BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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WILDCAT: A COMPUTER PROGRAM FOR THE PROSPECT-BY-PROSPECT METHOD OF ESTIMATING HYDROCARBON RESOURCES USING MONTE CARLO SIMULATION

by

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SUMMARY

The FORTRAN program WILDCAT is used in BMR for the assessment of undiscovered recoverable hydrocarbon resources on a prospect-by-prospect basis.

Input data consists of 1) estimated values of reservoir parameters either as single values or as probability distributions; 2) estimates of the probability of occurrence of each of the six critical factors used in determining the risk that the prospect contains hydrocarbons and 3) an estimate of the probability that the prospect will contain gas rather than oil.

Using Monte Carlo simulation, cumulative probability curves of resources are produced for each prospect. The results are reported in tabular and graphic form.

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THE PROSPECT-BY-PROSPECT METHOD	CHAPTER 1

Quantitative assessment of undiscovered recoverable hydrocarbon resources is necessary for strategic planning by industry and government. Two basic questions to be answered in the assessment of undiscovered resources are: does the resource exist?; and if it does, how large is it? Because resource assessments are always carried out with imperfect knowledge of at least one and usually many of the important factors, the uncertainties associated with our answers to the questions need to be quantified. The prospect-by-prospect method has been used to this end by the BMR for several years and the method is described in detail elsewhere (e.g., Riesz, 1978; and Gehman, Baker and White, 1980).

1.1 Estimating the Probability of Hydrocarbon Occurrence

In WILDCAT, the existence of hydrocarbons is assumed to be dependent on the coexistence and adequacy of six critical factors (adapted after Megill, 1971). The six critical factors are existence of:

1. Adequate source rocks
2. Suitable thermal history
3. Adequate reservoir rocks
4. Adequately sealed traps
5. Suitable sequence of trap development with respect to maturation
6. Adequate protection from biodegradation and flushing

If any of the six critical factors are inadequate or missing from an area, there is no possibility that the area contains hydrocarbons.

The probability that hydrocarbons do exist can be estimated by assigning a probability to the adequacy of each of the above factors. A probability of 0 indicates that it is known with certainty that the factor is inadequate. A probability of 1 indicates that it is known with certainty that the critical factor is adequate. Probabilities between 0 and 1 indicate the degree of uncertainty associated with our knowledge of the adequacy of any factor. If each of the critical factors is independent of the others, the chance of hydrocarbon occurrence is simply the product of the existence risk for each of the critical factors. For example, say that the probabilities of adequacy of each factor were 1.0, .90, .90, .70, .40, and .70. Then the existence risk for the prospect is 1.0 x .90 x .90 x .70 x .40 x .70 = 0.16, or 16 chances in 100.

1.2 Probable composition of the accumulation

In WILDCAT, it is assumed that the occurrence of gas and oil are mutually exclusive events, i.e., if oil occurs, gas cannot occur and vice versa. Because of this assumption, the sum of the probabilities that either will occur must equal 1.

The existence risk for gas is the product of the existence risk for hydrocarbons and the probability that the total accumulation is gas. Similarly, the existence risk for oil is the product of the existence risk for hydrocarbons and the probability that the total accumulation is oil. For example, say that gas was 3 times as likely to occur as oil. Then the probability that the total accumulation is gas is 3/(3+1) = .75, and the probability that the total accumulation is oil is 1/(3+1) = .25. The chance of occurrence for gas is then .16 x .75 = .12, and for oil, .16 x .25 = .04.

1.3 Estimation of reservoir parameters

In WILDCAT, the calculation of recoverable volumes of oil and gas resources, is based on the following equations (adapted after Moody, 1961):

$$Vo = \frac{Vr \times Phi \times (1-Sw) \times Ro}{FVF} \qquad (1)$$

$$Vg = \frac{Vr \times Phi \times (1-Sw) \times Rg}{Bg} \qquad (2)$$

$$\text{where } Bg = \frac{14.7 \text{ p.s.i.}}{P + 14.7 \text{ p.s.i.}} \times \frac{T}{520 \quad R} \times Z \qquad (3)$$

$$\text{and } Vr = A \times h \times Tf; \text{ or } Vr = Vt \times Np \times Tf \qquad (4)$$

The variables (reservoir parameters) used in the above equations are:

A - reservoir area (square kilometres)
Bg - gas expansion factor (ratio)
FVF - formation volume factor (ratio)
h - reservoir thickness (metres)
Np - fraction net pay (fraction)
P - reservoir pressure (pounds per square inch gauged)
Phi - porosity (fraction)
Rg - gas recovery factor (fraction)
Ro - oil recovery factor (fraction)
Sw - water saturation (fraction)
T - temperature (degrees Rankine)
Tf - fraction trap fill (fraction)
Vg - recoverable gas volume (million cubic metres)
Vo - recoverable oil volume (million cubic metres)
Vr - reservoir volume (million cubic metres)
Vt - trap volume (million cubic metres)
Z - gas deviation factor (ratio)

Because the value of each of the reservoir parameters is unknown, it is necessary to quantify the uncertainty (due to imperfect knowledge) of the estimates. If a single (constant) value is assigned to a reservoir parameter, it implies that the value is known with certainty. If a range of values is assigned to the parameter, then the range is an indication of the imprecision of our knowledge. The wider the spread of values, the more uncertain the value of the parameter. A distribution described by two values (a uniform distribution) indicates that little more is known about the parameter than its minimum and maximum possible values and that any value in the range is as likely to be correct as any other value. Three values (a triangular distribution) indicates not only that the range is known, but also that a most likely (modal) value is known for the parameter. If four or more values are used, the uncertainty can be described by assigning probabilities to each value.

WILDCAT assumes that the reservoir parameters are independent of each other. For a discussion of how to treat dependent and partially dependent data, see Newendorp (1975, p. 405-431).

1.4 Estimation of recoverable volumes of hydrocarbons

If each of the reservoir parameters has been given a single value, the volume of recoverable oil is calculated by substituting the values in equation (1). Similarly, relevant values are substituted in equation (2) to determine the recoverable volume of gas.

If any of the parameters have been assigned a range of possible values, WILDCAT converts the distribution that describes the range into a cumulative probability distribution and calculates the recoverable volume of oil or gas by simulation.

The probability distributions can assume various forms. Figures 1 through 4 illustrate some of the more commonly used distributions and their corresponding cumulative probability distributions. The figures also show how random values are selected from the cumulative distributions using random numbers which are generated by the computer as needed.

At each pass a random number between 0 and 1 is obtained from the computer for each distribution. The random number is equated with the cumulative probability curve of the relevant distribution and the value corresponding with that probability is substituted in the equation. When a value has been obtained for each variable, the equation is solved. The solution is retained and the process is repeated. After several thousand passes a probability distribution of all the solutions can be constructed. The process is illustrated in Figure 5.

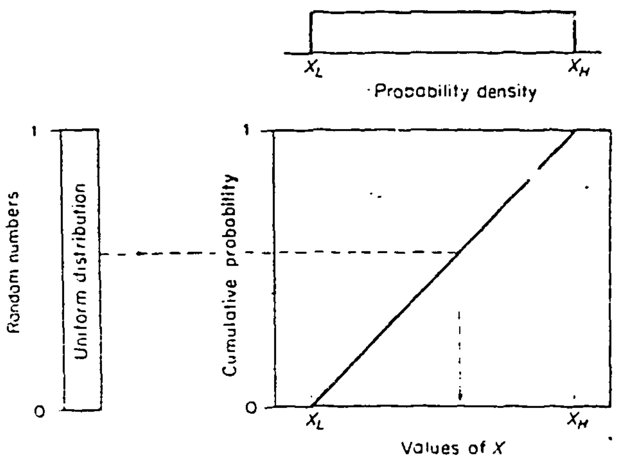


Figure 1 Selecting random values from a uniform distribution.
Source: McCray, 1975

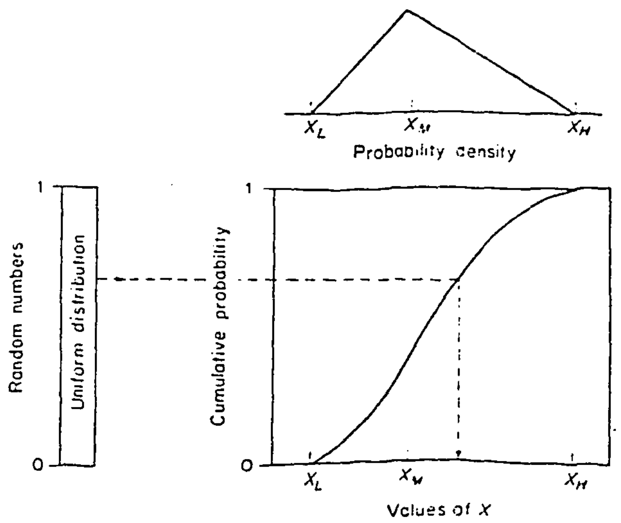


Figure 2 Selecting random values from a triangular distribution.
Source: McCray, 1975

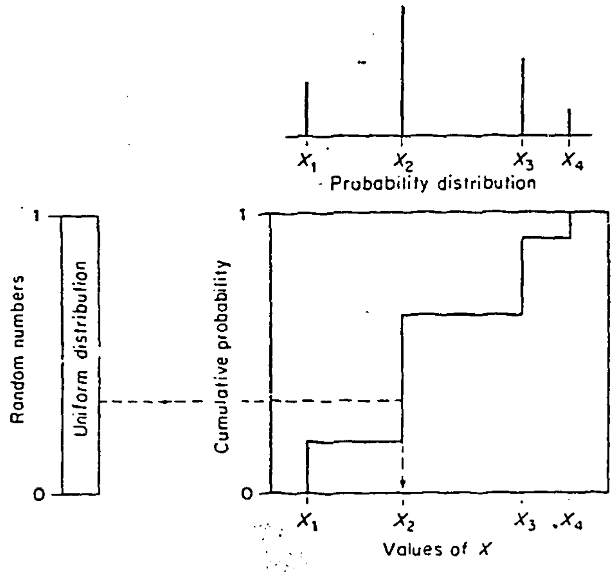


Figure 3 Random selections from a discrete distribution.
Source: McCray, 1975

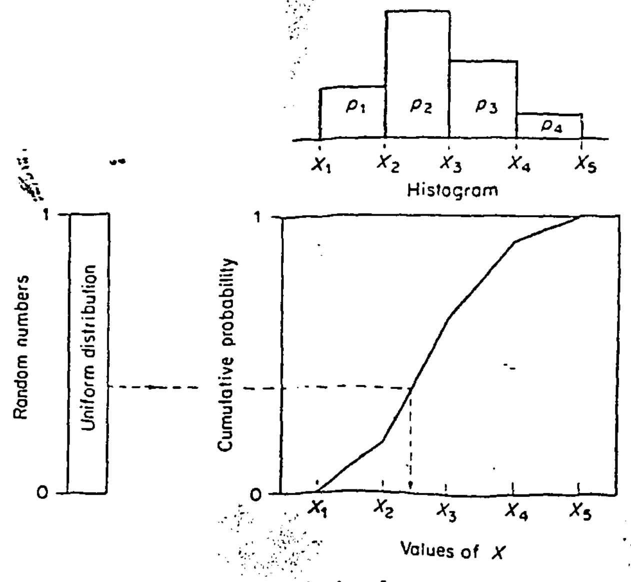
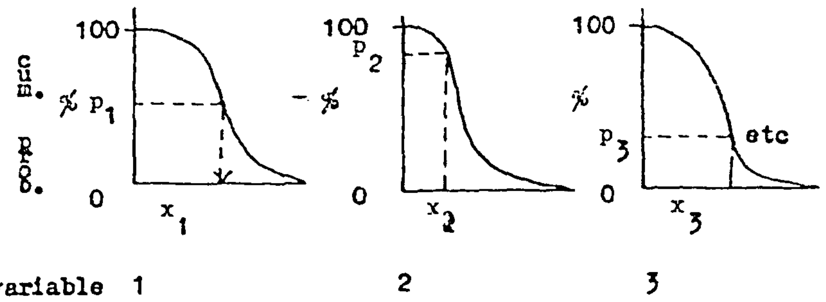


Figure 4 Random selections from a histogram.
Source: McCray, 1975

EACH VARIABLE USED IN RESOURCE CALCULATION



Values of p_1, p_2, p_3, . . . are chosen at random to select values x_1, x_2, x_3, where variables 1, 2, 3, .. may be V, Ø, Sw, etc. The values selected are substituted in the resource volume formulae to obtain a resource value. The process is repeated 2000 times and the values obtained used to produce a cumulative probability curve.

