347          WRITE(PERRS,*),'***EQUIL. THICKNESS<.25-SUBSTITUTING .25***'
ISN     348          THCKEQ=0.25
ISN     349     3010 THCKLO=THCKEQ
ISN     350          DELTA=(DENWAT-DENOIL)/DENWAT
ISN     351          FTHCK=DELTA*GRAV*THCKLO
ISN     352          FTHCK=SW/DSQRT(FTHCK)
ISN     353          STH=(305.79/(88.68-VISOIL))*K
ISN     354          IF(SW.LE.STH)GO TO 3100
ISN     355          SSLICK=-1.0*(SW*(DSQRT(K/((0.115*(FTHCK**2.0))+1.105))-1.0))
ISN     356          IF(SSLICK.GT.0.0)GO TO 3200
              C
              C      ****************************************************************
              C      *                                                              *
              C      *  NO CURRENT, ROUGH ICE, FINITE OR CONTINUOUS SPILL           *
              C      *     OIL COMPLETELY FILLS CAVITIES IN ICE UNDERSURFACE        *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     357     3100 VCAV=LCAV*DCAV*WCAV/1000000.0
ISN     358          VCAV=VCAV*100.0/SPCAVL*100.0/SPCAVW
ISN     359          VAREA=VCAV+(THCKEQ/100.0)
ISN     360          AS=VS/VAREA
LEVEL 1.3.0 (MAY 1983)        VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09      NAME: OILICE  PAGE:    13
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     361          AS=AS*GSPFAC
ISN     362          SSLICK=0.0
ISN     363          LS=2.0*(DSQRT(AS/3.141592654))
ISN     364          WS=LS
ISN     365          GO TO 7000
              C
```

```
                 C        ****************************************************************
                 C        *                                                              *
                 C        *  CURRENT, ROUGH ICE                                          *
                 C        *                                                              *
                 C        ****************************************************************
                 C
                 C
                 C        ****************************************************************
                 C        *                                                              *
                 C        *  CURRENT, ROUGH ICE                                          *
                 C        *    CALCULATE EQUIL. THICKNESS                                *
                 C        *    CHECK FOR FINITE OR CONTINUOUS SPILL                      *
                 C        *    CHECK FOR SMALL OR LARGE ROUGHNESS                        *
                 C        *                                                              *
                 C        ****************************************************************
                 C
ISN    366          3200 IF(ISPDUR.GT.1)GO TO 5000
ISN    367               IF(THCKEQ.LT.DCAV)GO TO 4000
                 C
                 C        ****************************************************************
                 C        *                                                              *
                 C        *  CURRENT, FINITE SPILL, SMALL ICE ROUGHNESS                  *
                 C        *    OIL IS FLUSHED FROM UPSTREAM CAVITIES AS SLICK MOVES,     *
                 C        *    RESULTING IN CIRCULAR SLICK DISPLACED DOWNSTREAM FROM SPILL
                 C        *                                                              *
                 C        ****************************************************************
                 C
ISN    368               VCAV=LCAV*DCAV*WCAV/1000000.0
ISN    369               VCAV=VCAV*100.0/SPCAVL*100.0/SPCAVW
ISN    370               VAREA=VCAV+(THCKEQ/100.0)
ISN    371               AS=VS/VAREA
ISN    372               AS=AS*GSPFAC
ISN    373               LS=2.0*(DSQRT(AS/3.141592654))
ISN    374               WS=LS
ISN    375               PDIR=CURDIR
ISN    376               PDIST=MHOUR*SSLICK*36.0
ISN    377               CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,OSLAT,OSLONG)
ISN    378               GO TO 7000
                 C
                 C        ****************************************************************
                 C        *                                                              *
                 C        *  CURRENT, FINITE SPILL, LARGE ICE ROUGHNESS                  *
                 C        *                                                              *
                 C        ****************************************************************
                 C
ISN    379          4000 DVORT=(SW**2.0)/(3.46*DELTA*GRAV)
ISN    380               LVORT=4.0*SW
ISN    381               IF(LVORT.LT.2.0*LCAV)GO TO 4010
ISN    382               DVORT=(2.0*(LCAV*DVORT))/LVORT
ISN    383          4010 IF(DVORT.GT.DCAV)GO TO 4200
ISN    384               LSHEAR=4.0*DELTA*GRAV
ISN    385               LSHEAR=LSHEAR*((DCAV**2.0)-((DCAV-(DVORT/2.0))**2.0))
ISN    386               LSHEAR=LSHEAR/(FS*(SW**2.0))
                 C
```



```
                 C        ****************************************************************
                 C        *                                                              *
```

```
                  C       *  SHEAR DIVIDES SLICK? YES->4100.                             *
                  C       *                       NO ->CALCULATE VWIDTH                  *
                  C       *                                                              *
                  C       ****************************************************************
                  C
ISN     387               IF(LSHEAR+LVORT.LT.LCAV)GO TO 4100
ISN     388               IF(LVORT.GT.LCAV)LVORT=LCAV
ISN     390               THCKTL=(DCAV-(DVORT/2.0))**2.0
ISN     391               THCKTL=(FS*(SW**2.0)*(LCAV-LVORT)/(4.0*DELTA*GRAV))+THCKTL
ISN     392               TKCKTL=DSQRT(THCKTL)
ISN     393               VWIDTH=THCKTL+(DCAV-DVORT)/2.0
ISN     394               VWIDTH=(LVORT*(DCAV-DVORT))+(((LCAV-LVORT)*VWIDTH)/2.0)
ISN     395               GO TO 4500
                  C
                  C       ****************************************************************
                  C       *                                                              *
                  C       *  SLICK DIVIDES? YES->4200.                                   *
                  C       *                 NO ->CALCULATE VWIDTH                        *
                  C       *                                                              *
                  C       ****************************************************************
                  C
ISN     396          4100 THCKST=(DCAV**2.0)-((FS*(SW**2.0)*(LCAV-LVORT))/4.0*DELTA*GRAV)
ISN     397               IF(THCKST.LT.0.0)GO TO 4200
ISN     398               VWIDTH=(DCAV**2.0)-((LCAV*FS*(SW**2.0))/(4.0*DELTA*GRAV))
ISN     399               VWIDTH=(LCAV*(DCAV+DSQRT(VWIDTH)))/2.0
ISN     400               GO TO 4500
                  C
                  C       ****************************************************************
                  C       *                                                              *
                  C       *  CAVITIES FLUSHED? YES->4300                                 *
                  C       *                    NO ->CALCULATE VWIDTH                     *
                  C       *                                                              *
                  C       ****************************************************************
                  C
ISN     401          4200 SFAIL=ITENS*(DENWAT-DENOIL)
ISN     402               SFAIL=(2.0*((DENWAT+DENOIL)/(DENWAT*DENOIL)))*DSQRT(SFAIL)
ISN     403               SFAIL=1.5*DSQRT(SFAIL)
ISN     404               IF(SW.GE.SFAIL)GO TO 4300
ISN     405               VWIDTH=(DCAV+((SW**2.0)/(4.0*DELTA*GRAV)))/2.0
ISN     406               VWIDTH=VWIDTH*((4.0*DELTA*GRAV)/(FS*(SW**2.0)))
ISN     407               VWIDTH=VWIDTH*((DCAV**2.0)-(((SW**2.0)/(4.0*DELTA*GRAV))**2.0))
ISN     408               VWIDTH=VWIDTH+(6.0*CD*DCAV*THCKEQ)
ISN     409               GO TO 4500
                  C
                  C       ****************************************************************
                  C       *                                                              *
                  C       *  WIDTH IS CALCULATED AS IF THERE WAS NO CURRENT. LENGTH IS   *
                  C       *  CALCULATED FROM THE AREA OF THE SPILL AS IF IT OCCURRED IN  *
                  C       *  SMOOTH ICE (BECAUSE CAVITIES ARE FLUSHED).                  *
                  C       *                                                              *
                  C       ****************************************************************
                  C
ISN     410          4300 VCAV=LCAV*DCAV*WCAV/1000000.0
ISN     411               VCAV=VCAV*100.0/SPCAVL*100.0/SPCAVW
ISN     412               VAREA=VCAV+(THCKEQ/100.0)
ISN     413               AS=VS/VAREA
ISN     414               AS=AS*GSPFAC
ISN     415               WS=2.0*(DSQRT(AS/3.141592654))
```

```
                    *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     416              RNDSP=.FALSE.
ISN     417              AS=(VS/(THCKEQ/100.0))*GSPFAC
ISN     418              LREC=(AS-(3.141592654*((WS/2.0)**2.0)))/WS
ISN     419              IF(LREC.GT.0.0)GO TO 4305
ISN     420              LREC=0.0
ISN     421              RNDSP=.TRUE.
ISN     422         4305 LS=LREC+WS
ISN     423              GO TO 7000
ISN     424         4310 PDIST=SSLICK*MHOUR*36.0
ISN     425              PDIR=CURDIR
ISN     426              CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN     427              OSLAT=PLAT1
ISN     428              OSLONG=PLONG1
ISN     429              GO TO 7000
                    C
                    C        ***************************************************************
                    C        *                                                             *
                    C        *  CALCULATE DIMENSIONS AND VOLUME OF SLICK AS IN NO CURRENT   *
                    C        *                                                             *
                    C        ***************************************************************
                    C
ISN     430         4500 VCAV=LCAV*DCAV*WCAV/1000000.0
ISN     431              VCAV=VCAV*100.0/SPCAVL*100.0/SPCAVW
ISN     432              VAREA=VCAV+(THCKEQ/100.0)
ISN     433              AS=VS/VAREA
ISN     434              AS=AS*GSPFAC
ISN     435              WS=2.0*(DSQRT(AS/3.141592654))
                    C
                    C        ***************************************************************
                    C        *                                                             *
                    C        *  RECALC NEW AREA USING LOWER VOLUME TRAPPED OIL DUE TO CURRENT
                    C        *  CALCULATE NEW LENGTH(WIDTH REMAINS THE SAME) AND PLOT IT.   *
                    C        *                                                             *
                    C        ***************************************************************
                    C
ISN     436              TEMP=(((VWIDTH*WCAV)/1000000.0)*(100.0/SPCAVW)*(100.0/SPCAVL))
ISN     437              AS=AS*VAREA/TEMP
ISN     438              RNDSP=.FALSE.
ISN     439              LREC=(AS-(3.141592654*((WS/2.0)**2.0)))/WS
ISN     440              IF(LREC.GT.0.0)GO TO 4505
ISN     441              LREC=0.0
ISN     442              RNDSP=.TRUE.
ISN     443         4505 LS=LREC+WS
ISN     444              SSLICK=0.0
ISN     445              GO TO 7000
                    C
                    C        ***************************************************************
                    C        *                                                             *
                    C        *  CURRENT, CONTINUOUS SPILL ROUTINES                         *
                    C        *      CHECK FOR SMALL OR LARGE ROUGHNESS                     *
                    C        *                                                             *
                    C        ***************************************************************
                    C
ISN     446         5000 IF(DCAV.GT.THCKEQ)GO TO 5050
                    C
                    C        ***************************************************************
```

```
      C       *                                                             *
      C       *  CURRENT, CONTINUOUS SPILL, SMALL ICE ROUGHNESS              *
      C       *       CALCULATE VOLUME/UNIT AREA; AREA,LENGTH AND WIDTH      *
      C       *       OF SLICK. CALCULATE OFFSET OF SLICK FROM ORIGIN.       *
```