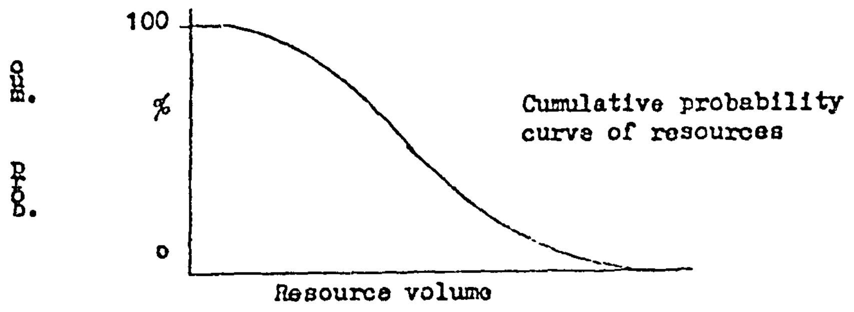


Figure 5: Steps taken in producing a cumulative probability curve of resources for a single prospect.
Source: Riesz, 1978

PROGRAM DESCRIPTION	CHAPTER 2

2.1 Objectives

WILDCAT is designed to calculate the hypothetical recoverable hydrocarbon resources of a prospect by Monte Carlo simulation.

The program operates on input data in the form of probability distributions of reservoir parameters to arrive at an estimate of the probable volume of recoverable hydrocarbons in the prospect. Estimates of the adequacy of six critical factors is assessed to determine the probability that the prospect contains any hydrocarbons at all. Further, the probability that the prospect contains gas rather than oil is assessed.

2.2 Program Structure

The program consists of a main program, WILDCAT, and 9 subroutines.

2.2.1 WILDCAT - main program

WILDCAT reads the input data and controls the scheduling of various subroutines. It also writes some reports.

The sequence of operations is:

1. Read the number of simulation passes required (default, 1000).

2. Read if punched card output is required for further processing.

3. Read the number of prospects (data sets) to be assessed.

4. Read if prospects are to be summed.

5. Read the title of the first set of data.

6. Read who compiled the data.

7. Read the compilation date.

8. Generate the date of the computer run.

9. Read what type of trap is being assessed.

10. Read what contours were used to determine the area of closure.

11. Read possible areas of closure.

12. Read reservoir depth.

13. Read whether prospect is onshore or offshore.

14. If prospect is offshore, read water depth.

15. Start reading the reservoir parameters. For each probability distribution of each reservoir parameter (steps 16-26):

    a) Read the number of pairs of values and their associated frequencies.
    b) Print the input data.
    c) Pass the input data to Subroutine VET for validation.
    d) Pass the input data to Subroutine ORDER for sorting.
    e) Pass the input data to Subroutine CPD for construction of cumulative probability distributions.

16. Read trap volume

17. Read fraction net pay

18. Read fraction trap fill

19. Read porosity

20. Read water saturation

21. Read oil recovery factor

22. Read gas recovery factor

23. Read temperature

24. Read pressure

25. Read gas deviation factor

26. Read formation volume factor

27. Read the geological existence risk factors.

28. Write the geological existence risk factors.

29. Calculate the prospect existence risk and the oil and gas existence risks.

30. Print the cumulative probability distributions.

31. Calculate the unrisked values for undiscovered resources. (This is the final answer if all values are singular.)

32. Convert answers to American measurement and, if no simulation is required, report results.

33. If prospects are to be added, adjust the array for later computation.

34. Schedule CALO to do simulation for oil resources.

35. Print results of simulation as a table of cumulative frequencies.

36. Schedule STAT to calculate statististics describing the oil distribution.

37. Convert mean, median and mode to American units and report the statistics calculated by STAT.

38. Schedule PROB to construct a cumulative probability distribution from the cumulative frequency data for oil.

39. Write a table of values for the cumulative probability data.

40. Schedule QUIPLOT to plot the cumulative probability

distribution for oil.

41. Schedule WRITER to write the summary report for oil.

42. Schedule CALG to simulate gas resources.

43. Write a table of cumulative frequencies for gas.

44. Schedule STAT to calculate statistics.

45. Convert to American units and write report.

46. Schedule PROB to construct cumulative probability distribution.

47. Schedule QUIPLOT to plot cumulative distribution.

48. Schedule WRITER to write summary report for gas.

49. If prospects are not to be summed, the program finishes here.

50. Schedule RASH to simulate the distribution of risked and summed oil resources.

51. Write a table of cumulative frequencies for the risked and summed oil.,

52. Schedule STAT to calculate statistics describing the simulated distribution.

53. Convert to American units and write report.

54. Schedule PERC to construct cumulative probability distribution of oil resources.

55. Schedule QUIPLOT to plot cumulative distribution.

56. Schedule RASH to simulate the distribution of risked and summed gas resources.

57. Write a table of cumulative frequencies for the risked and summed oil.

58. Schedule STAT to calculate statistics describing the simulated distribution.

59. Convert to American units and write report.

60. Schedule PERC to construct cumulative probability distribution of gas resources

61. Schedule QUIPLOT to plot cumulative distribution.

62. End of program.

2.2.2 Subroutine CALG

CALG controls the gas simulation.

The sequence of operations is:

1. Initialize arrays.
2. If a parameter is defined as a constant, retain that value and go to the next parameter.
3. If a parameter is not defined as a constant, schedule Subroutine MONTE to select a random value for that parameter, then go to the next parameter.
4. When all parameters have been assigned a value, substitute the values into the equation, solve it and retain the answer.
5. Do steps 2 through 4 NSP times.
6. Determine the maximum and minimum values calculated in the simulation phase.
7. Construct a cumulative frequency distribution of the simulated values.
8. Return

2.2.3 Subroutine CALO

CALO controls the oil simulation.

The sequence of operations is:

1. Initialize arrays.
2. If a parameter is defined as a constant, retain that value and go to the next parameter.
3. If a parameter is not defined as a constant,

schedule Subroutine MONTE to select a random value for that parameter, then go to the next parameter.

4. When all parameters have been assigned a value, substitute the values into the equation, solve it and retain the answer.

5. Do steps 2 through 4 NSP times.

6. Determine the maximum and minimum values calculated in the simulation phase.

7. Construct a cumulative frequency distribution of the simulated values.

8. Return.

2.2.4 Subroutine CPD

CPD constructs cumulative probability distributions.

The sequence of operations is:

1. Determine type of distribution.

2. Construct cumulative probability distribution.

3. Return.

2.2.5 Subroutine MONTE

MONTE does the Monte Carlo simulation.

The sequence of operations is:

1. Obtain random number from random number generator.

2. Equate the number with the cumulative probability of the distribution being sampled.

3. Determine the associated value.

4. Return.

2.2.6 Subroutine PERC

PERC constructs percent-probability-greater-than curves from the relative frequency distributions produced by simulation and returns the data ready for plotting.

The sequence of operations is:

1. Initialize arrays.
2. Convert cumulative frequency to cumulative probability.
3. Determine midpoints of intervals.
4. Return.

2.2.7 Subroutine PROB

2.2.8 Subroutine RASH

RASH risks and sums the hydrocarbon resources.

The sequence of operations is:

1. Initialize arrays.
2. Get a random number from the generator.
3. Equate the random number with the cumulative probability of the distribution.
4. Calculate the associated value.
5. Accumulate individual values and their sum.
6. Cumulate the frequency of occurrence of each range of values.
7. Return.

2.2.9 Subroutine STAT

STAT calculates statistics describing the distributions produced by simulation.

The sequence of operations is:

1. Initialize variables.
2. Calculate the mean of the distribution.
3. Calculate the variance and standard deviation of the distribution.
4. Calculate the median.
5. Calculate the mode.
6. Return.

2.2.10 Subroutine TEMP

TEMP converts temperature data from degrees Celsius or degrees Fahrenheit to degrees Rankine.

The sequence of operations is:

1. Test to see whether Celsius or Fahrenheit.
2. Convert to degrees Rankine.
3. Return.

2.2.11 Subroutine TYPER

2.2.12 Subroutine VET

VET validates the input data.

The sequence of operations is:

1. Test to see if the number of values has been given for the distribution.

2. Test to see that the number of values does not exceed the array size.

3. Test to see that there is at least one non-zero value in the array and that none of the frequencies are negative.

4. Schedule ORDER to sort values in ascending order if necessary.

5. If any tests are failed, write error message and terminate program.

6. Return.

2.2.13 Subroutine WRITER

WRITER writes a report summarizing the results of the simulation.

The sequence of operations is:

1. Convert existence risk to percent probability.

2. Make a statement about the existence risk.

3. Determine whether the report is about gas or oil.

4. Calculate equivalent American unit values for volume estimates.

5. Write the body of the report.

6. Return.

INPUT DATA PREPARATION	CHAPTER 3

Input is in card-image format. It can be put in on cards, but it is usually read from a file.

3.1 Data Format

	VARIABLE	DESCRIPTION
Card 1 cols. 1-3	KP	A3 Indication as to whether punched card output is required. Up to 3 alphabetic characters. YES or NO.
Card 2 cols. 1-2	NS	I2 Number of prospects to be assessed. Integer, maximum size 5.
Card 3 cols. 1-3	SUM	A3 Indication as to whether prospects are to be summed. Up to 3 alphabetic characters. YES or NO.

** Repeat card 4 through card L, NS times.

	VARIABLE	DESCRIPTION
Card 4 cols. 1-80	TITLE	8A10 Title of the data set. Up to 80 alphanumeric characters.
Card 5 cols. 1-80	C	8A10 Identification of the person or persons who compiled the data. Up to 80 alphanumeric characters.
Card 6 cols. 1-80	CD	8A10 Compilations data. Up to 80 alphanumeric characters.
Card 7 cols. 1-80	TRAP	8A10 Type of trap. Up to 80 alphanumeric characters.

Card 8			8A10
cols. 1-80	CU		List of contours used to determine area of trap closure. Up to 80 alphanumeric characters.
Card 9			8A10
cols. 1-80	AREA		Area of trap closure. Up to 80 alphanumeric characters.
Card 10			A10
cols. 1-10	DEPTH		Depth to reservoir. Up to 10 alphanumeric characters.
Card 11			A10
cols. 1-10	ON		Location of prospect. ONSHORE or OFFSHORE. Up to 10 characters.

If location is offshore (ON = OFFSHORE),

Card 12		A10
cols. 1-10	WD	Water depth. Up to 10 alphanumeric characters.

Otherwise,

Card A (card 12 if ONSHORE, card 13 if OFFSHORE)

		A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
col. 1	TYPE	Type of input data distribution. Single alphabetic character. K=constant, U=uniform, T=triangular, C=cumulative.
cols. 2-3	L	Number of pairs of values used to define the distribution. Integer, maximum size 10.
cols. 4-10		Blank.
cols. 11-20	VT(1)	Up to 10 pairs of values may be entered to describe the distribution. The first value of each pair (VT) is the trap volume and the second value (RFVT) is the associated frequency or probability. If there are four or more pairs of values, additional cards are required.
21-30	RFVT(1)	
31-40	VT(2)	
41-50	RFVT(2)	
.		
.		
.		

Card B		A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
col. 1	TYPE	Type of distribution. Single alphabetic character. K, U, T, C.
cols. 2-3	L	Number of pairs of values in distribution.
cols. 4-10		Blank.

```
cols. 11-20    FNP(1)      Fraction net pay.
      21-30    RFFNP(1)    Frequency or probability.
        .
        .      FNP(L)
        .      RFFNP(L)

Card C                     A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
col. 1         TYPE        Type of distribution.
cols. 2-3      L           Number of pairs of values.
cols. 4-10                 Blank
cols. 11-20    TF(1)       Trap fill.
      21-30    RFTF(1)     Frequency or probability.
        .
        .      TF(L)
        .      RFTF(L)

Card D                     A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
col. 1         TYPE        Type of distribution.
cols. 2-3      L           Number of pairs of values.
cols. 4-10                 Blank
cols. 11-20    PHI(1)      Porosity
      21-30    RFPHI(1)    Frequency or probability.
        .
        .      PHI(L)
        .      RFPHI(L)

Card E                     A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
col. 1         TYPE        Type of distribution.
cols. 2-3      L           Number of pairs of values.
cols. 4-10                 Blank
cols. 11-20    SW(1)       Water saturation.
      21-30    RFSW(1)     Frequency or probability.
        .
        .      SW(L)
        .      RFSW(L)

Card F                     A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
col. 1         TYPE        Type of distribution.
cols. 2-3      L           Number of pairs of values.
cols. 4-10                 Blank
cols. 11-20    RO(1)       Oil recovery factor.
      21-30    RFRO(1)     Probability.
        .
        .      RO(L)
        .      RFRO(L)

Card G                     A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
col. 1         TYPE        Type of distribution.
cols. 2-3      L           Number of pairs of values.
cols. 4-10                 Blank
cols. 11-20    RG(1)       Gas recovery factor
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```
        21-30   RFRG(i)     Probability.
          .
          .    RG(L)
          .    RFRG(L)

   Card H                   A1,I2,A1,6X,7F10.3,/,8F10.3,/,5F10.3
   col. 1       TYPE        Type of distribution.
   cols. 2-3    L           Number of pairs of values.
   col. 4       UNIT        Unit of measure. F (degrees Fahrenheit)
                            or C (degrees Celsius).
   cols. 5-10               Blank
   cols. 11-20  T(i)           Temperature
         21-30  RFT(i)         Probability
          .
          .     T(L)
          .     RFT(L)

   Card I                   A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
   col. 1       TYPE        Type of distribution.
   cols. 2-3    L           Number of pairs of values
   cols. 4-10               Blank
   cols. 11-20  P(i)        Pressure
         21-30  RFP(i)      Probability
          .
          .     P(L)
          .     RFP(L)

   Card J                   A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
   col. 1       TYPE        Type of distribution
   cols. 2-3    L           Number of pairs of values
   cols. 4-10               Blank
   cols. 11-20  Z(i)        Gas deviation factor.
         21-30  RFZ(i)      Probability.
          .
          .     Z(L)
          .     RFZ(L)

   Card K                   A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3
   col. 1       TYPE        Type of distribution.
   cols. 2-3    L           Number of pairs of values
   cols. 4-10               Blank
   cols. 11-20  FVF(i)      Formation volume factor
         21-30  RFFVF(i)    Probability
          .
          .     FVF(L)
          .     RFFVF(L)

   Card L                   8F10.3
   cols. 1-10   S           Probability of adequate source rocks.
        11-20   TH          Probability of adequate thermal history.
        21-30   R           Probability of adequate reservoir rocks.
```

31-40	TS	Probability of adequate trap and seal.
41-50	TI	Timing
51-60	F	Preservation from flushing
61-70	O	Relative likelihood that it's oil
71-80	G	Relative likelihood that it's gas

JOB CONTROL	CHAPTER 4

WILDCAT can be run by card input or through the Cyber system editor, ED. An ED library document (DEMOCAT) to run WILDCAT using the demonstration data exists under PID=DMRXVA, UID=DMRVRA.

The control cards for the job are:

1. WILDCAT,P3,T30,MS140000.
2. COMMENT. NAME AND EXTENSION OF PERSON RUNNING THE JOB
3. GETSET,DMR3922.
4. ATTACH,WILDCAT,RUNWILDCAT,ID=DMRVES,SN=DMR3922.
5. WILDCAT.
6. *EOS
7. Followed by the data set as shown in Appendix 3.

If a listing of the program is required with the output reports, the following control cards can be used.

1. WILDCAT,P3,T30,MS140000.
2. COMMENT. NAME AND EXTENSION OF PERSON RUNNING THE JOB
3. FTN,SL.
4. LGO.
5. *EOS
6. Followed by the program.
7. Followed by a *EOS card.
8. Followed by the data.