```
      *....*...1.........2.........3.........4.........5.........6.........7.*.......8
      C       *                                                             *
      C       ***************************************************************
      C
ISN   447         VCAV=LCAV*DCAV*WCAV/1000000.0
ISN   448         VCAV=VCAV*100.0/SPCAVL*100.0/SPCAVW
ISN   449         VAREA=VCAV+(THCKEQ/100.0)
ISN   450         WS=ISPRTE/((SSLICK*36.0)*(THCKEQ/100.0))
ISN   451         WS=WS*GSPFAC
ISN   452         AS=VS/VAREA
ISN   453         AS=AS*GSPFAC
ISN   454         LREC=(AS-(3.141592654*((WS/2.0)**2.0)))/WS
ISN   455         LS=LREC+WS
ISN   456         OFFSET=SSLICK*36.0*MHOUR
ISN   457         IF(OFFSET.GT.WS/2.0)OFFSET=WS/2.0
ISN   459         IF(MHOUR.LE.ISPDUR)GO TO 5010
ISN   460         PDIST=OFFSET+(SSLICK*36.0*(MHOUR-ISPDUR))
ISN   461         PDIR=CURDIR
ISN   462         CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN   463         OSLAT=PLAT1
ISN   464         OSLONG=PLONG1
ISN   465         GO TO 5040
ISN   466    5010 PDIST=OFFSET
ISN   467         PDIR=CURDIR
ISN   468         CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN   469         OSLAT=PLAT1
ISN   470         OSLONG=PLONG1
      C
      C       ***************************************************************
      C       *                                                             *
      C       *  IF THE CALCULATED LENGTH IS LESS THAN THE CALCULATED WIDTH  *
      C       *  OF THE SLICK, RECALCULATE TO BE A DISPLACED CIRCULAR SLICK. *
      C       *                                                             *
      C       ***************************************************************
      C
ISN   471    5040 IF(WS.LE.LS)GO TO 7000
ISN   472         RNDSP=.TRUE.
ISN   473         LREC=0.0
ISN   474         LS=2.0*(DSQRT(AS/3.141592654))
ISN   475         WS=LS
ISN   476         OSRAD=LS/2.0
ISN   477         PDIST=SSLICK*36.0*MHOUR
ISN   478         IF(PDIST.GT.OSRAD.AND.ISPDUR.GE.MHOUR)PDIST=OSRAD
ISN   480         PDIR=CURDIR
ISN   481         CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN   482         OSLAT=PLAT1
ISN   483         OSLONG=PLONG1
ISN   484         GO TO 7000
      C
      C       ***************************************************************
      C       *                                                             *
      C       *  CURRENT, CONTINUOUS SPILL LARGE ICE ROUGHNESS ROUTINES      *
      C       *                                                             *
```

```
             C       ************************************************************
             C
ISN     485    5050 DVORT=(SW**2.0)/(3.46*DELTA*GRAV)
ISN     486         LVORT=4.0*SW
ISN     487         IF(LVORT.LT.2.0*LCAV)GO TO 5060
ISN     488         DVORT=(2.0*(LCAV*DVORT))/LVORT
ISN     489    5060 IF(DVORT.GT.DCAV)GO TO 5200
ISN     490         LSHEAR=4.0*DELTA*GRAV
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09       NAME: OILICE   PAGE:    17
             *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN     491         LSHEAR=LSHEAR*((DCAV**2.0)-((DCAV-(DVORT/2.0))**2.0))
ISN     492         LSHEAR=LSHEAR/(FS*(SW**2.0))
             C
             C       ************************************************************
             C       *                                                          *
             C       *  SHEAR DIVIDES SLICK? YES->5100.                         *
             C       *                       NO ->CALCULATE VWIDTH              *
             C       *                                                          *
             C       ************************************************************
             C
ISN     493         IF(LSHEAR+LVORT.LT.LCAV)GO TO 5100
ISN     494         IF(LVORT.GT.LCAV)LVORT=LCAV
ISN     496         THCKTL=(DCAV-(DVORT/2.0))**2.0
ISN     497         THCKTL=(FS*(SW**2.0)*(LCAV-LVORT)/(4.0*DELTA*GRAV))+THCKTL
ISN     498         TKCKTL=DSQRT(THCKTL)
ISN     499         VWIDTH=THCKTL+(DCAV-DVORT)/2.0
ISN     500         VWIDTH=(LVORT*(DCAV-DVORT))+(((LCAV-LVORT)*VWIDTH)/2.0)
ISN     501         GO TO 5500
             C
             C       ************************************************************
             C       *                                                          *
             C       *  SLICK DIVIDES? YES->5200.                               *
             C       *                 NO ->CALCULATE VWIDTH                    *
             C       *                                                          *
             C       ************************************************************
             C
ISN     502    5100 THCKST=(DCAV**2.0)-((FS*(SW**2.0)*(LCAV-LVORT))/4.0*DELTA*GRAV)
ISN     503         IF(THCKST.LT.0.0)GO TO 5200
ISN     504         VWIDTH=(DCAV**2.0)-((LCAV*FS*(SW**2.0))/(4.0*DELTA*GRAV))
ISN     505         VWIDTH=(LCAV*(DCAV+DSQRT(VWIDTH)))/2.0
ISN     506         GO TO 5500
             C
             C       ************************************************************
             C       *                                                          *
             C       *  CAVITIES FLUSHED? YES->5300                             *
             C       *                    NO ->CALCULATE VWIDTH                 *
             C       *                                                          *
             C       ************************************************************
             C
ISN     507    5200 SFAIL=ITENS*(DENWAT-DENOIL)
ISN     508         SFAIL=(2.0*((DENWAT+DENOIL)/(DENWAT*DENOIL)))*DSQRT(SFAIL)
ISN     509         SFAIL=1.5*DSQRT(SFAIL)
ISN     510         IF(SW.GE.SFAIL)GO TO 5300
ISN     511         VWIDTH=(DCAV+((SW**2.0)/(4.0*DELTA*GRAV)))/2.0
ISN     512         VWIDTH=VWIDTH*((4.0*DELTA*GRAV)/(FS*(SW**2.0)))
ISN     513         VWIDTH=VWIDTH*((DCAV**2.0)-(((SW**2.0)/(4.0*DELTA*GRAV))**2.0))
ISN     514         VWIDTH=VWIDTH+(6.0*CD*DCAV*THCKEQ)
ISN     515         GO TO 5500
```

```
ISN       516    5300 VWIDTH=0.0
                C
                C       ****************************************************************
                C       *                                                              *
                C       *  SPEED OF SLICK IS TEMPORARILY CALCULATED AS IN SMOOTH ICE!  *
                C       *                                                              *
                C       ****************************************************************
                C
ISN       517    5500 WS=ISPRTE/((SSLICK*36.0)*(THCKEQ/100.0))
ISN       518         WS=WS*GSPFAC
ISN       519         VAREA=(((VWIDTH*WCAV)/1000000.0)*(100.0/SPCAVW)*(100.0/SPCAVL))
ISN       520         SEDGE=SSLICK*((THCKEQ*0.01)/((THCKEQ*0.01)+VAREA))
LEVEL 1.3.0 (MAY 1983)         VS FORTRAN          DATE: 1985 JAN 09      TIME: 16:42:09       NAME: OILICE   PAGE:     18
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       521         OFFSET=SSLICK*36.0*MHOUR
ISN       522         IF(MHOUR.GT.ISPDUR)GO TO 5507
ISN       523         LS=SEDGE*36.0*MHOUR
ISN       524         GO TO 5509
                C
                C       ****************************************************************
                C       *                                                              *
                C       *  SPILL HAS STOPPED ,CHECK IF THE CURRENT IS ENOUGH TO FLUSH  *
                C       *  THE CAVITIES.                                               *
                C       *                                                              *
                C       ****************************************************************
                C
ISN       525    5507 IF(VAREA.EQ.0.0)GO TO 5508
                C
                C       ****************************************************************
                C       *                                                              *
                C       *  SPILL HAS STOPPED AND OIL HAS SPREAD UNTIL CAVITIES RETAIN  *
                C       *  ALL OF IT.                                                  *
                C       *                                                              *
                C       ****************************************************************
                C
ISN       526         LS=(SEDGE*36.0*ISPDUR)*(((THCKEQ*0.01)+VAREA)/VAREA)
ISN       527         OFFSET=SSLICK*36.0*ISPDUR
ISN       528         SSLICK=0.0
ISN       529         GO TO 5509
ISN       530    5508 LS=(SEDGE*36.0*ISPDUR)
ISN       531    5509 LREC=LS-WS
ISN       532         AS=(3.141592654*((WS/2.0)**2.0))+(LREC*WS)
ISN       533         IF(LREC.LE.0.0)GO TO 5510
ISN       534         IF(OFFSET.GT.WS/2.0)OFFSET=WS/2.0
ISN       536         PDIST=OFFSET
ISN       537         IF(MHOUR.GT.ISPDUR)PDIST=OFFSET+(SSLICK*36.0*(MHOUR-ISPDUR))
ISN       539         PDIR=CURDIR
ISN       540         CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN       541         OSLAT=PLAT1
ISN       542         OSLONG=PLONG1
ISN       543         RNDSP=.FALSE.
                C
                C       ****************************************************************
                C       *                                                              *
                C       *  IF THE CALCULATED LENGTH IS LESS THAN THE CALCULATED WIDTH  *
                C       *  OF THE SLICK, RECALCULATE TO BE A DISPLACED CIRCULAR SLICK. *
                C       *                                                              *
                C       ****************************************************************
```

```
              C
ISN     544             IF(WS.LE.LS)GO TO 7000
ISN     545        5510 RNDSP=.TRUE.
ISN     546             AS=(3.141592654*((LS/2.0)**2.0))-(LREC*LS)
ISN     547             LS=2.0*(DSQRT(AS/3.141592654))
ISN     548             LREC=0.0
ISN     549             WS=LS
ISN     550             OSRAD=LS/2.0
ISN     551             PDIST=OFFSET
ISN     552             IF(PDIST.GT.OSRAD.AND.ISPDUR.GE.MHOUR)PDIST=OSRAD
ISN     554             PDIR=CURDIR
ISN     555             CALL QCOORD(SPLAT,SPLONG,PDIR,PDIST,PLAT1,PLONG1)
ISN     556             OSLAT=PLAT1
ISN     557             OSLONG=PLONG1
ISN     558             GO TO 7000
              C
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09      NAME: OILICE   PAGE:    19
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
              C         ****************************************************************
              C         *                                                              *
              C         *  PLOT AND PRINT THE RESULTS AND CHECK IF ANOTHER SET OF      *
              C         *  CALCULATIONS AND PLOTS ARE TO BE DONE                       *
              C         *                                                              *
              C         ****************************************************************
              C
ISN     559        7000 CALL PLOTIT
ISN     560             IF(MHOUR.LT.IDUR)GO TO 200
ISN     561             CLOSE(PTELAG)
              C
              C         ****************************************************************
              C         *                                                              *
              C         *    PRINT OIL TYPE ARRAY                                      *
              C         *                                                              *
              C         ****************************************************************
              C
ISN     562             OPEN(OILARR)
ISN     563             OPEN(PARRS)
ISN     564             WRITE(PARRS,9300),RDATE,RTIME,VERSNO
ISN     565             WRITE(PARRS,9301)
ISN     566        8000 READ(OILARR,*,END=8010)OTTYPE,VISOIL,DENOIL,ITENS,FS
ISN     567             WRITE(PARRS,9302),OTTYPE,VISOIL,DENOIL,ITENS,FS
ISN     568             GO TO 8000
ISN     569        8010 CLOSE(OILARR)
              C
              C         ****************************************************************
              C         *                                                              *
              C         *    PRINT ICE ROUGHNESS ARRAY                                 *
              C         *                                                              *
              C         ****************************************************************
              C
ISN     570             OPEN(ICEARR)
ISN     571             WRITE(PARRS,9300),RDATE,RTIME,VERSNO
ISN     572             WRITE(PARRS,9303)
ISN     573        8100 READ(ICEARR,*,END=8110),((COORD(I,J),J=1,6),I=1,2),DCAV,LCAV,
                       *                           WCAV,ANGCAV,SPCAVL,SPCAVW,CD
ISN     574             DO 8101 I=1,2
ISN     575             ICERGH(I,1)=(COORD(I,1)*3600+COORD(I,2)*60+COORD(I,3))/3600.
ISN     576             ICERGH(I,2)=(COORD(I,4)*3600+COORD(I,5)*60+COORD(I,6))/3600.
```