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APPENDIX 1

```
      PROGRAM WILDCAT(INPUT,OUTPUT,PUNCH,TAPE61=OUTPUT)
C***************************************************************************
C
C                                VARIABLE NAMES
C                                --------------
C
C     AREA  =  AREA OF TRAP CLOSURE
C     BG    =  MINIMUM GAS EXPANSION FACTOR
C     C     =  NAME OF PERSON(S) COMPILING DATA
C     CD    =  COMPILATION DATE
C     CFNP  =  FRACTION NET PAY VALUE IN CUMULATIVE PROB. DIST.
C     CFVF  =  FORMATION VOLUME FACTOR VALUE IN CUMULATIVE PROB. DIST.
C     CP    =  RESERVOIR PRESSURE VALUE IN CUMULATIVE PROB. DISTRIBUTION.
C     CPFNP =  CUMULATIVE PROBABILITY VALUE FOR FRACTION NET PAY
C     CPFVF =  CUMULATIVE PROBABILITY VALUE FOR FORMATION VOL. FACTOR.
C     CPHI  =  POROSITY VALUE IN CUMULATIVE PROBABILITY DISTRIBUTION.
C     CPP   =  CUMULATIVE PROBABILITY VALUE FOR RESERVOIR PRESSURE
C     CPPHI =  CUMULATIVE PROBABILITY VALUE FOR POROSITY
C     CPRG  =  CUMULATIVE PROBABILITY VALUE FOR GAS RECOVERY FACTOR
C     CPRO  =  CUMULATIVE PROBABILITY VALUE FOR OIL RECOVERY FACTOR
C     CPSW  =  CUMULATIVE PROBABILITY VALUE FOR WATER SATURATION
C     CPT   =  CUMULATIVE PROBABILITY VALUE FOR RESERVOIR TEMPERATURE
C     CPTF  =  CUMULATIVE PROBABILITY VALUE FOR FRACTION TRAP FILL
C     CPVT  =  CUMULATIVE PROBABILITY VALUE FOR TRAP VOLUME
C     CPZ   =  CUMULATIVE PROBABILITY VALUE FOR GAS DEVIATION FACTOR
C     CR    =  DATE OF COMPUTER RUN
C     CRG   =  GAS RECOVERY FACTOR VALUE IN CUMULATIVE PROB. DIST.
C     CRO   =  OIL RECOVERY FACTOR VALUE IN CUMULATIVE PROB. DIST.
C     CSW   =  WATER SATURATION VALUE IN CUMULATIVE PROB. DIST.
C     CT    =  RESERVOIR TEMPERATURE VALUE IN CUMULATIVE PROB. DIST.
C     CTF   =  FRACTION TRAP FILL VALUE IN CUMULATIVE PROB. DIST.
C     CU    =  CONTOURS USED TO DELINEATE TRAP
C     CVT   =  TRAP VOLUME VALUE IN CUMULATIVE PROB. DIST.
C     CZ    =  GAS DEVIATION FACTOR VALUE IN CUMULATIVE PROB. DIST.
C     C5    =  FIFTH CENTILE
C     C20   =  TWENTIETH CENTILE
C     C80   =  EIGHTIETH CENTILE
C     C95   =  NINETY-FIFTH CENTILE
C     DEPTH =  DEPTH
C     F     =  EXISTENCE RISK FACTOR FOR FLUSHING
C     FNP   =  FRACTION NET PAY -- A NUMBER BETWEEN 0 AND 1
C     FVF   =  FORMATION VOLUME FACTOR -- A NUMBER BETWEEN 0 AND 1
C     G     =  EXISTENCE RISK FACTOR FOR GAS
C     GER   =  GAS EXISTENCE RISK
C     I     =  INDEX
C     J     =  INDEX
C     K     =  INDEX
C     KK    =  LOOP COUNTER
C     KP    =  SIGNAL FOR CARD OUTPUT
C     L     =  COUNTER FOR INPUT DATA
C     M     =  COUNTER FOR CUMULATED DATA
```

```
C     MAX    =  ARRAY POSITION OF THE MAXIMUM CUMULATIVE FREQUENCY
C     MD     =  MEDIAN
C     MDA    =  MEDIAN IN AMERICAN UNITS
C     MEAN   =  MEAN
C     MIN    =  ARRAY POSITION OF THE SMALLEST NON-ZERO CUMULATIVE FREQUENCY
C     MNA    =  MEAN IN AMERICAN UNITS
C     MOA    =  MODE IN AMERICAN UNITS
C     MODE   =  MODE
C     NGAS   =  FREQUENCY OF VALUES IN SIMULATED GAS DISTRIBUTION
C     NOIL   =  FREQUENCY OF VALUES IN SIMULATED OIL DISTRIBUTION
C     NS     =  NUMBER OF DATA SETS
C     NSP    =  NUMBER OF SIMULATION PASSES
C     O      =  EXISTENCE RISK FACTOR FOR OIL
C     OER    =  OIL EXISTENCE RISK
C     ON     =  LOCATION, E.G., ONSHORE
C     P      =  RESERVOIR PRESSURE -- POUNDS PER SQUARE INCH GAUGED
C     PER    =  PROSPECT EXISTENCE RISK
C     PHI    =  POROSITY IN PERCENT
C     R      =  EXISTENCE RISK FACTOR FOR RESERVOIR
C     RES    =  NAME OF RESOURCE BEING PROCESSED
C     RFFNP  =  RELATIVE FREQUENCY OF FRACTION NET PAY VALUE
C     RFFVF  =  RELATIVE FREQUENCY OF FORMATION VOLUME FACTOR
C     RFNP   =  RANDOM VALUE FOR FRACTION NET PAY
C     RFP    =  RELATIVE FREQUENCY OF RESERVOIR PRESSURE
C     RFPHI  =  RELATIVE FREQUENCY OF POROSITY VALUE
C     RFRG   =  RELATIVE FREQUENCY OF GAS RECOVERY FACTOR VALUE
C     RFRO   =  RELATIVE FREQUENCY OF OIL RECOVERY FACTOR VALUE
C     RFSW   =  RELATIVE FREQUENCY OF WATER SATURATION VALUE
C     RFT    =  RELATIVE FREQUENCY OF RESERVOIR TEMPERATURE VALUE
C     RFTF   =  RELATIVE FREQUENCY OF FRACTION TRAP FILL VALUE
C     RFVF   =  RANDOM VALUE FOR FORMATION VOLUME FACTOR
C     RFVT   =  RELATIVE FREQUENCY OF TRAP VOLUME VALUE
C     RFZ    =  RELATIVE FREQUENCY OF GAS DEVIATION FACTOR VALUE
C     RG     =  GAS RECOVERY FACTOR -- A NUMBER BETWEEN 0 AND 1
C               THE FRACTION OF GAS IN PLACE WHICH IS RECOVERABLE
C     RO     =  OIL RECOVERY FACTOR -- A NUMBER BETWEEN 0 AND 1
C               THE FRACTION OF OIL IN PLACE WHICH IS RECOVERABLE
C     RP     =  RANDOM VALUE FOR PRESSURE
C     RPHI   =  RANDOM VALUE FOR POROSITY
C     RRG    =  RANDOM VALUE FOR GAS RECOVERY FACTOR
C     RRO    =  RANDOM VALUE FOR OIL RECOVERY FACTOR
C     RSW    =  RANDOM VALUE FORM WATER SATURATION
C     RT     =  RANDOM VALUE FOR TEMPERATURE
C     RTF    =  RANDOM VALUE FOR TRAP FILL
C     RVT    =  RANDOM VALUE FOR TRAP VOLUME
C     RXSG   =  RISKED AND SUMMED GAS VOLUMES
C     RXSO   =  RISKED AND SUMMED OIL VOLUMES
C     RYSG   =  RISKED AND SUMMED GAS CUMULATIVE PROBABILITIES
C     RYSO   =  RISKED AND SUMMED OIL CUMULATIVE PROBABILITIES
C     RZ     =  RANDOM VALUE FOR GAS DEVIATION FACTOR
C     S      =  EXISTENCE RISK FACTOR FOR SOURCE
```

```
C     SGAS  =  SIMULATED GAS DISTRIBUTION VALUES
C     SOIL  =  SIMULATED OIL DISTRIBUTION VALUES
C     STD   =  STANDARD DEVIATION
C     SUM   =  SIGNAL FOR SUMMATION OF PROSPECTS
C     SW    =  WATER SATURATION IN PERCENT
C     T     =  RESERVOIR TEMPERATURE IN DEGREES RANKINE
C     TF    =  FRACTION TRAP FILL -- A NUMBER BETWEEN 0 AND 1
C     TH    =  EXISTENCE RISK FACTOR FOR THERMAL HISTORY
C     TI    =  EXISTENCE RISK FACTOR FOR TIMING
C     TITLE =  TITLE OF DATA SET
C     TRAP  =  TYPE OF TRAP
C     TS    =  EXISTENCE RISK FACTOR FOR TRAP & SEAL
C     TYPE  =  TYPE OF DISTRIBUTION
C     UNIT  =  UNIT OF TEMPERATURE
C     VAR   =  VARIANCE
C     VGA   =  MINIMUM RECOVERABLE GAS VOLUME IN BILLIONS OF CUBIC FEET.
C     VGN   =  MINIMUM RECOVERABLE GAS VOLUME IN MILLIONS OF CUBIC METRES
C     VOA   =  MINIMUM RECOVERABLE OIL VOLUME IN MILLIONS OF BARRELS
C     VON   =  MINIMUM RECOVERABLE OIL VOLUME IN MILLIONS OF CUBIC METRES
C     VR    =  MINIMUM RESERVOIR VOLUME IN MILLIONS OF CUBIC METRES
C     VT    =  TRAP VOLUME IN MILLIONS OF CUBIC METRES
C     WD    =  WATER DEPTH
C     XGAS  =  SIMULATED GAS VOLUMES FOR INDIVIDUAL PROSPECTS
C     XOIL  =  SIMULATED OIL VOLUMES FOR INDIVIDUAL PROSPECTS
C     XSIM  =  ARRAY TO HOLD XGAS OR XOIL FOR PLOTTING
C     YGAS  =  ARRAY TO HOLD GAS CUMULATIVE FREQUENCIES
C     YOIL  =  ARRAY TO HOLD OIL CUMULATIVE FREQUENCIES
C     YSIM  =  ARRAY TO HOLD YGAS OR YOIL FOR PLOTTING
C     Z     =  GAS DEVIATION FACTOR
C
C          EXTERNALS
C          ---------
C
C     CALG    =  SUBROUTINE CONTROLLING GAS SIMULATION
C     CALO    =  SUBROUTINE CONTROLLING OIL SIMULATION
C     CPD     =  SUBROUTINE FOR CONSTRUCTION OF CUMULATIVE PROBABILITY
C                DISTRIBUTIONS
C     DATE    =  DATE FUNCTION
C     PERC    =  SUBROUTINE FOR CONSTRUCTION OF PROBABILITY-GREATER-THAN
C                CURVES
C     PROB    =  SUBROUTINE FOR
C     QUIPLOT =  SYSTEM ROUTINE FOR LINEPRINTER PLOTS
C     RASH    =  SUBROUTINE CONTROLLING SIMULATION OF RISKED AND SUMMED
C                RESOURCES
C     STAT    =  SUBROUTINE FOR CALCULATING STATISTICS OF DISTRIBUTIONS
C     TEMP    =  SUBROUTINE FOR CONVERSION OF TEMPERATURE DATA TO
C                DEGREES RANKINE
C     TYPER   =  SUBROUTINE FOR WRITING OUT TYPE OF DISTRIBUTION
C     VET     =  SUBROUTINE FOR DATA VALIDATION
C     WRITER  =  SUBROUTINE FOR SUMMARY REPORT WRITING
C
```

```
C
C                                  STANDARD FORMULAE
C                                  -----------------
C
C      VO = (VR * PHI * (1-SW) * RO) / FVF
C
C      VG = (VR * PHI * (1-SW) * RG) / BG
C
C      BG = (14.7 / (P+14.7)) * (T/520) * Z
C
C      VR = A * H * TF
C
C      VR = VT * FNP * TF
C
C*************************************************************************
      DIMENSION TITLE(5,8),GER(5),OER(5),XSIM(100),YSIM(100)
      DIMENSION C(8),CD(8),TRAP(8),CU(8),AREA(8)
      DIMENSION SOIL(101),SGAS(101),NOIL(100),NGAS(100)
      DIMENSION FVF(10),FNP(10),RXSO(100),RYSO(100),RXSG(100),RYSG(100)
      DIMENSION P(10),PHI(10),RFFVF(10)
      DIMENSION RFFNP(10),RFP(10),RFPHI(10),RFRG(10),RFRO(10),RFSW(10)
      DIMENSION RFT(10),RFTF(10),RFVT(10)
      DIMENSION RFZ(10),RG(10),RO(10),SW(10),T(10),TF(10)
      DIMENSION VT(10),Z(10)
      DIMENSION XOIL(5,100),XGAS(5,100),YOIL(5,100),YGAS(5,100)
      COMMON CFNP(22),CFVF(22),CP(22),CPHI(22),CRO(22),CRG(22)
      COMMON CSW(22),CT(22),CTF(22),CVT(22),CZ(22),CPVT(22)
      COMMON CPFNP(22),CPTF(22),CPPHI(22),CPSW(22),CPRO(22),CPRG(22)
      COMMON CPT(22),CPP(22),CPZ(22),CPFVF(22),M(11)
      INTEGER TYPE, UNIT,RES
      REAL MEAN,MD,MODE,MNA,MDA,MOA,MIN,MAX
C
C          SET NUMBER OF SIMULATION PASSES
C
      NSP=5000
C
C          FIND OUT IF PUNCHED CARD OUTPUT IS REQUIRED FOR FURTHER PROCESSING
C          BY PROGRAM PROSSAD
C
      READ 10, KP
   10 FORMAT(A3)
C
C          FIND OUT HOW MANY PROSPECTS ARE BEING ASSESSED
C
      READ 27,NS
   27 FORMAT(I2)
C
C          FIND OUT IF PROSPECTS ARE TO BE SUMMED
C