```
ISN     577     8101 CONTINUE
ISN     578     8105 WRITE(PARRS,9304),((ICERGH(I,J),J=1,2),I=1,2),DCAV,LCAV,
                    *                       WCAV,ANGCAV,SPCAVL,SPCAVW,CD
ISN     579          GO TO 8100
ISN     580     8110 CLOSE(ICEARR)
              C
              C      ****************************************************************
              C      *                                                              *
              C      *    PRINT GAS TO OIL SPREAD FACTOR ARRAY                      *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     581          OPEN(GORSPR)
ISN     582          WRITE(PARRS,9300),RDATE,RTIME,VERSNO
ISN     583          WRITE(PARRS,9305)
ISN     584     8200 READ(GORSPR,*,END=8210)TABGOR,GSPFAC
ISN     585          WRITE(PARRS,9306),TABGOR,GSPFAC
ISN     586          GO TO 8200
ISN     587     8210 CLOSE(GORSPR)
ISN     588          CLOSE(PARRS)
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09       NAME: OILICE   PAGE:    20
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
              C
              C      ****************************************************************
              C      *                                                              *
              C      *    END OF PROGRAM - TERMINATE THE RUN                        *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     589          STOP
ISN     590     9000 FORMAT ('1',26X,'D O M E   P E T R O L E U M',9X,A8,1X,A8//
                    *         26X,'OIL UNDER ICE COMPUTER MODEL'//
                    *         34X,'VERSION ',F3.1//
                    *         25X,'INPUT PARAMETER SPECIFICATIONS'////)
ISN     591     9001 FORMAT (' ENTER SPILL DATE(YYMMDD) AND HOUR')
ISN     592     9002 FORMAT ('        MODEL DURATION (HOURS)')
ISN     593     9003 FORMAT ('        SPILL LATITUDE(DEG,MIN,SEC N)')
ISN     594     9004 FORMAT ('        SPILL LONGITUDE(DEG,MIN,SEC W)')
ISN     595     9005 FORMAT ('        PLOT FREQUENCY (HOURS)')
ISN     596     9006 FORMAT ('        WEST PLOT LONGITUDE(DEG,MIN,SEC W)')
ISN     597     9007 FORMAT ('        EAST PLOT LONGITUDE(DEG,MIN,SEC W)')
ISN     598     9008 FORMAT ('        OIL TYPE(''0'' FOR LIST)')
ISN     599     9009 FORMAT ('        SPILL DURATION (HOURS)')
ISN     600     9010 FORMAT ('        SPILL QUANTITY (CUBIC METERS)')
ISN     601     9011 FORMAT ('        SPILL FLOW(CUBIC METERS/HOUR)')
ISN     602     9012 FORMAT ('        WATER DENSITY (G/CUBIC CM)')
ISN     603     9013 FORMAT ('        CURRENT VELOCITY(CM/SEC)')
ISN     604     9014 FORMAT ('        CURRENT DIRECTION(DEG,MIN,SEC)')
ISN     605     9015 FORMAT (' ****** INVALID RESPONSE - RETRY *****')
ISN     606     9016 FORMAT (' VERIFY PARAMETERS? (Y/N)')
ISN     607     9017 FORMAT (' RE-ENTER PARAMETERS? (Y/N)')
ISN     608     9018 FORMAT (A1)
ISN     609     9019 FORMAT ('        GAS TO OIL RATIO(-1 FOR LIST,0 FOR NO GAS)')
ISN     610     9020 FORMAT (' OIL TYPE==>',I3,
                    *          ' VISCOSITY==>',F8.4,
                    *          ' DENSITY==>',F8.4/
                    *          ' INTERFACIAL TENSION==>',F8.4,
                    *          ' INTERFACIAL FRICTION==>',F8.4//)
```

```
ISN     611     9021 FORMAT (' ****** END OF OIL PARAMETER ARRAY ******')
ISN     612     9022 FORMAT (' *ICE ROUGHNESS FIGURES NOT FOUND- SMOOTH ICE ASSUMED*')
ISN     613     9023 FORMAT (21X,'MODEL INPUT PARAMETER VERIFICATION'///
                    *        7X,'SPILL DATE-HOUR        ==> ',I6,'-',I2/
                    *        7X,'MODEL DURATION         ==> ',I3,' HOURS'/
                    *        7X,'SPILL LATITUDE         ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. N'/
                    *        7X,'SPILL LONGITUDE        ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. W'/
                    *        7X,'PLOT FREQUENCY         ==> ',I3,' HOURS'/
                    *        7X,'PLOT WEST LONGITUDE    ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. W'/
                    *        7X,'PLOT EAST LONGITUDE    ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. W'/
                    *        7X,'PLOT NORTH LATITUDE    ==> ',F8.4,' DEG. N'/
                    *        7X,'PLOT SOUTH LATITUDE    ==> ',F8.4,' DEG. N')
ISN     614     9024 FORMAT (7X,'OIL TYPE               ==> ',I2/
                    *        7X,'VISCOSITY              ==>',F8.4/
                    *        7X,'DENSITY                ==>',F8.4/
                    *        7X,'INTERFACIAL TENSION    ==>',F8.4/
                    *        7X,'INTERFACIAL FRICTION   ==>',F8.4/
                    *        7X,'GAS TO OIL RATIO       ==>',F6.1/
                    *        7X,'SPILL DURATION         ==>',I3,' HOURS'/
                    *        7X,'SPILL FLOW             ==>',F14.4,' CUBIC METERS/HOUR'/
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09      NAME: OILICE   PAGE:    21
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                    *        7X,'SPILL QUANTITY         ==> ',F14.4,' CUBIC METERS'/
                    *        7X,'WATER DENSITY          ==> ',F11.5,' G/CUBIC CM'/
                    *        7X,'CURRENT VELOCITY       ==> ',F9.4,' CM/SEC'/
                    *        7X,'CURRENT DIRECTION      ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                      F8.4,' DEG.')
ISN     615     9025 FORMAT (' GAS TO OIL RATIO==>',I3,
                    *        '    SPREAD FACTOR==>',F6.3/)
ISN     616     9026 FORMAT (' ****** END OF GAS TO OIL SPREAD FACTORS ******')
ISN     617     9100 FORMAT ('1',26X,'D O M E   P E T R O L E U M',9X,A8,1X,A8//
                    *             26X,'OIL UNDER ICE COMPUTER MODEL'//
                    *             34X,'VERSION ',F3.1//
                    *             27X,'HARDCOPY SIMULATION RESULTS'/)
ISN     618     9101 FORMAT (25X,'SIMULATION PARAMETERS SPECIFIED'////)
ISN     619     9102 FORMAT (6X,'SPILL DATE-HOUR        ==> ',I6,'-',I2/
                    *        6X,'MODEL DURATION         ==> ',I4,' HOURS'/
                    *        6X,'SPILL LATITUDE         ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. N'/
                    *        6X,'SPILL LONGITUDE        ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. W'/
                    *        6X,'PLOT FREQUENCY         ==> ',I3,' HOURS'/
                    *        6X,'PLOT WEST LONGITUDE    ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. W'/
                    *        6X,'PLOT EAST LONGITUDE    ==> ',I3,1X,I2,1X,I2,' OR ',
                    *                                   F8.4,' DEG. W'/
                    *        6X,'PLOT NORTH LATITUDE    ==> ',F8.4,' DEG. N'/
                    *        6X,'PLOT SOUTH LATITUDE    ==> ',F8.4,' DEG. N')
ISN     620     9103 FORMAT (6X,'OIL TYPE               ==> ',I2/
                    *        6X,'VISCOSITY              ==>',F8.4/
                    *        6X,'DENSITY                ==>',F8.4/
                    *        6X,'INTERFACIAL TENSION    ==>',F8.4/
                    *        6X,'INTERFACIAL FRICTION   ==>',F8.4/
                    *        6X,'GAS TO OIL RATIO       ==>',F6.1/
```

```
                  *        6X,'SPILL DURATION        ==> ',I4,' HOURS'/
                  *        6X,'SPILL FLOW            ==>',F14.4,' CUBIC METERS/HOUR'/
                  *        6X,'SPILL QUANTITY        ==> ',F14.4,' CUBIC METERS'/
                  *        6X,'WATER DENSITY         ==> ',F11.5,' G/CUBIC CM'/
                  *        6X,'CURRENT VELOCITY      ==> ',F9.4,' CM/SEC'/
                  *        6X,'CURRENT DIRECTION     ==> ',I3,1X,I2,1X,I2,' OR ',
                  *                                 F8.4,' DEG.'/)
ISN      621    9104 FORMAT (26X,'ICE ROUGHNESS CHARACTERICTICS'//
                  *        6X,'CAVITY DEPTH (CM.)    ===>',F10.4/
                  *        6X,'CAVITY LENGTH (CM.)   ===>',F10.4/
                  *        6X,'CAVITY WIDTH (CM.)    ===>',F10.4/
                  *        6X,'CAVITY ANGLE (DEG.)   ===>',F10.4/
                  *        6X,'CAVITY SPACING(LEN.CM.)=>',F10.4/
                  *        6X,'CAVITY SPACING(WID.CM.)=>',F10.4/
                  *        6X,'ROUGHNESS FORM DRAG   ===>',F10.4)
ISN      622    9300 FORMAT ('1',26X,'D O M E   P E T R O L E U M',9X,A8,1X,A8//
                  *           26X,'OIL UNDER ICE COMPUTER MODEL'//
                  *           34X,'VERSION ',F3.1//
                  *           30X,'INPUT TABLE VALUES'/)
ISN      623    9301 FORMAT (32X,'OIL TYPE ARRAY'//
                  *        16X,'OIL                       INTERFACIAL INTERFACIAL'/
                  *        16X,'TYPE VISCOSITY  DENSITY   TENSION     FRICTION '/)
ISN      624    9302 FORMAT (17X,I2,F10.4,F10.4,F10.4,3X,F10.4)
ISN      625    9303 FORMAT (29X,'ICE ROUGHNESS ARRAY'//
                  *    83X,'LENGTH   WIDTH'/
                  *    '  -----NORTH WEST-----  -----SOUTH EAST-----',
                  *    3X,'CAVITY   CAVITY   CAVITY   CAVITY   CAVITY   CAVITY',
                  *    5X,'DRAG'/
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09      NAME: OILICE   PAGE:    22
               *....*...1.........2.........3.........4.........5.........6.........7.*.......8
                  *    '  LATITUDE   LONGITUDE  LATITUDE   LONGITUDE',
                  *    3X,'DEPTH     LENGTH    WIDTH     ANGLE    SPACING  SPACING',
                  *    ' COEFFICIENT'/)
ISN      626    9304 FORMAT (1X,F9.5,3X,F9.5,1X,F9.5,3X,F9.5,F9.3,
                  *        F9.3,F9.3,F9.5,F9.3,F9.3,F12.5)
ISN      627    9305 FORMAT (26X,'GAS TO OIL SPREAD FACTORS'//
                  *        27X,'GAS TO OIL         SPREAD'/
                  *        27X,'  RATIO            FACTOR'/)
ISN      628    9306 FORMAT (30X,I3,11X,F6.3)
ISN      629         END
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:09      NAME: OILICE   PAGE:    23
STORAGE MAP
TAG: SET(S), REFERENCED(F), USED AS ARGUMENT(A), IN COMMON(C), EQUIVALENCED(E), INITIAL VALUE(I), NAMED CONSTANT(K),
     STATEMENT FUNCTION(T), SUBPROGRAM(X)
PROGRAM NAME: OILICE.   SIZE OF PROGRAM:    86E2 HEX BYTES.
```

NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.
ANGCAV	R*8	SF	0013D8	ANGDIF	R*8	SF	0013E0	ANGSL	R*8	SFC	000110	AS	R*8	SFC	0000F0
CCMPR#	R*4	FX	001730	CD	R*8	SF	001338	COORD	I*4	SF	0016F0	CURDIR	R*16	SF	0013E8
C0001.	L*4	FA	0014AC	C0002.	L*4	FA	0014B0	DABS	R*8	X	UNREFD	DATE		FX	001724
DCAV	R*8	SF	001358	DELTA	R*8	SF	001388	DENOIL	R*8	SF	0013F8	DENWAT	R*8	SF	001400
DSQRT	R*8	FX	00172C	DVORT	R*8	SF	001390	FDXPD#	R*4	FX	001734	FS	R*8	SF	001340

FTHCK	R*8	SFA	001398	GORSPR	I*4	SFA	0014B4	GRAV	R*8	SF	001360	GSPFAC	R*8	SF	001408
I	I*4	SF	001478	ICEARR	I*4	SFA	0014B8	ICEPTS	I*4	SFC	00012C	ICERGH	R*8	SF	0016D0
ICURD	I*4	SF	00148C	ICURM	I*4	SF	001490	ICURS	I*4	SF	001494	IDATE	I*4	SFC	000138
IDUR	I*4	SF	001480	IGOR	I*4	SF	001484	ILATD	I*4	SF	001498	ILATM	I*4	SF	00149C
ILATS	I*4	SF	0014A0	ILONGD	I*4	SF	0014BC	ILONGM	I*4	SF	0014C0	ILONGS	I*4	SF	0014C4
IOILTP	I*4	SF	0014C8	IPLFRQ	I*4	SF	0014CC	IPLODF	I*4	SF	0014D0	IPLODT	I*4	SF	0014D4
IPLOMF	I*4	SF	0014D8	IPLOMT	I*4	SF	0014DC	IPLOSF	I*4	SF	0014E0	IPLOST	I*4	SF	0014E4
IREENT	CHAR	SFA	0016C8	ISPDUR	I*4	SF	0014E8	ISPQTY	R*8	SF	001410	ISPRTE	R*8	SF	001418
ITENS	R*8	SF	0013A0	ITIME	I*4	SFC	00013C	IVERFY	CHAR	SFA	0016C9	IWDENS	R*8	SF	001420
J	I*4	F	00147C	K	R*8	SF	001330	LALRAT	R*8	SF	001428	LANDPT	I*4	SFC	000128
LCAV	R*8	SF	001368	LEAP	I*4	SF	001488	LREC	R*8	SFC	000120	LS	R*8	SFC	000100
LSHEAR	R*8	SF	001430	LVORT	R*8	SF	0013A8	MHOUR	I*4	SFC	000140	MOD		X	UNREFD
MODAYS	I*2	SFC	000148	OFFSET	R*8	SF	001438	OILARR	I*4	SFA	0014EC	OSLAT	R*16	SFCA	0000C0
OSLONG	R*16	SFCA	0000D0	OSRAD	R*16	SF	0013B0	OTTYPE	I*4	SF	0014F0	PARRS	I*4	SFA	0014A4
PDIR	R*16	SFCA	000040	PDIST	R*16	SFCA	000050	PERRS	I*4	SF	0014A8	PLAT1	R*16	SFCA	000080
PLAT2	R*16	FCA	0000A0	PLFRLA	R*16	SFC	000020	PLFRLO	R*16	SFC	000000	PLONG1	R*16	FCA	000090
PLONG2	R*16	FCA	0000B0	PLOTIT		FX	001738	PLTOLA	R*16	SFC	000030	PLTOLO	R*16	SFC	000010
PRESLT	I*4	SFC	000130	PROMPT	I*4	SF	0014F4	PTELAG	I*4	SFCA	000134	QCOORD		FX	00173C
RDATE	CHAR	FCA	000160	READER	I*4	SF	0014F8	RNDSP	L*4	SFC	000144	RTIME	CHAR	FCA	000168
SEDGE	R*8	SF	0013C0	SFAIL	R*8	SFA	0013C8	SPCAVL	R*8	SF	001440	SPCAVW	R*8	SF	001448
SPLAT	R*16	SFCA	000060	SPLONG	R*16	SFCA	000070	SSLICK	R*8	SFC	0000E8	STH	R*8	SF	001350
SW	R*8	SF	001348	TABGOR	I*4	SF	0014FC	TEMP	R*8	SF	001370	THCKEQ	R*8	SF	001450
THCKLO	R*8	SFC	0000E0	THCKST	R*8	SF	001458	THCKTL	R*8	SFA	001460	TIME		FX	001728
TKCKTL	R*4	SF	001500	VAREA	R*8	SF	0013D0	VCAV	R*8	SF	001378	VCLSE#	R*4	FX	001740
VERSNO	R*8	SFC	000118	VISOIL	R*8	SF	001468	VLDIO#	R*4	FX	001744	VOPEN#	R*4	FX	001748
VS	R*8	SFC	0000F8	VSCOM#		FX	00174C	VSERH#		X	UNREFD	VWIDTH	R*8	SFA	001470
WCAV	R*8	SF	001380	WS	R*8	SFC	000108								

COMMON INFORMATION

NAME: . SIZE: 170 HEX BYTES. (E) - EQUIVALENCED

NAME	MODE	DISPL.	NAME	MODE	DISPL.	NAME	MODE	DISPL.	NAME	MODE	DISPL.
PLFRLO	R*16	000000	PLTOLO	R*16	000010	PLFRLA	R*16	000020	PLTOLA	R*16	000030
PDIR	R*16	000040	PDIST	R*16	000050	SPLAT	R*16	000060	SPLONG	R*16	000070
PLAT1	R*16	000080	PLONG1	R*16	000090	PLAT2	R*16	0000A0	PLONG2	R*16	0000B0
OSLAT	R*16	0000C0	OSLONG	R*16	0000D0	THCKLO	R*8	0000E0	SSLICK	R*8	0000E8
AS	R*8	0000F0	VS	R*8	0000F8	LS	R*8	000100	WS	R*8	000108
ANGSL	R*8	000110	VERSNO	R*8	000118	LREC	R*8	000120	LANDPT	I*4	000128
ICEPTS	I*4	00012C	PRESLT	I*4	000130	PTELAG	I*4	000134	IDATE	I*4	000138
ITIME	I*4	00013C	MHOUR	I*4	000140	RNDSP	L*4	000144	MODAYS	I*2	000148
RDATE	CHAR	000160	RTIME	CHAR	000168						

LABEL INFORMATION.

LABEL	DEFINED	ADDR.	LABEL	DEFINED	ADDR.	LABEL	DEFINED	ADDR.	LABEL	DEFINED	ADDR.
1	40	001B64	20	58	001C32	21	59	001C4A	30	67	001D02
31	68	001D1A	40	72	001D70	41	73	001D88	50	80	001E6E
51	81	001E86	60	88	001F6C	61	89	001F84	62	93	001FCC
63	94	001FE4	64	102	0020E6	65	103	0020FE	82	120	002336
83	124	002386	84	128	0023EC	85	131	002476	86	134	0024A2
87	135	0024BA	88	140	00251A	89	144	002568	90	147	0025C2
91	151	0025FE	93	153	00260C	94	154	002624	95	159	002688
96	160	0026A0	100	165	0026F0	101	166	002708	110	171	00276C
111	172	002784	120	176	0027CC	121	177	0027E4	130	182	00283A
131	183	002852	135	190	002934	140	195	002962	141	196	00297A
150	203	002B6C	151	204	002B84	160	208	002C14	161	209	002C22
170	213	002DC4	180	217	002E78	190	225	002EC8	195	236	002F5E

200	242	003168	210	253	00320A	220	254	003216	500	257	00324A
510	261	003296	600	268	003306	610	272	00333C	640	273	00334C
650	276	003384	660	280	0033D0	800	291	0034A4	810	294	0034CC
840	295	0034DC	845	299	003520	847	304	003578	850	321	0036FE
890	326	00374E	3000	342	0038A4	3010	349	003948	3100	357	003A24
3200	366	003ABC	4000	379	003BB4	4010	383	003C14	4100	396	003DA0
4200	401	003E8A	4300	410	004000	4305	422	0040FC	4310	424	004112
4500	430	004188	4505	443	0042A8	5000	446	0042C6	5010	466	004482
5040	471	0044D2	5050	485	004604	5060	489	004664	5100	502	0047F0
5200	507	0048DA	5300	516	004A50	5500	517	004A58	5507	525	004B54
5508	530	004BDC	5509	531	004C08	5510	545	004D40	7000	559	004E74
8000	566	004F10	8010	569	004F9A	8100	573	00500A	8101	577	0051AC
8105	578	0051C2	8110	580	005276	8200	584	0052E6	8210	587	005340
9000	590	000FEA	9001	591	000FC4	9002	592	000FA3	9003	593	000F7B
9004	594	000F52	9005	595	000F31	9006	596	000F04	9007	597	000ED7
9008	598	000EB6	9009	599	000E95	9010	600	000E6D	9011	601	000E45
9012	602	000E20	9013	603	000DFD	9014	604	000DD4	9015	605	000DAA
9016	606	000D8D	9017	607	000D6E	9018	608	000D69	9019	609	000D34
9020	610	000CC4	9021	611	000C97	9022	612	000C5D	9023	613	000A82
9024	614	0008A6	9025	615	000873	9026	616	000840	9100	617	0007BE
9101	618	000795	9102	619	0005E3	9103	620	000405	9104	621	0002FA
9300	622	000281	9301	623	000203	9302	624	0001EF	9303	625	0000DF
9304	626	0000B4	9305	627	00005B	9306	628	000050			

```
*** VS FORTRAN ERROR MESSAGES ***
LEVEL 1.3.0 (MAY 1983)           VS FORTRAN          DATE: 1985 JAN 09      TIME: 16:42:09      NAME: OILICE   PAGE:    25
IFX00301   CNTL    0(I)          TRMFLG HAS BEEN SPECIFIED BUT SYSTERM IS NOT A TERMINAL. TRMFLG CANCELED.
*STATISTICS*  SOURCE STATEMENTS = 618, PROGRAM SIZE = 34530 BYTES, PROGRAM NAME = OILICE    PAGE:     1.
*STATISTICS* 1 DIAGNOSTIC GENERATED. SEVERITY CODE IS 0.
****** END OF COMPILATION 1 ******
```

A11.2 PLOTIT

```
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09      TIME: 16:42:10                      PAGE:    26
OPTIONS IN EFFECT:  NOLIST   MAP NOXREF   GOSTMT NODECK   SOURCE NOTERM   OBJECT FIXED  NOTEST NOTRMFLG   SRCFLG NOSYM
                    OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN  )  LINECOUNT(64)      CHARLEN(500)     SDUMP
                  *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        1             SUBROUTINE PLOTIT
ISN        2             REAL*16       OSRAD,PLAT3,PLONG3
ISN        3             REAL*8        SCOORD(4,2)
ISN        4             REAL*8        PLSTEP,DEGDIF,PLAT4,PLONG4
ISN        5             INTEGER*4     ISDATE,ISTIME,ISYY,ISMM,ISDD,ILEAP
ISN        6             CHARACTER*11 SSHAPE
                  C      ****************************************************************
ISN        7             REAL*16       PLFRLO,PLTOLO,PLFRLA,PLTOLA,PDIR,PDIST
ISN        8             REAL*16       SPLAT,SPLONG,PLAT1,PLONG1,PLAT2,PLONG2,OSLAT,OSLONG
ISN        9             REAL*8        THCKLO,SSLICK,AS,VS,LS,WS,ANGSL,VERSNO,LREC
ISN       10             INTEGER*4     LANDPT,ICEPTS,PRESLT,PTELAG,IDATE,ITIME,MHOUR
ISN       11             LOGICAL*4     RNDSP
ISN       12             INTEGER*2     MODAYS(12)
ISN       13             CHARACTER*8   RDATE,RTIME
                  C      ****************************************************************
ISN       14             COMMON        PLFRLO,PLTOLO,PLFRLA,PLTOLA,PDIR,PDIST,
                       *               SPLAT,SPLONG,PLAT1,PLONG1,PLAT2,PLONG2,OSLAT,OSLONG,
                       *               THCKLO,SSLICK,AS,VS,LS,WS,ANGSL,VERSNO,LREC,
                       *               LANDPT,ICEPTS,PRESLT,PTELAG,IDATE,ITIME,MHOUR,
                       *               RNDSP,
                       *               MODAYS,
                       *               RDATE,RTIME
                  C      ****************************************************************
ISN       15             WRITE(PTELAG,9100),'GEN A PLOT.                                '
ISN       16             WRITE(PTELAG,9100),'EVERY MESSAGE CONNECT TL.                  '
ISN       17             WRITE(PTELAG,9100),'EVERY MESSAGE STYLE DUPLEX.                '
ISN       18             WRITE(PTELAG,9100),'EVERY MESSAGE BLANKING OFF.                '
ISN       19             WRITE(PTELAG,9100),'EVERY CURVE SYMBOL COUNT 0.                '
ISN       20             WRITE(PTELAG,9100),'EVERY CURVE THICKNESS 3.                   '
ISN       21             WRITE(PTELAG,9100),'LEGEND FRAME ON.                           '
ISN       22             WRITE(PTELAG,9100),'PAGE BORDER OFF.                           '
ISN       23             WRITE(PTELAG,9100),'GRID TEXTURE SOLID.                        '
ISN       24             WRITE(PTELAG,9100),'X GRID ON.                                 '
ISN       25             WRITE(PTELAG,9100),'X LENGTH 7.0.                              '
ISN       26             WRITE(PTELAG,9100),'X AXIS TEXT "LONGITUDE".                   '
ISN       27             WRITE(PTELAG,9100),'Y GRID ON.                                 '
ISN       28             WRITE(PTELAG,9100),'Y LENGTH 7.0.                              '
ISN       29             WRITE(PTELAG,9100),'Y AXIS TEXT "LATITUDE".                    '
ISN       30             WRITE(PTELAG,9100),'MESSAGE 1 HEIGHT .2,COLOR WHITE.           '
ISN       31             WRITE(PTELAG,9100),'MESSAGE 1 TEXT "OIL UNDER ICE".            '
ISN       32             WRITE(PTELAG,9100),'MESSAGE 1 CONNECT BC,X 50,Y 100.           '
ISN       33             WRITE(PTELAG,9100),'MESSAGE 1 UNITS PLOT-%.                    '
ISN       34             WRITE(PTELAG,9100),'MESSAGE 2 X 8.5,Y 8.3,HEIGHT .1.           '
ISN       35             WRITE(PTELAG,9100),'MESSAGE 2 COLOR WHITE.                     '
ISN       36             WRITE(PTELAG,9100),'MESSAGE 2 TEXT "OILSPILL MODEL".           '
ISN       37             WRITE(PTELAG,9100),'MESSAGE 3 X 8.5,Y 8.1,HEIGHT .1.           '
ISN       38             WRITE(PTELAG,9100),'MESSAGE 3 COLOR WHITE.                     '
ISN       39             WRITE(PTELAG,9101),VERSNO
ISN       40             WRITE(PTELAG,9100),'MESSAGE 4 X 8.5,Y 7.9,HEIGHT .1.           '
ISN       41             WRITE(PTELAG,9100),'MESSAGE 4 COLOR WHITE.                     '
```