      READ 10,SUM
C
```

```
C           START READING THE REAL DATA
C
      DO 200 KK=1,NS
C
C           READ THE TITLE OF THE DATA SET
C
      READ 20, (TITLE(KK,K),K=1,8)
   20 FORMAT(8A10)
      WRITE 1054
 1054 FORMAT(1H1,19X,43H* * * * * C O N F I D E N T I A L * * * * *,//)
      WRITE 1000,(TITLE(KK,K),K=1,8)
 1000 FORMAT(5X,*PROSPECT TITLE:*,12X,8A10,/,5X,14(*-*))
C
C           DATA COMPILED BY
C
      READ 40,(C(I),I=1,8)
   40 FORMAT(8A10)
      WRITE 1003,(C(I),I=1,8)
 1003 FORMAT(5X,*DATA COMPILED BY:*,10X,8A10,/,5X,16(*-*))
C
C           COMPILATION DATE
C
      READ 40,(CD(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
 1004 FORMAT(5X,*COMPILATION DATE:*,10X,8A10,/,5X,16(*-*))
C
C           GENERATE DATE OF COMPUTER RUN
C
      CALL DATE(CR)
      WRITE 1033,CR
 1033 FORMAT(5X,*DATE OF COMPUTER RUN:*,5X,A10,/,5X,20(*-*))
C
C           TYPE OF TRAP
C
      READ 40,(TRAP(I),I=1,8)
      WRITE 1043,(TRAP(I),I=1,8)
 1043 FORMAT(5X,*TRAP:*,22X,8A10,/,5X,4(*-*))
C
C           CONTOURS USED
C
      READ 40,(CU(I),I=1,8)
      WRITE 1044,(CU(I),I=1,8)
 1044 FORMAT(5X,*CONTOURS USED:*,13X,8A10,/,5X,13(*-*))
C
C           AREA
C
      READ 40,(AREA(I),I=1,8)
      WRITE 1049,(AREA(I),I=1,8)
 1049 FORMAT(5X,*AREA (SQUARE KILOMETRES):  *,8A10,/,5X,24(*-*))
C
C           DEPTH
```

```
C
      READ 50,DEPTH
   50 FORMAT(A10)
      WRITE 1052,DEPTH
 1052 FORMAT(5X,*DEPTH (METRES):*,12X,A10,/,5X,14(*-*))
C
C          ONSHORE/OFFSHORE
C
      READ 50,ON
      IF(ON.EQ.7HONSHORE) GO TO 9
      WRITE 1064,ON
 1064 FORMAT(5X,*LOCATION:*,18X,A10,/,5X,8(*-*))
C
C          WATER DEPTH
C
      READ 50,WD
      WRITE 1065,WD
 1065 FORMAT(5X,*WATER DEPTH (METRES):*,6X,A10,/,5X,20(*-*))
      GO TO 19
    9 WRITE 1064,ON
   19 WRITE 1053
 1053 FORMAT(/,1X,*RESERVOIR PARAMETERS*,/,1X,20(*-*))
C
C                    RESERVOIR PARAMETERS
C                    --------------------
C
C
C          1.  READ THE NUMBER OF PAIRS OF VALUES AND THEIR ASSOCIATED
C              FREQUENCIES OR RELATIVE FREQUENCIES.
C          2.  PRINT THE INPUT DATA.
C          3.  PASS THE DATA TO SUBROUTINE VET FOR VALIDATION,
C              THEN TO SUBROUTINE ORDER FOR SORTING.
C          4.  PASS THE DATA TO SUBROUTINE CPD FOR CONSTRUCTION
C              OF CUMULATIVE PROBABILITY DISTRIBUTIONS.
C              CPD PASSES THE DATA TO SUBROUTINE NORM
C              IF NORMALIZATION IS NECESSARY.
C
C           TRAP VOLUME IN MILLIONS OF CUBIC METRES
C
      READ 30, TYPE,L,(VT(I),RFVT(I), I=1,L)
   30 FORMAT(A1,I2,7X,7F10.3,/,8F10.3,/,5F10.3)
      WRITE 1005,(VT(I), I=1,L)
 1005 FORMAT(/,1X,*TRAP VOLUME*,15X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 1
      CALL TYPER(TYPE,L,VT,RFVT)
      GO TO 2
    1 WRITE 1006,(RFVT(I),I=1,L)
 1006 FORMAT(1X,*FREQUENCY DISTRIBUTION*,4X,10F10.3)
    2 CALL VET(TYPE,L,VT,RFVT)
      M(1)=L
      CALL CPD(TYPE,M(1),VT,RFVT,CVT,CPVT)
```

```
C
C         FRACTION NET PAY
C
      READ 30, TYPE,L,(FNP(I),RFFNP(I),I=1,L)
      WRITE 1007,(FNP(I),I=1,L)
 1007 FORMAT(/,1X,*FRACTION NET PAY*,10X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 3
      CALL TYPER(TYPE,L,FNP,RFFNP)
      GO TO 4
    3 WRITE 1006,(RFFNP(I),I=1,L)
    4 CALL VET(TYPE,L,FNP,RFFNP)
      M(2)=L
      CALL CPD(TYPE,M(2),FNP,RFFNP,CFNP,CPFNP)
C
C         FRACTION TRAP FILL
C
      READ 30, TYPE,L,(TF(I),RFTF(I),I=1,L)
      WRITE 1008,(TF(I),I=1,L)
 1008 FORMAT(/,1X,*FRACTION TRAP FILL*,8X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 5
      CALL TYPER(TYPE,L,TF,RFTF)
      GO TO 6
    5 WRITE 1006,(RFTF(I),I=1,L)
    6 CALL VET(TYPE,L,TF,RFTF)
      M(3)=L
      CALL CPD(TYPE,M(3),TF,RFTF,CTF,CPTF)
C
C         POROSITY
C
      READ 30, TYPE,L,(PHI(I),RFPHI(I),I=1,L)
      WRITE 1009,(PHI(I),I=1,L)
 1009 FORMAT(/,1X,*POROSITY*,18X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 7
      CALL TYPER(TYPE,L,PHI,RFPHI)
      GO TO 8
    7 WRITE 1006,(RFPHI(I),I=1,L)
    8 CALL VET(TYPE,L,PHI,RFPHI)
      M(4)=L
      CALL CPD(TYPE,M(4),PHI,RFPHI,CPHI,CPPHI)
C
C         WATER SATURATION
C
      READ 30, TYPE,L,(SW(I),RFSW(I),I=1,L)
      WRITE 1010,(SW(I),I=1,L)
 1010 FORMAT(/,1X,*WATER SATURATION*,10X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 11
      CALL TYPER(TYPE,L,SW,RFSW)
      GO TO 12
   11 WRITE 1006,(RFSW(I),I=1,L)
   12 CALL VET(TYPE,L,SW,RFSW)
      M(5)=L
```

```
      CALL CPD(TYPE,M(5),SW,RFSW,CSW,CPSW)
C
C            OIL RECOVERY FACTOR
C
      READ 30, TYPE,L,(RO(I),RFRO(I),I=1,L)
      WRITE 1011,(RO(I),I=1,L)
 1011 FORMAT(/,1X,*OIL RECOVERY FACTOR*,7X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 13
      CALL TYPER(TYPE,L,RO,RFRO)
      GO TO 14
   13 WRITE 1006,(RFRO(I),I=1,L)
   14 CALL VET(TYPE,L,RO,RFRO)
      M(6)=L
      CALL CPD(TYPE,M(6),RO,RFRO,CRO,CPRO)
C
C            GAS RECOVERY FACTOR
C
      READ 30, TYPE,L,(RG(I),RFRG(I),I=1,L)
      WRITE 1012,(RG(I),I=1,L)
 1012 FORMAT(/,1X,*GAS RECOVERY FACTOR*,7X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 15
      CALL TYPER(TYPE,L,RG,RFRG)
      GO TO 16
   15 WRITE 1006,(RFRG(I),I=1,L)
   16 CALL VET(TYPE,L,RG,RFRG)
      M(7)=L
      CALL CPD(TYPE,M(7),RG,RFRG,CRG,CPRG)
C
C            TEMPERATURE
C
      READ 60, TYPE,L,UNIT,(T(I),RFT(I),I=1,L)
   60 FORMAT(A1,I2,A1,6X,7F10.3,/,8F10.3,/,5F10.3)
      WRITE 1013,UNIT,(T(I),I=1,L)
 1013 FORMAT(/,1X,*TEMPERATURE IN DEGREES *,A1,2X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 17
      CALL TYPER(TYPE,L,T,RFT)
      GO TO 18
   17 WRITE 1006,(RFT(I),I=1,L)
   18 CALL VET(TYPE,L,T,RFT)
      CALL TEMP(L,UNIT,T)
      M(8)=L
      CALL CPD(TYPE,M(8),T,RFT,CT,CPT)
C
C            PRESSURE
C
      READ 30, TYPE,L,(P(I),RFP(I),I=1,L)
      WRITE 1014,(P(I),I=1,L)
 1014 FORMAT(/,1X,*PRESSURE (P.S.I.G.)*,7X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 21
      CALL TYPER(TYPE,L,P,RFP)
      GO TO 22
```

```
   21 WRITE 1006,(RFP(I),I=1,L)
   22 CALL VET(TYPE,L,P,RFP)
      M(9)=L
      CALL CPD(TYPE,M(9),P,RFP,CP,CPP)
C
C           GAS DEVIATION FACTOR
C
      READ 30, TYPE,L,(Z(I),RFZ(I),I=1,L)
      WRITE 1015,(Z(I),I=1,L)
 1015 FORMAT(/,1X,*GAS DEVIATION FACTOR*,6X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 23
      CALL TYPER(TYPE,L,Z,RFZ)
      GO TO 24
   23 WRITE 1006,(RFZ(I),I=1,L)
   24 CALL VET(TYPE,L,Z,RFZ)
      M(10)=L
      CALL CPD(TYPE,M(10),Z,RFZ,CZ,CPZ)
C
C           FORMATION VOLUME FACTOR
C
      READ 30, TYPE,L,(FVF(I),RFFVF(I),I=1,L)
      WRITE 1016,(FVF(I),I=1,L)
 1016 FORMAT(/,1X,*FORMATION VOLUME FACTOR*,3X,10F10.3)
      IF(TYPE.EQ.1H ) GO TO 25
      CALL TYPER(TYPE,L,FVF,RFFVF)
      GO TO 26
   25 WRITE 1006,(RFFVF(I),I=1,L)
   26 CALL VET(TYPE,L,FVF,RFFVF)
      M(11)=L
      CALL CPD(TYPE,M(11),FVF,RFFVF,CFVF,CPFVF)
C
C           EXISTENCE RISK FACTORS
C
      READ 70, S,TH,R,TS,TI,F,O,G
   70 FORMAT(8F10.3)
      WRITE 1054
      WRITE 1000,(TITLE(KK,I),I=1,8)
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 1029
 1029 FORMAT(//,5X,*EXISTENCE RISK FACTORS*,/,5X,22(*-*),/)
      WRITE 1055,S
 1055 FORMAT(5X,*PROBABILITY THAT SOURCE ROCKS ARE PRESENT*,4X,F10.3)
      WRITE 1056,TH
 1056 FORMAT(5X,*PROBABILITY THAT THERMAL HISTORY WAS ADEQUATE*,F10.3)
      WRITE 1057,R
 1057 FORMAT(5X,*PROBABILITY THAT RESERVOIR FACIES ARE PRESENT*,F10.3)
      WRITE 1058,TS
 1058 FORMAT(5X,*PROBABILITY THAT STRUCTURE & SEAL ARE PRESENT*,F10.3)
      WRITE 1059,TI
```

```
 1059 FORMAT(5X,*PROBABILITY THAT TIMING WAS ADEQUATE*,9X,F10.3)
      WRITE 1060,F
 1060 FORMAT(5X,*PROBABILITY THAT PRESERVATION WAS ADEQUATE*,3X,F10.3)
C
C          CALCULATE THE PROSPECT EXISTENCE RISK AND
C          THE OIL AND GAS EXISTENCE RISKS.
C
      PER = S * TH * R * TS * TI * F
      WRITE 1061,PER
 1061 FORMAT(50X,10(*-*),/,5X,*CHANCE OF HYDROCARBON OCCURRENCE*,13X,F10
     +.3,///)
      OER(KK) = O / (O + G)
      OER(KK) = OER(KK) * PER
      WRITE 1062,O,OER(KK)
 1062 FORMAT(5X,*RELATIVE LIKELIHOOD OF OIL OCCURRING*,F10.3,20X,*OIL EX
     +ISTENCE RISK=*,F10.3,/)
      GER(KK) = G / (O + G)
      GER(KK) = GER(KK) * PER
      WRITE 1063,G,GER(KK)
 1063 FORMAT(5X,*RELATIVE LIKELIHOOD OF GAS OCCURRING*,F10.3,20X,*GAS EX
     +ISTENCE RISK=*,F10.3)
C
C          PRINT CUMULATIVE PROBABILITY DISTRIBUTIONS
C
      WRITE 1054
      WRITE 1000,(TITLE(KK,K),K=1,8)
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 1001
 1001 FORMAT(//,10X,*CUMULATIVE PROBABILITY DISTRIBUTIONS FOR BASE DATA*
     +,/,10X,50(*-*))
      K=M(1)
      WRITE 1017,(CVT(I),I=1,K)
 1017 FORMAT(/,1X,*TRAP VOLUME*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPVT(I),I=1,K)
 1018 FORMAT(1X,*CUM. PROB.*,1X,12F10.3,/,12X,10F10.3)
      K=M(2)
      WRITE 1019,(CFNP(I),I=1,K)
 1019 FORMAT(/,1X,*FRAC NETPAY*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPFNP(I),I=1,K)
      K=M(3)
      WRITE 1020,(CTF(I),I=1,K)
 1020 FORMAT(/,1X,*F.TRAP FILL*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPTF(I),I=1,K)
      K=M(4)
      WRITE 1021,(CPHI(I),I=1,K)
 1021 FORMAT(/,1X,*POROSITY*,3X,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPPHI(I),I=1,K)
      K=M(5)
      WRITE 1022,(CSW(I),I=1,K)
```

```
 1022 FORMAT(/,1X,*WATER SAT'N*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPSW(I),I=1,K)
      K=M(6)
      WRITE 1023,(CRO(I),I=1,K)