```
ISN       42          WRITE(PTELAG,9102),RDATE,RTIME
ISN       43          WRITE(PTELAG,9100),'MESSAGE 5 X 8.5,Y 7.7,HEIGHT .1.         '
ISN       44          WRITE(PTELAG,9100),'MESSAGE 5 COLOR WHITE.                   '
ISN       45          ISTIME=ITIME+MHOUR
ISN       46          ISDAYS=ISTIME/24
ISN       47          ISTIME=MOD(ISTIME,24)
ISN       48          ISDATE=IDATE
LEVEL 1.3.0 (MAY 1983)           VS FORTRAN          DATE: 1985 JAN 09      TIME: 16:42:10       NAME: PLOTIT  PAGE:    27
               *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN       49          ISYY=ISDATE/10000
ISN       50          MODAYS(2)=28
ISN       51          ILEAP=MOD(ISYY,4)
ISN       52          IF(ILEAP.EQ.0)MODAYS(2)=29
ISN       54          ISMM=(ISDATE-(ISYY*10000))/100
ISN       55          ISDD=(ISDATE-(ISYY*10000)-(ISMM*100))
ISN       56          ISDD=ISDD+ISDAYS
ISN       57     80   IF(ISDD.LE.MODAYS(ISMM))GO TO 90
ISN       58          ISDD=ISDD-MODAYS(ISMM)
ISN       59          ISMM=ISMM+1
ISN       60          IF(ISMM.LE.12)GO TO 80
ISN       61          ISMM=1
ISN       62          ISYY=ISYY+1
ISN       63          MODAYS(2)=28
ISN       64          ILEAP=MOD(ISYY,4)
ISN       65          IF(ILEAP.EQ.0)MODAYS(2)=29
ISN       67          GO TO 80
ISN       68     90   ISDATE=(ISYY*10000)+(ISMM*100)+ISDD
ISN       69          WRITE(PTELAG,9103),ISYY,ISMM,ISDD,ISTIME
ISN       70          WRITE(PTELAG,9100),'MESSAGE 6 UNITS COORDINATE.              '
ISN       71          WRITE(PTELAG,9100),'MESSAGE 6 CONNECT BL.                    '
ISN       72          WRITE(PTELAG,9104),PLTOLO,SPLAT
ISN       73          WRITE(PTELAG,9100),'MESSAGE 6 COLOR WHITE.                   '
ISN       74          WRITE(PTELAG,9100),'MESSAGE 6 TEXT " 1 (KM)".                '
ISN       75          WRITE(PTELAG,9100),'MESSAGE 6 POINTER UNITS COORDINATE.      '
ISN       76          PLAT1=SPLAT
ISN       77          PLONG1=PLTOLO
ISN       78          PDIR=90.0
ISN       79          PDIST=1000.0
ISN       80          CALL QCOORD(PLAT1,PLONG1,PDIR,PDIST,PLAT2,PLONG2)
ISN       81          WRITE(PTELAG,9105),PLONG2,SPLAT
ISN       82          WRITE(PTELAG,9100),'MESSAGE 6 STUB 0.                        '
ISN       83          WRITE(PTELAG,9100),'MESSAGE 6 ARROWHEAD 0.                   '
ISN       84          WRITE(PTELAG,9100),'MESSAGE 7 X 8.5,Y 7.3,HEIGHT .1.         '
ISN       85          WRITE(PTELAG,9100),'MESSAGE 7 COLOR WHITE.                   '
ISN       86          WRITE(PTELAG,9108),VS
ISN       87          WRITE(PTELAG,9100),'MESSAGE 8 X 8.5,Y 6.9,HEIGHT .1.         '
ISN       88          WRITE(PTELAG,9100),'MESSAGE 8 COLOR WHITE.                   '
ISN       89          WRITE(PTELAG,9109),AS
ISN       90          WRITE(PTELAG,9100),'MESSAGE 9 X 8.5,Y 6.5,HEIGHT .1.         '
ISN       91          WRITE(PTELAG,9100),'MESSAGE 9 COLOR WHITE.                   '
ISN       92          WRITE(PTELAG,9110),THCKLO
ISN       93          DEGDIF=PLFRLO-PLTOLO
ISN       94          PLSTEP=1
ISN       95          IF(DEGDIF.LT.3)PLSTEP=0.2
ISN       97          IF(DEGDIF.LT.1.5)PLSTEP=0.1
ISN       99          IF(DEGDIF.LT.0.3)PLSTEP=0.02
ISN      101          IF(DEGDIF.LT.0.15)PLSTEP=0.01
ISN      103          IF(DEGDIF.LT.0.03)PLSTEP=0.002
```

```
ISN    105         IF(DEGDIF.LT.0.015)PLSTEP=0.001
ISN    107         WRITE(PTELAG,9106),'XMIN    ',PLFRLO
ISN    108         WRITE(PTELAG,9106),'XMAX    ',PLTOLO
ISN    109         WRITE(PTELAG,9106),'X STEP  ',PLSTEP
ISN    110         WRITE(PTELAG,9106),'YMIN    ',PLFRLA
ISN    111         WRITE(PTELAG,9106),'YMAX    ',PLTOLA
ISN    112         WRITE(PTELAG,9106),'Y STEP  ',PLSTEP
ISN    113         WRITE(PTELAG,9100),'CURVE 1.                                 '
ISN    114         WRITE(PTELAG,9100),'CURVE COLOR GREEN.                       '
ISN    115         WRITE(PTELAG,9100),'CURVE TEXTURE CHAINDASHED.               '
ISN    116         WRITE(PTELAG,9100),'CURVE 2.                                 '
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:10      NAME: PLOTIT   PAGE:    28
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN    117         WRITE(PTELAG,9100),'CURVE COLOR BLUE.                        '
ISN    118         WRITE(PTELAG,9100),'CURVE SHADE COLOR BLUE.                  '
ISN    119         WRITE(PTELAG,9100),'CURVE SHADE PATTERN 135190.              '
ISN    120         WRITE(PTELAG,9100),'CURVE PAIR 1.                            '
ISN    121         WRITE(PTELAG,9100),'CURVE 3.                                 '
ISN    122         WRITE(PTELAG,9100),'CURVE COLOR WHITE.                       '
ISN    123         WRITE(PTELAG,9100),'CURVE SHADE COLOR WHITE.                 '
ISN    124         WRITE(PTELAG,9100),'CURVE SHADE PATTERN 45150.               '
ISN    125         WRITE(PTELAG,9100),'CURVE SHADE PAIR 3.                      '
ISN    126         WRITE(PTELAG,9100),'CURVE 4.                                 '
ISN    127         WRITE(PTELAG,9100),'CURVE SYMBOL COUNT 9999.                 '
ISN    128         WRITE(PTELAG,9100),'CURVE SYMBOL TYPE 4.                     '
ISN    129         WRITE(PTELAG,9100),'CURVE COLOR RED.                         '
ISN    130         WRITE(PTELAG,9100),'INPUT DATA.                              '
ISN    131         OPEN(LANDPT)
ISN    132         WRITE(PTELAG,9100),'"MAINLAND"                               '
ISN    133    100  READ(LANDPT,*,END=150),PLAT4,PLONG4
ISN    134         WRITE(PTELAG,9107),PLONG4,PLAT4
ISN    135         GO TO 100
ISN    136    150  CLOSE(LANDPT)
ISN    137         OPEN(ICEPTS)
ISN    138         WRITE(PTELAG,9100),'"LANDFAST ICE"                           '
ISN    139    200  READ(ICEPTS,*,END=250),PLAT4,PLONG4
ISN    140         WRITE(PTELAG,9107),PLONG4,PLAT4
ISN    141         GO TO 200
ISN    142    250  CLOSE(ICEPTS)
ISN    143         WRITE(PTELAG,9100),'"OIL SLICK AREA"                         '
ISN    144         IF(RNDSP)GO TO 300
ISN    145         GO TO 400
ISN    146    300  DO 350,I=0,360,10
ISN    147         PDIR=I
ISN    148         OSRAD=LS/2.0
ISN    149         CALL QCOORD(OSLAT,OSLONG,PDIR,OSRAD,PLAT1,PLONG1)
ISN    150         WRITE(PTELAG,9107),PLONG1,PLAT1
ISN    151         IF(I.NE.0)GO TO 310
ISN    152         SCOORD(1,1)=PLAT1
ISN    153         SCOORD(1,2)=PLONG1
ISN    154         GO TO 350
ISN    155    310  IF(I.NE.90)GO TO 320
ISN    156         SCOORD(2,1)=PLAT1
ISN    157         SCOORD(2,2)=PLONG1
ISN    158         GO TO 350
ISN    159    320  IF(I.NE.180)GO TO 330
ISN    160         SCOORD(3,1)=PLAT1
ISN    161         SCOORD(3,2)=PLONG1
```

```
ISN      162          GO TO 350
ISN      163     330  IF(I.NE.270)GO TO 350
ISN      164          SCOORD(4,1)=PLAT1
ISN      165          SCOORD(4,2)=PLONG1
ISN      166          GO TO 350
ISN      167     350  CONTINUE
ISN      168          GO TO 600
ISN      169     400  PDIR=ANGSL+90.0
ISN      170          IF(PDIR.GE.360.0)PDIR=PDIR-360.0
ISN      172          OSRAD=WS/2.0
ISN      173          DO 450,I=1,19
ISN      174          CALL QCOORD(OSLAT,OSLONG,PDIR,OSRAD,PLAT1,PLONG1)
ISN      175          WRITE(PTELAG,9107),PLONG1,PLAT1
ISN      176          IF(I.NE.1)GO TO 410
ISN      177          SCOORD(1,1)=PLAT1
```


```
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      178          SCOORD(1,2)=PLONG1
ISN      179     410  IF(I.NE.19)GO TO 440
ISN      180          SCOORD(2,1)=PLAT1
ISN      181          SCOORD(2,2)=PLONG1
ISN      182     440  PDIR=PDIR+10.0
ISN      183          IF(PDIR.GE.360.0)PDIR=PDIR-360.0
ISN      185     450  CONTINUE
ISN      186          PDIR=ANGSL
ISN      187          PDIST=LREC
ISN      188          CALL QCOORD(OSLAT,OSLONG,PDIR,PDIST,PLAT2,PLONG2)
ISN      189          PDIR=ANGSL-90.0
ISN      190          IF(PDIR.LT.0.0)PDIR=PDIR+360.0
ISN      192          DO 550,I=1,19
ISN      193          CALL QCOORD(PLAT2,PLONG2,PDIR,OSRAD,PLAT1,PLONG1)
ISN      194          WRITE(PTELAG,9107),PLONG1,PLAT1
ISN      195          IF(I.NE.1)GO TO 510
ISN      196          SCOORD(3,1)=PLAT1
ISN      197          SCOORD(3,2)=PLONG1
ISN      198     510  IF(I.NE.19)GO TO 540
ISN      199          SCOORD(4,1)=PLAT1
ISN      200          SCOORD(4,2)=PLONG1
ISN      201     540  PDIR=PDIR+10.0
ISN      202          IF(PDIR.GE.360.0)PDIR=PDIR-360.0
ISN      204     550  CONTINUE
ISN      205          WRITE(PTELAG,9107),SCOORD(1,2),SCOORD(1,1)
ISN      206     600  WRITE(PTELAG,9100),'"SPILL LOCATION"                         '
ISN      207          WRITE(PTELAG,9107),SPLONG,SPLAT
ISN      208          WRITE(PTELAG,9100),'EOD.                                     '
ISN      209          WRITE(PTELAG,9100),'SEND.                                    '
ISN      210          WRITE(PTELAG,9100),'**FILE**                                 '
                C
                C     ****************************************************************
                C     *                                                              *
                C     *    GENERATE PRINTED REPORT PAGE OF SIMULATION RESULTS        *
                C     *                                                              *
                C     ****************************************************************
                C
ISN      211          IF(RNDSP)GO TO 900
ISN      212          SSHAPE='OVAL'
ISN      213          GO TO 950
ISN      214     900  SSHAPE='CIRCULAR'
```

```
ISN      215     950  WRITE(PRESLT,9300),RDATE,RTIME,
                     *                     VERSNO,
                     *                     ISYY,ISMM,ISDD,ISTIME,
                     *                     SSHAPE,
                     *                     SSLICK,
                     *                     VS,
                     *                     AS,
                     *                     LS,
                     *                     WS,
                     *                     THCKLO,
                     *                     SCOORD(1,1),SCOORD(1,2),
                     *                     SCOORD(2,1),SCOORD(2,2),
                     *                     SCOORD(3,1),SCOORD(3,2),
                     *                     SCOORD(4,1),SCOORD(4,2),
                     *                     ANGSL
              C
              C       ******************************************************************
              C       *                                                                *
              C       *    END OF PROGRAM - RETURN TO MAINLINE                         *
```

```
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
              C       *                                                                *
              C       ******************************************************************
              C
ISN      216             RETURN
ISN      217     9100 FORMAT (1X,A40)
ISN      218     9101 FORMAT (1X,'MESSAGE 3 TEXT "VERSION ',F3.1,'".')
ISN      219     9102 FORMAT (1X,'MESSAGE 4 TEXT "RUN: ',A8,1X,A8,'".')
ISN      220     9103 FORMAT (1X,'MESSAGE 5 TEXT "SIMULATION: ',I2,'/',I2,'/',
                     *           I2,1X,I2,':00".')
ISN      221     9104 FORMAT (1X,'MESSAGE 6 X ',F9.5,',Y ',F8.5,
                     *           ',HEIGHT .1.')
ISN      222     9105 FORMAT (1X,'MESSAGE 6 POINTER BL ',F9.5,1X,F8.5,'.')
ISN      223     9106 FORMAT (1X,A7,F9.5,'.')
ISN      224     9107 FORMAT (1X,F9.5,5X,F9.5)
ISN      225     9108 FORMAT (1X,'MESSAGE 7 TEXT "OIL VOLUME:" "  ',
                     *           F15.5,' CU.M.".')
ISN      226     9109 FORMAT (1X,'MESSAGE 8 TEXT "SLICK AREA:" "  ',
                     *           F15.5,' SQ.M.".')
ISN      227     9110 FORMAT (1X,'MESSAGE 9 TEXT "SLICK THICKNESS:" "  ',
                     *           F15.5,' CM.".')
ISN      228     9300 FORMAT ('1',26X,'D O M E   P E T R O L E U M',9X,A8,1X,A8//
                     *               26X,'OIL UNDER ICE COMPUTER MODEL'/
                     *               34X,'VERSION ',F3.1//
                     *               30X,'SIMULATION RESULTS'/
                     *               32X,I2,'/',I2,'/',I2,1X,I2,':00'//
                     *               32X,'OIL SLICK DATA'///
                     *               14X,'SHAPE =========> ',A11/
                     *               14X,'SPEED(CM/SEC)==> ',F16.5/
                     *               14X,'VOLUME(CU.M.)==> ',F16.5/
                     *               14X,'AREA(SQ.M.) ===> ',F16.5/
                     *               14X,'LENGTH(M.) ====> ',F16.5/
                     *               14X,'WIDTH(M.) =====> ',F16.5/
                     *               14X,'THICKNESS(CM.)=> ',F16.5/
                     *               14X,'COORDINATES====> ',F9.5,' DEG. N. LAT. ',
                     *               F9.5,' DEG. W. LONG. '/
                     *               31X,F9.5,' DEG. N. LAT. ',F9.5,' DEG. W. LONG. '/
                     *               31X,F9.5,' DEG. N. LAT. ',F9.5,' DEG. W. LONG. '/
```

```
                 *              31X,F9.5,' DEG. N. LAT. ',F9.5,' DEG. W. LONG. '/
                 *              14X,'ANGLE =========> ',F9.5,' DEG.')
ISN      229           END
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:10      NAME: PLOTIT   PAGE:    31
STORAGE MAP
TAG: SET(S), REFERENCED(F), USED AS ARGUMENT(A), IN COMMON(C), EQUIVALENCED(E), INITIAL VALUE(I), NAMED CONSTANT(K),
     STATEMENT FUNCTION(T), SUBPROGRAM(X)
PROGRAM NAME: PLOTIT.   SIZE OF PROGRAM:    3BC0 HEX BYTES.
```

NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.
ANGSL	R*8	FC	000110	AS	R*8	FC	0000F0	CMOVE#	R*4	FX	001174	DEGDIF	R*8	SF	001050
I	I*4	SF	001068	ICEPTS	I*4	FCA	00012C	IDATE	I*4	FC	000138	ILEAP	I*4	SF	001078
ISDATE	I*4	SF	00107C	ISDAYS	I*4	SF	001080	ISDD	I*4	SF	00106C	ISMM	I*4	SF	001070
ISTIME	I*4	SF	001084	ISYY	I*4	SF	001074	ITIME	I*4	FC	00013C	LANDPT	I*4	FCA	000128
LREC	R*8	FC	000120	LS	R*8	FC	000100	MHOUR	I*4	FC	000140	MOD		X	UNREFD
MODAYS	I*2	SFC	000148	OSLAT	R*16	FCA	0000C0	OSLONG	R*16	FCA	0000D0	OSRAD	R*16	SFA	001038
PDIR	R*16	SFCA	000040	PDIST	R*16	SFCA	000050	PLAT1	R*16	SFCA	000080	PLAT2	R*16	FCA	0000A0
PLAT3	R*16		UNREFD	PLAT4	R*8	SF	001048	PLFRLA	R*16	FC	000020	PLFRLO	R*16	FC	000000
PLONG1	R*16	SFCA	000090	PLONG2	R*16	FCA	0000B0	PLONG3	R*16		UNREFD	PLONG4	R*8	SF	001058
PLOTIT	R*4	X	UNREFD	PLSTEP	R*8	SF	001060	PLTOLA	R*16	FC	000030	PLTOLO	R*16	FC	000010
PRESLT	I*4	FC	000130	PTELAG	I*4	FC	000134	QCOORD		FX	001178	RDATE	CHAR	FC	000160
RNDSP	L*4	FC	000144	RTIME	CHAR	FC	000168	SCOORD	R*8	SF	001130	SPLAT	R*16	FC	000060
SPLONG	R*16	FC	000070	SSHAPE	CHAR	SFA	001120	SSLICK	R*8	FC	0000E8	THCKLO	R*8	FC	0000E0
VCLSE#	R*4	FX	00117C	VERSNO	R*8	FC	000118	VLDIO#	R*4	FX	001180	VOPEN#	R*4	FX	001184
VS	R*8	FC	0000F8	VSCOM#		FX	001188	VSERH#		X	UNREFD	WS	R*8	FC	000108

COMMON INFORMATION

NAME: . SIZE: 170 HEX BYTES. (E) - EQUIVALENCED

NAME	MODE	DISPL.	NAME	MODE	DISPL.	NAME	MODE	DISPL.	NAME	MODE	DISPL.
PLFRLO	R*16	000000	PLTOLO	R*16	000010	PLFRLA	R*16	000020	PLTOLA	R*16	000030
PDIR	R*16	000040	PDIST	R*16	000050	SPLAT	R*16	000060	SPLONG	R*16	000070
PLAT1	R*16	000080	PLONG1	R*16	000090	PLAT2	R*16	0000A0	PLONG2	R*16	0000B0

OSLAT	R*16	0000C0	OSLONG	R*16	0000D0	THCKLO	R*8	0000E0	SSLICK	R*8	0000E8
AS	R*8	0000F0	VS	R*8	0000F8	LS	R*8	000100	WS	R*8	000108
ANGSL	R*8	000110	VERSNO	R*8	000118	LREC	R*8	000120	LANDPT	I*4	000128
ICEPTS	I*4	00012C	PRESLT	I*4	000130	PTELAG	I*4	000134	IDATE	I*4	000138
ITIME	I*4	00013C	MHOUR	I*4	000140	RNDSP	L*4	000144	MODAYS	I*2	000148
RDATE	CHAR	000160	RTIME	CHAR	000168						

LABEL INFORMATION.

LABEL	DEFINED	ADDR.	LABEL	DEFINED	ADDR.	LABEL	DEFINED	ADDR.	LABEL	DEFINED	ADDR.
80	57	0017CA	90	68	001866	100	133	002004	150	136	00205E
200	139	00209E	250	142	0020F8	300	146	002142	310	155	0021EC
320	159	00221C	330	163	00224C	350	167	00227C	400	169	002298
410	179	00237A	440	182	0023A4	450	185	0023FC	510	198	002500
540	201	00252A	550	204	002582	600	206	0025C0	900	214	00269E
950	215	0026AC	9100	217	000409	9101	218	0003E4	9102	219	0003BD
9103	220	000384	9104	221	00035A	9105	222	000334	9106	223	000327
9107	224	00031B	9108	225	0002E8	9109	226	0002B5	9110	227	00027F
9300	228	000050									

```
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:10      NAME: PLOTIT   PAGE:    32
*STATISTICS*   SOURCE STATEMENTS = 217, PROGRAM SIZE = 15296 BYTES, PROGRAM NAME = PLOTIT     PAGE:   26.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
****** END OF COMPILATION 2 ******
```

A11.3 QCOORD

```
LEVEL 1.3.0 (MAY 1983)          VS FORTRAN          DATE: 1985 JAN 09     TIME: 16:42:11                    PAGE:    33
OPTIONS IN EFFECT:  NOLIST   MAP NOXREF   GOSTMT NODECK   SOURCE NOTERM   OBJECT FIXED  NOTEST NOTRMFLG    SRCFLG NOSYM
                    OPT(0) LANGLVL(77) NOFIPS   FLAG(I)  NAME(MAIN   ) LINECOUNT(64)      CHARLEN(500)      SDUMP
                *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN        1          SUBROUTINE QCOORD(DLAT,DLONG,DDIR,DIST,DNLAT,DNLONG)
                C
                C     **************************************************************
                C     *                                                            *
                C     *  QCOORD                                                    *
                C     *                                                            *
                C     *  PURPOSE:   TO CALCULATE A NEW SET OF COORDINATES FROM AN   *
                C     *             ORIGIN,AZIMUTH AND DISTANCE.                   *
                C     *             PUISSANTS SHORT LINE FORMULA IS USED TO DO THE  *
                C     *             CALCULATIONS.                                  *
                C     *                                                            *
                C     *  PARAMETERS:                                               *
                C     *      ** ALL PARAMETERS ARE QUAD PRECISION REAL NUMBERS **   *
                C     *    DLAT   - THE ORIGIN POINT LATITUDE IN DEGREES.          *
                C     *    DLONG  - THE ORIGIN POINT LONGITUDE IN DEGREES.         *
                C     *    DDIR   - THE AZIMUTH IN DEGREES FROM TRUE NORTH.        *
                C     *    DIST   - THE DISTANCE FROM THE ORIGIN IN METERS.        *
                C     *    DNLAT  - THE RESULTANT LATITUDE PORTION OF THE          *
                C     *             COORDINATE (IN DEGREES).                       *
                C     *    DNLONG - THE RESULTANT LONGITUDE PORTION OF THE         *
                C     *             COORDINATE (IN DEGREES).                       *
                C     *                                                            *
                C     *  RESTRICTIONS:                                             *
                C     *                                                            *
                C     *    THE CONSTANTS USED FOR THE SEMIMAJOR AXIS AND           *
                C     *    FLATTENING ARE FOR THE NORTH AMERICAN CONTINENT ONLY.   *
                C     *    THIS INCLUDES THE BEAUFORT SEA.                         *
                C     *                                                            *
                C     **************************************************************
                C
ISN        2          REAL*16 DLAT,DLONG,DDIR,DIST,DNLAT,DNLONG
ISN        3          REAL*16 DPHI,DLAM,XM,XN1,XN2,A,B,F,RLAT,RLONG,RDIR,SIN2LT,CSQR,P
ISN        4          REAL*16 SIN2DI,TEMP,TEMP2,SNLAT,RNLAT
                C
                C     **************************************************************
                C     *                                                            *
                C     *  ASSIGN CONSTANTS                                          *
                C     *                                                            *
                C     **************************************************************
                C
ISN        5          A = 6378206.4
ISN        6          F = .003390075304
ISN        7          P = 206264.8062
                C
                C     **************************************************************
                C     *                                                            *
                C     *  CONVERT INPUT LAT/LONG/AZIMUTH TO RADIANS FOR FORTRAN     *
                C     *  FUNCTIONS                                                 *
                C     *                                                            *
                C     **************************************************************
```