 1023 FORMAT(/,1X,*OIL REC FAC*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPRO(I),I=1,K)
      K=M(7)
      WRITE 1024,(CRG(I),I=1,K)
 1024 FORMAT(/,1X,*GAS REC FAC*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPRG(I),I=1,K)
      K=M(8)
      WRITE 1025,(CT(I),I=1,K)
 1025 FORMAT(/,1X,*TEMPERATURE*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPT(I),I=1,K)
      K=M(9)
      WRITE 1026,(CP(I),I=1,K)
 1026 FORMAT(/,1X,*PRESSURE*,3X,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPP(I),I=1,K)
      K=M(10)
      WRITE 1027,(CZ(I),I=1,K)
 1027 FORMAT(/,1X,*GAS DEV FAC*,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPZ(I),I=1,K)
      K=M(11)
      WRITE 1028,(CFVF(I),I=1,K)
 1028 FORMAT(/,1X,*FM VOL FAC*,1X,12F10.3,/,12X,10F10.3)
      WRITE 1018,(CPFVF(I),I=1,K)
C
C          CALCULATE THE UNRISKED VALUES FOR UNDISCOVERED RESOURCES.
C          THIS IS THE FINAL ANSWER IF ALL VALUES ARE SINGULAR.
C
      DO 210 J=1,11
      K=M(J)
      IF(J.EQ.1) RVT=CVT(K)
      IF(J.EQ.2) RFNP=CFNP(K)
      IF(J.EQ.3) RTF=CTF(K)
      IF(J.EQ.4) RPHI=CPHI(K)
      IF(J.EQ.5) RSW=CSW(K)
      IF(J.EQ.6) RRO=CRO(K)
      IF(J.EQ.7) RRG=CRG(K)
      IF(J.EQ.8) RT=CT(K)
      IF(J.EQ.9) RP=CP(K)
      IF(J.EQ.10) RZ=CZ(K)
      IF(J.EQ.11) RFVF=CFVF(K)
  210 CONTINUE
      BGM = (14.7/(CP(1)+14.7)) * (RT/520.) * RZ
      VR = CVT(1) * CFNP(1) * CTF(1)
      VON = (VR*CPHI(1)*(1-RSW) * CRO(1)) / RFVF
      VGN = (VR*CPHI(1)*(1-RSW)*CRG(1))/BGM
C
C         CONVERT TO AMERICAN MEASUREMENTS
C          BARRELS OF OIL
```

```
C          BILLIONS (THOUSANDS OF MILLIONS) OF CUBIC FEET
C
      VOA = VON * 6.2898106
      VGA = VGN * 0.0353147
C
C          CHECK TO SEE WHETHER WE NEED TO DO ANY SIMULATION
C
      DO 220 J=1,11
      IF(M(J).GT.1) GO TO 230
  220 CONTINUE
C
C          ALL VALUES ARE SINGULAR SO JUST REPORT THE RESULTS
C          OF THE CALCULATIONS.
C
      WRITE 1054
      WRITE 1002,(TITLE(KK,K),K=1,8)
 1002 FORMAT(28X,8A10,/,28X,80(*-*),///,10X,*ALL RESERVOIR PARAMETERS AR
     +E SINGULAR -- NO SIMULATION HAS BEEN DONE.*,/,10X,69(*-*),//)
      WRITE 1030
 1030 FORMAT(42X,*RECOVERABLE RESOURCES*,/,42X,21(*-*),//)
      WRITE 1031
 1031 FORMAT(20X,*OIL*,40X,*GAS*,/,20X,*---*,40X,*---*,/)
      WRITE 1032,VON,VGN
 1032 FORMAT(10X,F15.3,1X,*MILLION CUBIC METRES*,10X,F15.3,1X,*MILLION C
     +UBIC METRES*,/)
      WRITE 1035,VOA,VGA
 1035 FORMAT(10X,F10.3,1X,*MILLION BARRELS*,15X,F10.3,1X,*BILLION CUBIC
     +FEET*,//)
      WRITE 1034,OER(KK),GER(KK)
 1034 FORMAT(7X,*OIL EXISTENCE RISK*,5X,F10.4,10X,*GAS EXISTENCE RISK*,
     +7X,F10.4,/)
C
C          NO SIMULATION WAS REQUIRED BUT THE ARRAY
C          MUST BE FIXED FOR RISKING AND SUMMING.
C
      XOIL(KK,1) = VON
      XOIL(KK,2) = VON
      YOIL(KK,1) = 1.0
      YOIL(KK,2) = 0.0
      XGAS(KK,1) = VGN
      XGAS(KK,2) = VGN
      YGAS(KK,1) = 1.0
      YGAS(KK,2) = 0.0
      GO TO 200
C
C          DO SIMULATION FOR OIL RESOURCES
C
  230 CALL CALO(NSP,SOIL,NOIL)
C
C          PRINT RESULTS OF SIMULATION FOR OIL.
C
```

```
      WRITE 1054
      WRITE 1000,(TITLE(KK,I),I=1,8)
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 2000,(SOIL(J),NOIL(J),SOIL(J+50),NOIL(J+50),
     +J=1,50)
 2000 FORMAT(2(10X,F15.3,10X,I5))
C
C           CALCULATE SOME STATISTICS TO DESCRIBE THE
C           DISTRIBUTION JUST GENERATED FOR OIL.
C
      CALL STAT(NSP,SOIL,NOIL,MEAN,MD,MODE,VAR,STD)
C
C           CONVERT CUBIC METRES TO BARRELS.
C
      MNA = MEAN * 6.2898106
      MDA = MD   * 6.2898106
      MOA = MODE * 6.2898106
      WRITE 1054
      WRITE 1000,(TITLE(KK,K),K=1,8)
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 1037
 1037 FORMAT(5X,*STATISTICS DESCRIBING THE DISTRIBUTION GENERATED BY SIM
     +ULATION.*,/,5X,63(*-*),///)
      WRITE 1039
 1039 FORMAT(6X,*MILLION CUBIC METRES OF OIL*,14X,*MILLION BARRELS OF OI
     +L*,/,6X,27(*-*),14X,22(*-*),/)
      WRITE 1040,MEAN,MNA,STD
 1040 FORMAT(5X,*MEAN VALUE   =*,2X,F15.3,25X,F15.3,20X,*STANDARD DEVIAT
     +ION =*,F20.5)
      WRITE 1041,MD,MDA,VAR
 1041 FORMAT(5X,*MEDIAN VALUE =*,2X,F15.3,25X,F15.3,20X,*VARIANCE =*,10X
     +,F20.5)
      WRITE 1042,MODE,MOA
 1042 FORMAT(5X,*MODAL VALUE  =*,2X,F15.3,25X,F15.3,///)
C
C           PLOT THE SIMULATED OIL RESOURCES
C
      CALL PROB(NSP,KK,SOIL,NOIL,XOIL,YOIL,C95,C80,C20,C5)
      WRITE 1054
      WRITE 1000,(TITLE(KK,I),I=1,8)
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 3000,(XOIL(KK,J),YOIL(KK,J),XOIL(KK,J+50),YOIL(KK,J+50),
     +J=1,50)
 3000 FORMAT(4(10X,F15.3))
      DO 300 I=1,100
```

```
      XSIM(I)=XOIL(KK,I)
      YSIM(I)=YOIL(KK,I)
  300 CONTINUE
      CALL QUIPLOT(XSIM,YSIM,100,1,14H*UNRISKED OIL*,7H*CPROB*)
C
C          WRITE A REPORT
C
      RES=3HOIL
      MIN=XSIM(1)
      MAX=XSIM(100)
      CALL WRITER(KK,TITLE,C,CD,CR,OER,MODE,MOA,MIN,MAX
     +,C95,C80,C20,C5,MD,MDA,RES)
C
C          DO SIMULATION FOR UNRISKED GAS RESOURCES
C
      CALL CALG(NSP,SGAS,NGAS)
      WRITE 1054
      WRITE 1000,(TITLE(KK,I),I=1,8)
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 2000,(SGAS(J),NGAS(J),SGAS(J+50),NGAS(J+50),J=1,50)
C
C          CALCULATE STATISTICS TO DESCRIBE THE DISTRIBUTION
C
      CALL STAT(NSP,SGAS,NGAS,MEAN,MD,MODE,VAR,STD)
C
C          CONVERT MILLIONS OF CUBIC METRES TO BILLIONS
C          (THOUSAND MILLION) OF CUBIC FEET
C
      MNA = MEAN * 0.0353147
      MDA = MD   * 0.0353147
      MOA = MODE * 0.0353147
      WRITE 1054
      WRITE 1000,(TITLE(KK,K),K=1,8)
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 1037
      WRITE 1045
 1045 FORMAT(6X,*MILLION CUBIC METRES OF GAS*,14X,*BILLION CUBIC FEET OF
     + GAS*,/,6X,27(*-*),14X,25(*-*),/)
      WRITE 1040,MEAN,MNA,STD
      WRITE 1041,MD,MDA,VAR
      WRITE 1042,MODE,MOA
C
C          PLOT UNRISKED GAS RESOURCES
C
      CALL PROB(NSP,KK,SGAS,NGAS,XGAS,YGAS,C95,C80,C20,C5)
      WRITE 1054
      WRITE 1000,(TITLE(KK,I),I=1,8)
```

```
      WRITE 1003,(C(I),I=1,8)
      WRITE 1004,(CD(I),I=1,8)
      WRITE 1033,CR
      WRITE 3000,(XGAS(KK,J),YGAS(KK,J),XGAS(KK,J+50),YGAS(KK,J+50),
     +J=1,50)
      DO 310 I=1,100
      XSIM(I)=XGAS(KK,I)
      YSIM(I)=YGAS(KK,I)
  310 CONTINUE
      CALL QUIPLOT(XSIM,YSIM,100,1,14H*UNRISKED GAS*,7H*CPROB*)
C
C          WRITE A REPORT
C
      RES=3HGAS
      MIN=XSIM(1)
      MAX=XSIM(100)
      CALL WRITER(KK,TITLE,C,CD,CR,GER,MODE,MOA,MIN,MAX
     +,C95,C80,C20,C5,MD,MDA,RES)
  200 CONTINUE
C
C          IF PROSPECTS ARE NOT TO BE SUMMED, THE JOB IS FINISHED
C
      IF(SUM.NE.3HYES) GO TO 280
C
C          IF OIL EXISTENCE RISK FOR ALL PROSPECTS IS EQUAL TO ZERO --
C          SKIP DOWN AND DO SIMULATION FOR GAS
C
      DO 240 I=1,NS
      IF(OER(I).GT.0.) GO TO 250
  240 CONTINUE
      WRITE 1050
 1050 FORMAT(1H1,/////,10X,*THE OIL EXISTENCE RISK FOR ALL PROSPECTS IS
     +ZERO.*)
      GO TO 260
C
C          DO SIMULATION FOR RISKED AND SUMMED OIL RESOURCES
C
  250 NSP=10000
      CALL RASH(NSP,NS,OER,SOIL,NOIL,XOIL,YOIL)
      WRITE 1054
      WRITE 1047
 1047 FORMAT(27X,*RISKED AND SUMMED OIL RESOURCES*,/,27X,31(*-*)/)
      WRITE 1038
 1038 FORMAT(5X,*PROSPECTS INCLUDED IN THE SUMMATION ARE:*)
      DO 80 I=1,NS
      WRITE  1066,(TITLE(I,J),J=1,8)
 1066 FORMAT(2X,8A10)
   80 CONTINUE
      WRITE 1033,CR
      WRITE 2000,(SOIL(J),NOIL(J),SOIL(J+50),NOIL(J+50),
     +J=1,50)
```

```
C
C          CALCULATE STATISTICS TO DESCRIBE THE DISTRIBUTION
C          OF RISKED AND SUMMED OIL RESOURCES
C
      CALL STAT(NSP,SOIL,NOIL,MEAN,MD,MODE,VAR,STD)
C
C          CONVERT CUBIC METRES TO BARRELS
C
      MNA = MEAN * 6.2898106
      MDA = MD   * 6.2898106
      MOA = MODE * 6.2898106
      WRITE 1054
      WRITE 1047
      WRITE 1038
      DO 90 I=1,NS
      WRITE 1066,(TITLE(I,J),J=1,8)
   90 CONTINUE
      WRITE 1033,CR
      WRITE 1037
      WRITE 1039
      WRITE 1040,MEAN,MNA,STD
      WRITE 1041,MD,MDA,VAR
      WRITE 1042,MODE,MOA
C
C          PLOT THE SIMULATED RISKED AND SUMMED OIL RESOURCES
C
      CALL PERC(NSP,SOIL,NOIL,RXSO,RYSO)
      WRITE 1054
      WRITE 1047
      WRITE 1038
      DO 100 I=1,NS
      WRITE 1066,(TITLE(I,J),J=1,8)
  100 CONTINUE
      WRITE 1033,CR
      WRITE 3000,(RXSO(J),RYSO(J),RXSO(J+50),RYSO(J+50),J=1,50)
      CALL QUIPLOT(RXSO,RYSO,100,1,12H*RISKED OIL*,7H*CPROB*)
C
C          IF GAS EXISTENCE RISK FOR ALL PROSPECTS IS ZERO --
C          THE JOB IS FINISHED
C
  260 DO 270 I=1,NS
      IF(GER(I).GT.0.) GO TO 290
  270 CONTINUE
      WRITE 1051
 1051 FORMAT(1H1,/////,10X,*THE GAS EXISTENCE RISK FOR ALL PROSPECTS IS
     +ZERO.*)
      GO TO 280
C
C          DO SIMULATION FOR RISKED GAS RESOURCES
C
  290 CALL RASH(NSP,NS,GER,SGAS,NGAS,XGAS,YGAS)
```

```
C
C         PRINT RESULTS OF SIMULATION
C
      WRITE 1054
      WRITE 1048
 1048 FORMAT(27X,*RISKED AND SUMMED GAS RESOURCES*,/,27X,31(*-*)/)
      WRITE 1038
      DO 110 I=1,NS
      WRITE 1066,(TITLE(I,J),J=1,8)
  110 CONTINUE
      WRITE 2000,(SGAS(J),NGAS(J),SGAS(J+50),NGAS(J+50),J=1,50)
      CALL STAT(NSP,SGAS,NGAS,MEAN,MD,MODE,VAR,STD)
C
C          CONVERT MILLIONS OF CUBIC METRES TO BILLIONS
C          (THOUSAND MILLION) OF CUBIC FEET
C
      MNA = MEAN * 0.0353147
      MDA = MD   * 0.0353147
      MOA = MODE * 0.0353147
      WRITE 1054
      WRITE 1048
      WRITE 1037
      WRITE 1038
      DO 120 I=1,NS
      WRITE 1066,(TITLE(I,J),J=1,8)