```
              C
ISN      8           RLAT=DLAT*0.0174532925
ISN      9           RLONG=DLONG*0.0174532925
ISN     10           RDIR=DDIR*0.0174532925
              C
              C      ****************************************************************
              C      *                                                              *
```



```
              *....*...1.........2.........3.........4.........5.........6.........7.*.......8
              C      *  COMPUTE XM                                                  *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     11           SIN2LT=QSIN(RLAT)**2
ISN     12           B=A-(F*A)
ISN     13           CSQR=((A**2)-(B**2))/(A**2)
ISN     14           XM=A*(1.0-CSQR)/(1.-(CSQR*SIN2LT))**1.5
              C
              C      ****************************************************************
              C      *                                                              *
              C      *  COMPUTE XN1                                                 *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     15           XN1=A/QSQRT(1.-(CSQR*SIN2LT))
              C
              C      ****************************************************************
              C      *                                                              *
              C      *  COMPUTE THE CHANGE IN LATITUDE IN SECONDS (DPHI).          *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     16           SIN2DI=QSIN(RDIR)**2
ISN     17           TEMP=(DIST**3)/((XN1**3)*6.)
ISN     18           DPHI=(DIST/XN1)*QCOS(RDIR)
ISN     19           DPHI=DPHI-(((DIST**2)/((XN1**2)*2.))*QTAN(RLAT)*SIN2DI)
ISN     20           DPHI=DPHI-(TEMP*QCOS(RDIR)*SIN2DI*(((QTAN(RLAT)**2)*3.)+1.))
              C
              C      ****************************************************************
              C      *                                                              *
              C      *  DO A SECOND ITERATION TO GET A MORE ACCURATE                *
              C      *  CHANGE IN LATITUDE                                          *
              C      *                                                              *
              C      ****************************************************************
              C
ISN     21           TEMP=(CSQR*QSIN(RLAT)*QCOS(RLAT)*3.)/((1.-(CSQR*SIN2LT))*2.)
ISN     22           DPHI=1.-(TEMP*DPHI)
ISN     23           TEMP=(DIST*QCOS(RDIR))/XM
ISN     24           TEMP=TEMP-(((DIST**2)*QTAN(RLAT)*SIN2DI)/(XM*XN1*2.))
ISN     25           TEMP2=((QTAN(RLAT)**2)*3.)+1.
ISN     26           TEMP=TEMP-(((DIST**3)*QCOS(RDIR)*SIN2DI*TEMP2)/(XM*(XN1**2)*6.))
ISN     27           DPHI=P*DPHI*TEMP
              C
              C      ****************************************************************
              C      *                                                              *
              C      *  COMPUTE THE NEW LATITUDE IN DEGREES AND RADIANS AND SECONDS *
              C      *                                                              *
              C      ****************************************************************
```

```
              C
ISN      28          DNLAT=DLAT+(DPHI*.000277778)
ISN      29          RNLAT=DNLAT*0.0174532925
ISN      30          SNLAT=DNLAT*3600.
              C
              C      ******************************************************
              C      *                                                    *
              C      *  COMPUTE XN2                                       *
              C      *                                                    *
              C      ******************************************************
              C
```



```
             *....*...1.........2.........3.........4.........5.........6.........7.*.......8
ISN      31          XN2=A/QSQRT(1.-(CSQR*(QSIN(RNLAT)**2)))
              C
              C      ******************************************************
              C      *                                                    *
              C      *  COMPUTE THE CHANGE IN LONGITUDE IN SECONDS (DLAM). *
              C      *                                                    *
              C      ******************************************************
              C
ISN      32          DLAM=(DIST**2)/((XN2**2)*6.)
ISN      33          DLAM=1.0-(DLAM*(1.-(SIN2DI*(1.0/QCOS(RNLAT)**2))))
ISN      34          DLAM=DLAM*P*(DIST/XN2)*QSIN(RDIR)*(1.0/QCOS(RNLAT))
              C
              C      ******************************************************
              C      *                                                    *
              C      *  COMPUTE THE NEW LONGITUDE IN DEGREES              *
              C      *                                                    *
              C      ******************************************************
              C
ISN      35          DNLONG=DLONG-(DLAM*.000277778)
              C
              C      ******************************************************
              C      *                                                    *
              C      *  RETURN TO MAINLINE                                *
              C      *                                                    *
              C      ******************************************************
              C
ISN      36          RETURN
ISN      37          END
```


STORAGE MAP
TAG: SET(S), REFERENCED(F), USED AS ARGUMENT(A), IN COMMON(C), EQUIVALENCED(E), INITIAL VALUE(I), NAMED CONSTANT(K),
STATEMENT FUNCTION(T), SUBPROGRAM(X)
PROGRAM NAME: QCOORD. SIZE OF PROGRAM: 11DE HEX BYTES.

NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.	NAME	MODE	TAG	ADDR.
A	R*16	SF	000168	B	R*16	SF	000178	CSQR	R*16	SF	0001D8	DDIR	R*16	F	0002BC
DIST	R*16	FA	0002C0	DLAM	R*16	SF	0001E8	DLAT	R*16	F	0002C4	DLONG	R*16	F	0002D4
DNLAT	R*16	SF	0002D8	DNLONG	R*16	SF	0002E0	DPHI	R*16	SF	0001F8	F	R*16	SF	000188
FQXPQ#	R*4	FX	0002E4	P	R*16	SF	000198	QCOORD	R*4	X	UNREFD	QCOS	R*16	FX	0002C8

QSIN	R*16	FX	0002CC	QSQRT	R*16	FX	0002DC	QTAN	R*16	FX	0002D0	RDIR	R*16	SFA	000208
RLAT	R*16	SFA	000218	RLONG	R*16	SF	000238	RNLAT	R*16	SFA	000248	SIN2DI	R*16	SF	000278
SIN2LT	R*16	SF	000288	SNLAT	R*16	SF	000258	TEMP	R*16	SF	000228	TEMP2	R*16	SF	000268
VSCOM#		X	UNREFD	VSERH#		X	UNREFD	XM	R*16	SF	0001A8	XN1	R*16	SF	0001B8
XN2	R*16	SF	0001C8												

```
***** NO USER LABELS *****

*STATISTICS*   SOURCE STATEMENTS = 37, PROGRAM SIZE = 4574 BYTES, PROGRAM NAME = QCOORD    PAGE:   33.
*STATISTICS*    NO DIAGNOSTICS GENERATED.
****** END OF COMPILATION 3 ******