  120 CONTINUE
      WRITE 1033,CR
      WRITE 1045
      WRITE 1040,MEAN,MNA,STD
      WRITE 1041,MD,MDA,VAR
      WRITE 1042,MODE,MOA
C
C          PLOT RISKED GAS RESOURCES
C
      CALL PERC(NSP,SGAS,NGAS,RXSG,RYSG)
      WRITE 1054
      WRITE 1048
      WRITE 1038
      DO 130 I=1,NS
      WRITE 1066,(TITLE(I,J),J=1,8)
  130 CONTINUE
      WRITE 1033,CR
      WRITE 3000,(RXSG(J),RYSG(J),RXSG(J+50),RYSG(J+50),J=1,50)
      CALL QUIPLOT(RXSG,RYSG,100,1,12H*RISKED GAS*,7H*CPROB*)
C
  280 STOP
      END
```

```
      SUBROUTINE CALG(NSP,SGAS,NGAS)
C***********************************************************************
C
C           'CALG' CONTROLS THE SIMULATION CALCULATIONS
C           FOR GAS IN INDIVIDUAL PROSPECTS
C
C           VARIABLES NOT IN COMMON
C           -----------------------
C
C     BG     =  MINIMUM GAS EXPANSION FACTOR CALCULATED AT EACH
C                SIMULATION PASS
PASS
C     CI     =  CLASS INTERVAL
C     CI2    =  ONE-HALF CLASS INTERVAL
C     I      =  LOOP COUNTER
C     J      =  LOOP COUNTER
C     MAX    =  MAXIMUM VALUE IN GAS DISTRIBUTION
C     MIN    =  MINIMUM VALUE IN GAS DISTRIBUTION
C     NGAS   =  CUMULATIVE FREQUENCY (Y-AXIS OF CUMULATIVE FREQUENCY
C                DISTRIBUTION)
C     NSP    =  NUMBER OF SIMULATION PASSES
C     RFNP   =  RANDOM VALUE OF FRACTION NET PAY
C     RP     =  RANDOM VALUE OF PRESSURE
C     RPHI   =  RANDOM VALUE OF POROSITY
C     RRG    =  RANDOM VALUE OF GAS RECOVERY FACTOR
C     RSW    =  RANDOM VALUE OF WATER SATURATION
C     RT     =  RANDOM VALUE OF TEMPERATURE
C     RTF    =  RANDOM VALUE OF FRACTION TRAP FILL
C     RVT    =  RANDOM VALUE OF TRAP VOLUME
C     RZ     =  RANDOM VALUE OF GAS DEVIATION FACTOR
C     SGAS   =  VOLUME OF GAS (X-AXIS OF CUMULATIVE FREQUENCY
C                DISTRIBUTION)
C     VG     =  VOLUME OF GAS CALCULATED AT EACH SIMULATION PASS
C     VR     =  RESERVOIR VOLUME CALCULATED AT EACH SIMULATION PASS
C
C           EXTERNAL
C           --------
C
C     MONTE =  SUBROUTINE MONTE DOES THE MONTE CARLO SIMULATION
C
C***********************************************************************
      DIMENSION SGAS(101),NGAS(100),VG(5000)
      COMMON CFNP(22),CFVF(22),CP(22),CPHI(22),CRO(22),CRG(22)
      COMMON CSW(22),CT(22),CTF(22),CVT(22),CZ(22),CPVT(22)
      COMMON CPFNP(22),CPTF(22),CPPHI(22),CPSW(22),CPRO(22),CPRG(22)
      COMMON CPT(22),CPP(22),CPZ(22),CPFVF(22),M(11)
      REAL MAX,MIN
C
C           INITIALIZE ARRAYS
C
      DO 10 J=1,100
```

```
      SGAS(J)=0.
      NGAS(J)=0
   10 CONTINUE
      SGAS(101)=0.0
C
C           DO SIMULATION
C
      DO 30 I=1,NSP
      DO 40 J=1,10
      IF(M(J).NE.1) GO TO 50
      IF(J.EQ.1) RVT=CVT(1)
      IF(J.EQ.2) RFNP=CFNP(1)
      IF(J.EQ.3) RTF=CTF(1)
      IF(J.EQ.4) RPHI=CPHI(1)
      IF(J.EQ.5) RSW=CSW(1)
      IF(J.EQ.6) GO TO 40
      IF(J.EQ.7) RRG=CRG(1)
      IF(J.EQ.8) RT=CT(1)
      IF(J.EQ.9) RP=CP(1)
      IF(J.EQ.10) RZ=CZ(1)
      GO TO 40
   50 IF(J.EQ.1) CALL MONTE(M(1),CVT,CPVT,RVT)
      IF(J.EQ.2) CALL MONTE(M(2),CFNP,CPFNP,RFNP)
      IF(J.EQ.3) CALL MONTE(M(3),CTF,CPTF,RTF)
      IF(J.EQ.4) CALL MONTE(M(4),CPHI,CPPHI,RPHI)
      IF(J.EQ.5) CALL MONTE(M(5),CSW,CPSW,RSW)
      IF(J.EQ.6) GO TO 40
      IF(J.EQ.7) CALL MONTE(M(7),CRG,CPRG,RRG)
      IF(J.EQ.8) CALL MONTE(M(8),CT,CPT,RT)
      IF(J.EQ.9) CALL MONTE(M(9),CP,CPP,RP)
      IF(J.EQ.10) CALL MONTE(M(10),CZ,CPZ,RZ)
   40 CONTINUE
      BG = (14.7/(RP+14.7)) * (RT/520.) * RZ
      VR = RVT * RFNP * RTF
      VG(I) = (VR * RPHI * (1-RSW) * RRG) / BG
   30 CONTINUE
C
C           TEST TO SEE WHAT INTERVAL THE VALUE FOR GAS
C           FALLS INTO AND INCREMENT THE FREQUENCY
C
      MAX=0.0
      MIN=99999999.
      DO 60 I=1,NSP
      IF(VG(I).GE.MAX) MAX=VG(I)
      IF(VG(I).LE.MIN) MIN=VG(I)
   60 CONTINUE
      CI=(MAX-MIN)/99.
      CI2=CI/2.
      SGAS(1)=MIN-CI2
      DO 70 I=2,101
      SGAS(I)=SGAS(I-1)+CI
```

```
   70 CONTINUE
      DO 80 I=1,NSP
      DO 80 J=2,101
      IF(VG(I).LE.SGAS(J)) NGAS(J-1)=NGAS(J-1)+1
   80 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE CALO(NSP,SOIL,NOIL)
C***********************************************************************
C
C           'CALO' CONTROLS THE SIMULATION CALCULATIONS
C           FOR OIL IN INDIVIDUAL PROSPECTS
C
C           VARIABLES NOT IN COMMON
C           -----------------------
C
C      CI    =  CLASS INTERVAL
C      CI2   =  ONE-HALF CLASS INTERVAL
C      I     =  LOOP COUNTER
C      J     =  LOOP COUNTER
C      MAX   =  MAXIMUM VALUE IN OIL DISTRIBUTION
C      MIN   =  MINIMUM VALUE IN OIL DISTRIBUTION
C      NOIL  =  CUMULATIVE FREQUENCY (Y-AXIS OF CUMULATIVE FREQUENCY
C                DISTRIBUTION)
C      NSP   =  NUMBER OF SIMULATION PASSES
C      RFNP  =  RANDOM VALUE OF FRACTION NET PAY
C      RFVF  =  RANDOM VALUE OF FORMATION VOLUME FACTOR
C      RPHI  =  RANDOM VALUE OF POROSITY
C      RRO   =  RANDOM VALUE OF OIL RECOVERY FACTOR
C      RSW   =  RANDOM VALUE OF WATER SATURATION
C      RTF   =  RANDOM VALUE OF FRACTION TRAP FILL
C      RVT   =  RANDOM VALUE OF TRAP VOLUME
C      SOIL  =  VOLUME OF OIL (X-AXIS OF CUMULATIVE FREQUENCY
C                DISTRIBUTION)
C      VO    =  VOLUME OF OIL CALCULATED AT EACH SIMULATION PASS
C      VR    =  RESERVOIR VOLUME CALCULATED AT EACH SIMULATION PASS
C
C           EXTERNAL
C           --------
C
C      MONTE =  SUBROUTINE MONTE DOES THE MONTE CARLO SIMULATION
C
C***********************************************************************
      DIMENSION SOIL(101),NOIL(100),VO(5000)
      COMMON CFNP(22),CFVF(22),CP(22),CPHI(22),CRO(22),CRG(22)
      COMMON CSW(22),CT(22),CTF(22),CVT(22),CZ(22),CPVT(22)
      COMMON CPFNP(22),CPTF(22),CPPHI(22),CPSW(22),CPRO(22),CPRG(22)
      COMMON CPT(22),CPP(22),CPZ(22),CPFVF(22),M(11)
      REAL  MAX,MIN
C
C           INITIALIZE ARRAYS
C
      DO 10 J=1,100
      SOIL(J)=0.
      NOIL(J)=0
   10 CONTINUE
      SOIL(101)=0.0
C
```

```
C          DO SIMULATION
C
      DO 30 I=1,NSP
      DO 40 J=1,11
      IF(M(J).NE.1) GO TO 50
      IF(J.EQ.1) RVT=CVT(1)
      IF(J.EQ.2) RFNP=CFNP(1)
      IF(J.EQ.3) RTF=CTF(1)
      IF(J.EQ.4) RPHI=CPHI(1)
      IF(J.EQ.5) RSW=CSW(1)
      IF(J.EQ.6) RRO=CRO(1)
      IF(J.EQ.7) GO TO 40
      IF(J.EQ.8) GO TO 40
      IF(J.EQ.9) GO TO 40
      IF(J.EQ.10) GO TO 40
      IF(J.EQ.11) RFVF=CFVF(1)
      GO TO 40
   50 IF(J.EQ.1) CALL MONTE(M(1),CVT,CPVT,RVT)
      IF(J.EQ.2) CALL MONTE(M(2),CFNP,CPFNP,RFNP)
      IF(J.EQ.3) CALL MONTE(M(3),CTF,CPTF,RTF)
      IF(J.EQ.4) CALL MONTE(M(4),CPHI,CPPHI,RPHI)
      IF(J.EQ.5) CALL MONTE(M(5),CSW,CPSW,RSW)
      IF(J.EQ.6) CALL MONTE(M(6),CRO,CPRO,RRO)
      IF(J.EQ.7) GO TO 40
      IF(J.EQ.8) GO TO 40
      IF(J.EQ.9) GO TO 40
      IF(J.EQ.10) GO TO 40
      IF(J.EQ.11) CALL MONTE(M(11),CFVF,CPFVF,RFVF)
   40 CONTINUE
      VR = RVT * RFNP * RTF
      VO(I) = (VR * RPHI * (1-RSW) * RRO) / RFVF
   30 CONTINUE
C
C          TEST TO SEE WHAT INTERVAL THE VALUE
C          FALLS INTO AND INCREMENT THE FREQUENCY
C
      MAX=0.0
      MIN=9999999.
      DO 60 I=1,NSP
      IF(VO(I).GE.MAX) MAX=VO(I)
      IF(VO(I).LE.MIN) MIN=VO(I)
   60 CONTINUE
      CI=(MAX-MIN)/99.
      CI2=CI/2.
      SOIL(1)=MIN-CI2
      DO 70 I=2,101
      SOIL(I)=SOIL(I-1)+CI
   70 CONTINUE
      DO 80 I=1,NSP
      DO 80 J=2,101
      IF(VO(I).LE.SOIL(J)) NOIL(J-1)=NOIL(J-1)+1
```

```
      80 CONTINUE
         RETURN
         END
```

```
      SUBROUTINE CPD(TYPE,M,VAL,RELF,CVAL,CPR)
C***********************************************************************
C
C          'CPD' CONSTRUCTS CUMULATIVE PROBABILITY
C           DISTRIBUTIONS FROM THE BASE DATA FOR USE
C           IN MONTE CARLO SIMULATION
C
C           VARIABLES
C           ---------
C
C     CPR   =  CUMULATIVE PROBABILITY (Y-AXIS OF CUMULATIVE PROBABILITY
C               DISTRIBUTION)
C     CVAL  =  PARAMETER VALUE (X-AXIS OF CUMULATIVE PROBABILITY
C               DISTRIBUTION)
C     EM    =  NEWENDORP'S M
C     I     =  LOOP COUNTER
C     IND   =  INDICATES WHETHER PROBABILITY HAS BEEN
C               CALCULATED FOR THE MODE
C     J     =  SUBSCRIPT
C     M     =  NUMBER OF VALUES IN DISTRIBUTION
C     MEAN  =  MEAN
C     RELF  =  FREQUENCY, RELATIVE FREQUENCY, PROBABILITY OR CUMULATIVE
C               PROBABILITY (INPUT DATA)
C     STEP  =  INTERVAL WIDTH IN CUMULATIVE PROBABILITY DISTRIBUTION
C     TOT   =  TOTAL FREQUENCY USED IN VARIOUS TESTS
C     TYPE  =  TYPE OF DISTRIBUTION
C     VAL   =  PARAMETER VALUE (INPUT DATA)
C     X     =  NEWENDORP'S X
C     XPRIME =  NEWENDORP'S X'
C
C          EXTERNAL
C          --------
C
C     NORM  =  SUBROUTINE NORM NORMALIZES FREQUENCY DISTRIBUTION
C
C***********************************************************************
      DIMENSION VAL(10),RELF(10),CVAL(22),CPR(22)
      REAL MEAN
      INTEGER TYPE
C
C
C          CHECK TO SEE WHAT DISTRIBUTION THE FACTOR VALUES TAKE.
C          'TYPE' TAKES PRECEDENT OVER 'L'
C
C          IS IT A CONSTANT?
C
      IF(TYPE.EQ.1HK.OR.M.EQ.1) GO TO 10
C
C          IS IT A UNIFORM DISTRIBUTION?
C
      IF(TYPE.EQ.1HU) GO TO 50
```

```
C
C          IS IT 2 DISCRETE VALUES?
C
      IF(M.EQ.2) GO TO 30
C
C          IS IT A TRIANGULAR DISTRIBUTION?
C
      IF(TYPE.EQ.1HT) GO TO 100
C
C          IS IT 3 DISCRETE VALUES?
C
      IF(M.EQ.3) GO TO 90
C