 H96-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED XREF,LET,LIST,MAP,AMODE=24
        DEFAULT OPTION(S) USED -  SIZE=(262144,49152)
****OILUICE   NOW REPLACED IN DATA SET    AMODE 24
RMODE IS 24
AUTHORIZATION CODE IS         0.
```

CROSS REFERENCE TABLE

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
OILICE	00	86E2								
PLOTIT	86E8	3BC0								
QCOORD	C2A8	11DE								
PLISTART*	D488	50								
			PLICALLA	D48E	PLICALLB	D492				
PLIMAIN *	D4D8	8								
***DATE2*	D4E0	C0								
***DATE1*	D5A0	154								
			DATE	D5A8						
IBMBIEP1*	D6F8	46C								
			IBMBIEPA	D6F8	IBMBIEPC	DA2A	IBMBIEPD	DA2C		
IBMBILC1*	DB68	8								
IBMBJDT1*	DB70	98								
			IBMBJDTA	DB70						
IBMBPIR1*	DC08	3B4								
			IBMBPIRA	DC2A	IBMBPIRB	DC2C	IBMBPIRC	DC2E		
IBMBEER1*	DFC0	4								
			IBMBEERA	DFC0						
IBMBERR1*	DFC8	748								
			IBMBERRA	DFC8	IBMBERRB	E016	IBMBERRC	E65E		
IBMBOCL1*	E710	1AC								
			IBMBOCLA	E710	IBMBOCLB	E712	IBMBOCLC	E714	IBMBOCLD	E716
IBMBEEF1*	E8C0	159								
			IBMBEEFA	E8C0						
IFYLSQRT*	EA20	228								
			DSQRT	EA20	IH$DSQRT	EA20	D#SQRT	EA20		
IFYCCMPR*	EC48	2C4								
			CXMPR#	EC48	CCMPR#	ECF2				
IFYFDXPD*	EF10	708								

			FDXPD#	EF10						
IFYLDFIO*	F618	133C	VLDIO#	F618	LDFIO#	F62C				
IFYVCLOS*	10958	2D0	VCLSE#	10958						
IFYVOPEN*	10C28	950	VOPEN#	10C28						
IFYVSCOM*	11578	EE8	VSCOM#	115B0						
***TIME2*	12460	C0								
***TIME1*	12520	15C	TIME	12528						
NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
IBMBJTT1*	12680	74	IBMBJTTA	12680						
IFYCMOVE*	126F8	280	CMOVE#	126F8						
IFYFQXPQ*	12978	C50	IH$QEXP	12978	QEXP	12978	Q#EXP	12978	FQXP2#	129AE
			FQXPQ#	129E2	IH$QLOGO	12A0A	QLOG10	12A0A	Q#LOG1	12A0A
			IH$QLOG	12A30	QLOG	12A30	Q#LOG	12A30		
IFYQSCN *	135C8	488	QCOS	135C8	IH$QCOS	135C8	Q#COS	135C8	QSIN	135EC
			IH$QSIN	135EC	Q#SIN	135EC				
IFYQSQRT*	13A50	2C0	QSQRT	13A50	IH$QSQRT	13A50	Q#SQRT	13A50		
IFYQTNCT*	13D10	548	QTAN	13D10	IH$QTAN	13D10	Q#TAN	13D10	IH$QCOTN	13D2E
			QCOTAN	13D2E	Q#COTN	13D2E				
IFYVCOMD*	14258	29F0	COMHDSCT	14260						
IFYLEXP *	16C48	48C	IH$DEXP	16C48	D#EXP	16C48	DEXP	16C48		
IFYLLGN *	170D8	388	IH$DLOG	170D8	D#LOG	170D8	DLOG	170D8		
IFYVCOM2*	17460	4D0	IFYDCOM2	17460	VSINIT	17460	VSEXIT	17628	VCNSL	17736
IFYVCVTH*	17930	1158	ADCON#	17930	FCVAO	179F2	FCVLO	17A62	FCVZO	17C14
			FCVIO	17F32	FCVCO	184C8	FCVDO	184C8	FCVQO	184D8
			FCVEO	184E8						
IFYUATBL*	18A88	648								
IFYUOPT *	190D0	518								
IFYVCMSS*	195E8	313	IXCCMSD	195E8	IFYVCMSE	19606				
IFYVCOMH*	19900	17B8	VCOMHALT	1A9A8						
IFYVCONI*	1B0B8	2E4	FQCONI#	1B0B8						
IFYVCONO*	1B3A0	74C	FQCONO#	1B3A0						
IFYVDIOS*	1BAF0	17B0	IFYDDIOS	1BAF0						
IFYVERRE*	1D2A0	21C								
IFYVERRM*	1D4C0	550								
IFYVFNTH*	1DA10	168F	IFYDFNTH	1DA10						
IFYVIIOS*	1F0A0	360								

NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
IFYVSIOS*	1F400	1E28								
			IFYDSIOS	1F400						
IFYVSTAE*	21228	D58								
IFYVTRCH*	21F80	A0C								
IFYVTEN *	22990	2A8								
			FTEN#	22990	FQTEN#	22B28				
IFYVVIOS*	22C38	18B0								
			IFYVVSEQ	22C38	IFYVVDIR	22C4C				
$BLANKCOM	244E8	170								

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
1720			1724	DATE	***DATE1
1728	TIME	***TIME1	172C	DSQRT	IFYLSQRT
1730	CCMPR#	IFYCCMPR	1734	FDXPD#	IFYFDXPD
1738	PLOTIT	PLOTIT	173C	QCOORD	QCOORD
1740	VCLSE#	IFYVCLOS	1744	VLDIO#	IFYLDFIO
1748	VOPEN#	IFYVOPEN	174C	VSCOM#	IFYVSCOM
1514			1524		
152C			1530		
1534			1538		
153C			1540		
1544			1548		
154C			1550		
1554			1558		
15F0			1624		
1628			162C		
1630			1634		
1638			2F6A		
2FA6			2FBE		
3086			3116		
7FFE			802E		
804E			805E		
80DE			80EE		
812E			81BE		
820E			822E		
823E			826E		
828E			829E		
82AE			82C2		
82D2			8306		
83A6			84FE		
851E			8556		
8576			8586		
8596			85A6		
85B6			85C6		
85D6			85F6		
8636			8646		
8676			86B6		
9CA8			9CCC		
9CF0			9D14		
9D38			9D5C		
9D80			9DB0		
9DD4			9778		
977C			9780		
9784			9788		
978C			9794		
979C			97A0		

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
97A4		
97B0		
97B8		
97C0		
97C8		
97D0		
97D8		
97E4		
985C	CMOVE#	IFYCMOVE
9864	VCLSE#	IFYVCLOS
986C	VOPEN#	IFYVOPEN
99B4		
99FC		
9A44		
9A8C		
9AD4		
9B1C		
9B64		
9BAC		
9BF4		
9C3C		
9C84		
A462		
A4AA		
A4F2		
A53A		
A582		
A5CA		
A612		
A65A		
A6A2		
A6F8		
A76E		
A7BE		
A888		
AB9E		
ACB4		
AD04		
AD4C		
9F7A		
9FD6		
A026		
A06E		
A10C		
A154		
A19C		
A1E0		
A224		
A26C		
A362		
A3BA		
A412		

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
BF98		
BFB8		
C008		
C028		

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
97A8		
97B4		
97BC		
97C4		
97CC		
97D4		
97E0		
9858		
9860	QCOORD	QCOORD
9868	VLDIO#	IFYLDFIO
9870	VSCOM#	IFYVSCOM
99D8		
9A20		
9A68		
9AB0		
9AF8		
9B40		
9B88		
9BD0		
9C18		
9C60		
A43E		
A486		
A4CE		
A516		
A55E		
A5A6		
A5EE		
A636		
A67E		
A6D4		
A724		
A792		
A7FA		
AA18		
AC8C		
ACD8		
AD28		
ADA0		
9FB2		
9FFA		
A04A		
A0E0		
A130		
A178		
A1BC		
A204		
A248		
A332		
A38E		
A3E6		
BF88		

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
BFA8		
BFF8		
C018		
C048		

C058			C068		
C088			C098		
C0A8			C0C8		
C0DC			C0EC		
C100			C120		
C160			C170		
C188			C198		
C1A8			C1B8		
C1C8			C1F8		
C208			C218		
C228			C258		
C27C			C28C		
C29C			C570	QCOS	IFYQSCN
C574	QSIN	IFYQSCN	C578	QTAN	IFYQTNCT
C584	QSQRT	IFYQSQRT	C58C	FQXPQ#	IFYFQXPQ
D498	PLIMAIN	PLIMAIN	D49C	SYSPINT	$UNRESOLVED(W)
D4A0	PLIFLOW	$UNRESOLVED(W)	D4A4	PLITABS	$UNRESOLVED(W)
D4B4	PLICOUNT	$UNRESOLVED(W)	D4B8	PLIXOPT	$UNRESOLVED(W)
D4BC	IBMBPOPT	$UNRESOLVED(W)	D4C0	PLIXHD	$UNRESOLVED(W)
D4C4	IBMBEATA	$UNRESOLVED(W)	D4CC	IBMBPIRA	IBMBPIR1
D4D0	IBMBPIRB	IBMBPIR1	D4D4	IBMBPIRC	IBMBPIR1
D4D8	***DATE1	***DATE1	D4E4	***DATE1	***DATE1
D4E8	***DATE1	***DATE1	D4EC	***DATE1	***DATE1
D4F0	***DATE1	***DATE1	D4F4	***DATE1	***DATE1
D4F8	***DATE1	***DATE1	D4FC	***DATE1	***DATE1
D500	IBMBIEPA	IBMBIEP1	D504	IBMBIEPD	IBMBIEP1
D508	IBMBJDTA	IBMBJDT1	D544	***DATE1	***DATE1
D560	***DATE1	***DATE1	D5B0	***DATE2	***DATE2
D5B8	***DATE2	***DATE2	D64C	***DATE2	***DATE2
D654	***DATE2	***DATE2	DB44	PLITABS	$UNRESOLVED(W)
DB3C	SYSPINT	$UNRESOLVED(W)	DB40	PLIFLOW	$UNRESOLVED(W)
DB30	IBMBPIRB	IBMBPIR1	DB54	PLICOUNT	$UNRESOLVED(W)
DB58	PLIXOPT	$UNRESOLVED(W)	DB20	IBMBILC1	IBMBILC1
DF40	IBMBJWTA	$UNRESOLVED(W)	DF44	IBMBTOCA	$UNRESOLVED(W)
DF48	IBMBTOCB	$UNRESOLVED(W)	DF4C	IBMBTPRA	$UNRESOLVED(W)
DEE8	IBMBOCLB	IBMBOCL1	DEFC	IBMBOCLB	IBMBOCL1
DF30	IBMBOCLD	IBMBOCL1	DF38	IBMBERRB	IBMBERR1
DF3C	IBMBPGOA	$UNRESOLVED(W)	DF50	IBMBPQDA	$UNRESOLVED(W)
DF68	IBMBERRC	IBMBERR1	DEEC	IBMBOCLC	IBMBOCL1
DF80	IBMBPGRA	$UNRESOLVED(W)	DF84	IBMBPIIA	$UNRESOLVED(W)
DF88	IBMBPITA	$UNRESOLVED(W)	DEF0	IBMBOCLA	IBMBOCL1
DF2C	IBMBOCLA	IBMBOCL1	DF34	IBMBERRA	IBMBERR1
DF70	IBMBEERA	IBMBEER1	E6E0	IBMBERCA	$UNRESOLVED(W)
E6E4	IBMBEEFA	IBMBEEF1	E8A4	IBMBSCPA	$UNRESOLVED(W)
EB6C	COMHDSCT	IFYVCOMD	EE40	COMHDSCT	IFYVCOMD
F28C	COMHDSCT	IFYVCOMD	F5A8	IH$DLOG	IFYLLGN
F5AC	IH$DEXP	IFYLEXP	F644	COMHDSCT	IFYVCOMD
10AE0	COMHDSCT	IFYVCOMD	110E4	COMHDSCT	IFYVCOMD

LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION	LOCATION	REFERS TO SYMBOL	IN CONTROL SECTION
1212C	COMHDSCT	IFYVCOMD	12130	VSINIT	IFYVCOM2
12134	VSEXIT	IFYVCOM2	12138	VCNSL	IFYVCOM2
12464	***TIME1	***TIME1	12468	***TIME1	***TIME1
1246C	***TIME1	***TIME1	12470	***TIME1	***TIME1
12474	***TIME1	***TIME1	12478	***TIME1	***TIME1
1247C	***TIME1	***TIME1	12480	IBMBIEPA	IBMBIEP1
12484	IBMBIEPD	IBMBIEP1	12488	IBMBJTTA	IBMBJTT1
124C4	***TIME1	***TIME1	124E0	***TIME1	***TIME1
12530	***TIME2	***TIME2	12538	***TIME2	***TIME2

125CC	***TIME2	***TIME2
128B0	COMHDSCT	IFYVCOMD
137D0	COMHDSCT	IFYVCOMD
13FEC	COMHDSCT	IFYVCOMD
14264	VSCOM#	IFYVSCOM
1426C	IFYVCMSE	IFYVCMSS
142E0	VLDIO#	IFYLDFIO
14274	IFYUATBL	IFYUATBL
14280	IFYVCVTH	IFYVCVTH
14288	FCVLO	IFYVCVTH
14290	FCVIO	IFYVCVTH
14298	FCVDO	IFYVCVTH
142A0	IFYVCONO	IFYVCONO
142A8	IFYVSIOS	IFYVSIOS
142B0	IFYVIIOS	IFYVIIOS
142B8	IFYVERRE	IFYVERRE
142C0	IFYVFNTH	IFYVFNTH
16E6C	COMHDSCT	IFYVCOMD
197C4	COMHDSCT	IFYVCOMD
1B384	FQTEN#	IFYVTEN
1BA24	FQTEN#	IFYVTEN
1E394	COMHDSCT	IFYVCOMD
21998	COMHDSCT	IFYVCOMD
125D4	***TIME2	***TIME2
12F80	COMHDSCT	IFYVCOMD
13C04	COMHDSCT	IFYVCOMD
14260	IBCOM#	$UNRESOLVED(W)
14268	IFYVASYN	$UNRESOLVED(W)
142DC	LDFIO#	IFYLDFIO
14270	IFYUOPT	IFYUOPT
1427C	IFYVCOMH	IFYVCOMH
14284	FCVAO	IFYVCVTH
1428C	FCVZO	IFYVCVTH
14294	FCVCO	IFYVCVTH
1429C	FCVEO	IFYVCVTH
142A4	IFYVCONI	IFYVCONI
142AC	IFYVDIOS	IFYVDIOS
142B4	IFYVERRM	IFYVERRM
142BC	IFYVTRCH	IFYVTRCH
142C4	IFYVSTAE	IFYVSTAE
17298	COMHDSCT	IFYVCOMD
1B380	FTEN#	IFYVTEN
1BA20	FTEN#	IFYVTEN
1BB48	IFYVVDIR	IFYVVIOS
1F464	IFYVVSEQ	IFYVVIOS

LOCATION D4A8 REQUESTS CUMULATIVE PSEUDO REGISTER LENGTH
ENTRY ADDRESS 00
TOTAL LENGTH 24658

A11.4 DATE

```
/***********************************************************************\
*                                                                       *
*  PROGRAM     : DATE                     DATE     : 83/07/19           *
*                                                                       *
*  WRITTEN BY  : PERRY DEVETZIS           COMPILER : OS PL/I            *
*                                                                       *
*  VARIABLES   :                                                        *
*                                                                       *
*           DAT : REFORMATTED DATE PASSED BACK TO FORTRAN ROUTINE       *
*               : IN THE FORM YY/MM/DD                                  *
*         TDATE : RAW PL/I DATE IN FORM YYMMDD                          *
*                                                                       *
*  THIS DATE ROUTINE PROVIDES THE CURRENT DATE TO ANY FORTRAN G OR H    *
*  ROUTINE.  IT GETS THE DATE FROM THE PL/I BUILTIN DATE FUNCTION       *
*  REFOMATS IT AND RETURNS IT TO THE FORTRAN ROUTINE.                   *
*                                                                       *
\***********************************************************************/
DATE : PROCEDURE (DAT) OPTIONS(MAIN FORTRAN);

  DCL DAT CHAR(8),
      TDATE CHAR(6);
  DCL DATE BUILTIN;
  DCL SUBSTR BUILTIN;

  TDATE = DATE;
  DAT = SUBSTR(TDATE,1,2)  '/'  SUBSTR(TDATE,3,2)  '/'
    SUBSTR(TDATE,5,2);

  RETURN;
END; /*DATE*/
```

A11.5 TIME

```
/*******************************************************************\
*                                                                   *
*  PROGRAM     : TIME                    DATE     : 83/07/19        *
*                                                                   *
*  WRITTEN BY : PERRY DEVETZIS           COMPILER : OS PL/I         *
*                                                                   *
*  VARIABLES  :                                                     *
*                                                                   *
*            TIM : REFORMATTED TIME PASSED BACK TO FORTRAN ROUTINE  *
*                : IN THE FORM HH:MM                               *
*          TTIME : RAW PL/I TIME IN FORM YYMMDD                     *
*                                                                   *
*  THIS TIME ROUTINE PROVIDES THE CURRENT TIME TO ANY FORTRAN G OR H *
*  ROUTINE.  IT GETS THE TIME FROM THE PL/I BUILTIN TIME FUNCTION   *
*  REFOMATS IT AND RETURNS IT TO THE FORTRAN ROUTINE.               *
*                                                                   *
\*******************************************************************/
TIME : PROCEDURE (TIM) OPTIONS(MAIN FORTRAN);

  DCL TIM CHAR(8),
      TTIME CHAR(6);
  DCL TIME BUILTIN;
  DCL SUBSTR BUILTIN;

  TTIME = TIME;
  TIM = SUBSTR(TTIME,1,2)  ':'  SUBSTR(TTIME,3,2)  ':'
    SUBSTR(TTIME,5,2);

  RETURN;
END; /*TIME*/
```

REFERENCES

Cox, J.C. and L.A. Schultz. 1981. The containment of oil spilled under rough ice. 1981 Oil Spill Conference Proceedings. 203-208.

Danielwicz, B.W. and G.R. Pilkington. 1980. Selected environmental characteristics of Beaufort Sea ice, Dome Petroleum Limited.

Dome Petroleum Limited. 1981. Oil and gas under sea ice study. Volumes 1 and 2. Canadian Offshore Oil Spill Research Association.

Goodman, R.H. and M.F. Fingas. 1983. Detection of oil under ice, a joint Esso/EPS project. Proceedings of the Sixth Arctic Marine Oil Program Technical Seminar, June 1983. 233-240.