C          IS IT A CUMULATIVE PROBABILITY DISTRIBUTION?
C
      IF(TYPE.EQ.1HC) GO TO 900
C
C          IS IT A NORMAL DISTRIBUTION?
C
      IF(TYPE.EQ.1HN) GO TO 1000
C
C          IS IT A LOGNORMAL DISTRIBUTION?
C
      IF(TYPE.EQ.1HL) GO TO 1000
C
C          IT MUST BE SOMETHING ELSE.  TEST TO SEE
C          WHAT IT IS.
C
      TOT = 0.0
      DO 5 I=1,M
      TOT = TOT + RELF(I)
    5 CONTINUE
      IF(TOT.GT.1.) GO TO 15
C
C          IT MUST BE A RELATIVE FREQUENCY DISTRIBUTION.
C
      IF(RELF(1).LE.0.0) GO TO 6
      M=M+1
      CVAL(1) = VAL(1)
      CPR(1) = 0.0
      GO TO 8
    6 CVAL(1) = VAL(1)
      CPR(1) = 0.0
      DO 9 I=2,M
      CVAL(I) = VAL(I)
      CPR(I) = CPR(I-1) + RELF(I)
    9 CONTINUE
      GO TO 1000
    8 DO 7 I=2,M
      CVAL(I) = VAL(I-1)
      CPR(I) = CPR(I-1) + RELF(I-1)
```

```
    7 CONTINUE
      GO TO 1000
C
C            IT MUST BE A GENERAL FREQUENCY DISTRIBUTION,
C            SO IT WILL HAVE TO BE NORMALIZED.
C
   15 CALL NORM(M,VAL,RELF)
      GO TO 800
C
C            THE FACTOR HAS BEEN GIVEN AS A CONSTANT.
C
   10 CVAL(1) = VAL(1)
      CPR(1) = 1.0
      GO TO 1000
C
C     THE DISTRIBUTION HAS 2 VALUES.  IS IT A UNIFORM DISTRIBUTION?
C
   30 IF(RELF(1).LE.0) GO TO 50
      IF(RELF(2).LE.0) GO TO 50
      IF(RELF(1).EQ.RELF(2)) GO TO 50
C
C            IT IS A FREQUENCY DISTRIBUTION WITH 2 VALUES,
C            SO IT WILL HAVE TO BE NORMALIZED.
C
      CALL NORM(M,VAL,RELF)
      GO TO 800
C
C            THE FACTOR HAS BEEN GIVEN AS A UNIFORM DISTRIBUTION
C            OR THE DATA IMPLY THAT IT IS A UNIFORM DISTRIBUTION
C
   50 CVAL(1) = VAL(1)
      CVAL(2) = VAL(M)
      CPR(1) = 0.0
      CPR(2) = 1.0
      GO TO 1000
   90 IF(RELF(1).LE.0.0.AND.RELF(3).LE.0.0) GO TO 100
C
C            IT IS A FREQUENCY DISTRIBUTION WITH 3 VALUES,
C            SO IT WILL HAVE TO BE NORMALIZED.
C
      CALL NORM(M,VAL,RELF)
      GO TO 800
C
C
C            THE FACTOR HAS BEEN GIVEN AS A TRIANGULAR DISTRIBUTION
C            OR THE DATA IMPLY THAT IT IS A TRIANGULAR DISTRIBUTION.
C
  100 MEAN = (VAL(1) + VAL(2) + VAL(3)) / 3.
      CPR(1)=0.0
      CVAL(1)=VAL(1)
      X=VAL(1)
```

```
      STEP=(VAL(3)-VAL(1))/20.
      EM=(VAL(2)-VAL(1))/(VAL(3)-VAL(1))
      J=2
      DO 120 I=2,21
      X=X+STEP
      CVAL(J)=X
      XPRIME=(X-VAL(1))/(VAL(3)-VAL(1))
      IF(X.GE.VAL(2)) GO TO 110
      CPR(J)=(XPRIME**2)/EM
      J=J+1
      GO TO 120
  110 IF(VAL(1).EQ.VAL(2)) GO TO 115
      IF(IND.GE.1) GO TO 115
      CVAL(J)=VAL(2)
      CPR(J)=EM
      IND=99
      J=J+1
      CVAL(J)=X
  115 CPR(J)=1.-(((1.-XPRIME)**2)/(1.-EM))
      J=J+1
  120 CONTINUE
      M=J-1
C      MEDN = (VAL(2) + 2.0 * MEAN) / 3.
C      IF(MEDN.GE.MEAN) GO TO 110
C      CPR(2) = 1-(((VAL(3) - VAL(2)) / (VAL(3) - MEDN)) * 0.5)
C      GO TO 120
C 110  CPR(2) = ((VAL(2) - VAL(1)) / (MEDN - VAL(1))) * 0.5
C 120  CPR(1) = 0.0
C      CPR(3) = 1.0
C      CVAL(1) = VAL(1)
C      CVAL(2) = VAL(2)
C      CVAL(3) = VAL(3)
      GO TO 1000
C
C          THE DISTRIBUTION HAS BEEN NORMALIZED, NOW
C          CUMULATE IT.
C
  800 CPR(1) = 0.0
      DO 850 I=1,M
      CVAL(I) = VAL(I)
  850 CONTINUE
      DO 860 I=2,M
      CPR(I) = CPR(I-1) + RELF(I-1)
  860 CONTINUE
      GO TO 1000
C
C          THE FACTOR HAS BEEN GIVEN AS A CUMULATIVE
C          PROBABILITY DISTRIBUTION.
C
  900 DO 910 I=1,M
      CVAL(I) = VAL(I)
```

```
      CPR(I)=RELF(I)
  910 CONTINUE
 1000 RETURN
      END
```

```
      SUBROUTINE MONTE(M,CVAL,CPR,RVAL)
C*********************************************************************:
C
C          'MONTE' DOES THE MONTE CARLO SIMULATION
C          ON THE CUMULATIVE PROBABILITY DISTRIBUTIONS
C          CONSTRUCTED FROM BASE DATA.
C
C          VARIABLES
C          ---------
C
C     CPR   =  CUMULATIVE PROBABILITY (Y-AXIS OF THE CUMULATIVE
C               PROBABILITY DISTRIBUTION
C     CVAL  =  PARAMETER VALUE (X-AXIS OF THE CUMULATIVE
C               PROBABILITY DISTRIBUTION
C     DUM   =  DUMMY VARIABLE
C     I     =  LOOP COUNTER
C     M     =  NUMBER OF VALUES IN DISTRIBUTION
C     RN    =  RANDOM NUMBER RETURNED BY RANF
C     RVAL  =  RANDOMLY SELECTED PARAMETER VALUE
C
C          EXTERNAL
C          --------
C
C     RANF  =  RANDOM FUNCTION
C
C*******************************************************************
C
      DIMENSION CVAL(M),CPR(M)
C
   40 RN = RANF(DUM)
      DO 50 I=2,M
      IF(RN.LE.CPR(I)) GO TO 60
   50 CONTINUE
      WRITE 1000,RN,CPR(I)
 1000 FORMAT(1H1,10X,*PANIC STATIONS*,/,5X,*RANDOM NUMBER =*,F20.9,/,5X,
     +*MAXIMUM PROBABILITY =*,F20.9)
      GO TO 99
   60 RVAL = CVAL(I-1) + ((RN-CPR(I-1)) * (CVAL(I)-CVAL(I-1)))/
     +    (CPR(I)-CPR(I-1))
      GO TO 100
   99 STOP
  100  RETURN
      END
```

```
      SUBROUTINE NORM(L,VAL,RELF)
C*********************************************************************
C
C           'NORM' NORMALIZES FREQUENCY DISTRIBUTIONS
C
C           VARIABLES
C           ---------
C
C      A      =  ONE-HALF OF EACH CLASS INTERVAL
C      AREA   =  AREA OF EACH CLASS INTERVAL
C      CB     =  CLASS BOUNDARY
C      I      =  INDEX
C      L      =  NUMBER OF VALUES IN THE DISTRIBUTION
C      N      =  INDEX
C      RELF   =  FREQUENCY (INPUT DATA), PROBABILITY (OUTPUT)
C      RF     =  RELATIVE FREQUENCY
C      TOT    =  TOTAL AREA UNDER THE CURVE
C      TOTAL  =  TOTAL RELATIVE FREQUENCY
C      VAL    =  DISCRETE PARAMETER VALUES (INPUT DATA), CLASS
C                BOUNDARIES (OUTPUT)
C
C*****************************************************************
C
      DIMENSION RELF(12),VAL(12)
      DIMENSION CB(12),AREA(12),RF(12)
C
C           FIND CLASS WIDTHS
C
      A=(VAL(2) - VAL(1))/2.
      CB(1) = VAL(1) - A
      IF(CB(1).LE.0.) CB(1)=0.0
C
C           DEFINE CLASS BOUNDARIES
C
      IF(L.GT.2) GO TO 5
      CB(2) = VAL(1) + A
      GO TO 15
    5 DO 10 I=2,L
      CB(I)=VAL(I-1) + A
      IF(I.GE.L) GO TO 15
      A=(VAL(I+1) - VAL(I)) / 2.
   10 CONTINUE
   15 CB(L+1) = VAL(L) + A
C
C           EXPAND THE ARRAY AND
C           REPLACE ORIGINAL VALUES WITH THE CLASS BOUNDS
C
      L=L+1
      DO 20 I=1,L
      VAL(I) = CB(I)
   20 CONTINUE
```

```
C
C
C          CALCULATE TOTAL AREA
C
      TOT= 0.0
      DO 30 I =2,L
      AREA(I-1) = (VAL(I)-VAL(I-1)) * RELF(I-1)
      TOT = TOT + AREA(I-1)
   30 CONTINUE
C
C          FIND RELATIVE FREQUENCIES
C
      TOTAL = 0.0
      N=L-1
      DO 40 I=1,N
      RF(I) = (AREA(I)/TOT) * RELF(I)
      TOTAL = TOTAL + RF(I)
   40 CONTINUE
      DO 50 I=1,N
      RELF(I) = RF(I)/TOTAL
   50 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE ORDER(L,VAL,RELF)
C*****************************************************************
C
C           'ORDER' USES THE BUBBLE SORT TO SORT TWO ARRAYS.
C           THE FINAL ORDER IS ASCENDING VALUES.  IF THE FIRST TWO
C           VALUES ARE EQUAL THE ASSOCIATED RELATIVE FREQUENCY VALUES
C           ARE IN ASCENDING ORDER.  IF THE LAST TWO VALUES ARE EQUAL
C           THE ASSOCIATED RELATIVE FREQUENCIES ARE IN DESCENDING ORDER.
C
C           VARIABLES
C           ---------
C
C      A     =  TEMPORARY LOCATION FOR VALUES BEING MOVED
C      I     =  LOOP COUNTER
C      L     =  NUMBER OF VALUES IN ARRAY
C      RELF  =  RELATIVE FREQUENCY
C      SWAP  =  INDICATOR
C      VAL   =  PARAMETER VALUE
C
C*****************************************************************::
C
      DIMENSION VAL(L),RELF(L)
      INTEGER SWAP
   10 SWAP = 0
      DO 100 I=2,L
      IF(VAL(I).GT.VAL(I-1)) GO TO 100
      IF(VAL(I).EQ.VAL(I-1).AND.RELF(I).GE.RELF(I-1)) GO TO 100
      A=VAL(I)
      VAL(I) = VAL(I-1)
      VAL(I-1) = A
      A = RELF(I)
      RELF(I) = RELF(I-1)
      RELF(I-1) = A
      SWAP = SWAP + 1
  100 CONTINUE
      IF(SWAP.GT.0) GO TO 10
      IF(VAL(L).NE.VAL(L-1)) GO TO 200
      A = RELF(L)
      RELF(L) = RELF(L-1)
      RELF(L-1) = A
  200 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE PERC(NSP,SMV,NSM,XSIM,YSIM)
C*************************************************************************:
C
C        'PERC' CONSTRUCTS PROBABILITY-GREATER-THAN
C        CURVES FROM THE RELATIVE FREQUENCY DISTRIBUTIONS
C        PRODUCED BY SIMULATION, AND RETURNS DATA READY FOR
C        PLOTTING.
C
C          VARIABLES
C          ---------
C
C     ENSP  =  REAL EQUIVALENT OF NSP
C     J     =  LOOP COUNTER
C     NSM   =  FREQUENCY ASSOCIATED WITH SMV
C     SMV   =  CLASS BOUNDARIES
C     XSIM  =  MIDPOINTS OF CLASS BOUNDARIES
C     YSIM  =  PROBABILITIES (RELATIVE FREQUENCIES) DERIVED FROM NSM
C
C*******************************************************************
C
      DIMENSION SMV(101),NSM(100),XSIM(100),YSIM(100)
C
      ENSP=NSP
C
C
C          INITIALIZE ARRAYS
C
      DO 10 J=1,100
      XSIM(J) = 0.
      YSIM(J) = 0.
   10 CONTINUE
      DO 20 J=1,100
      YSIM(J)=1.0-NSM(J)/ENSP
      XSIM(J)=(SMV(J)+SMV(J+1))/2.
   20 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE PROB(NSP,KK,SMV,NSM,XOIL,YOIL,C95,C80,C20,C5)
C****************************************************************************
C
C          'PROB' CONSTRUCTS
C
C          VARIABLES
C          ---------
C
C     C5    =  5TH CENTILE
C     C20   =  20TH CENTILE
C     C80   =  80TH CENTILE
C     C95   =  95TH CENTILE
C     ENSP  =  REAL EQUIVALENT OF NSP
C     I     =  LOOP COUNTER, INDEX
C     J     =  LOOP COUNTER, SUBSCRIPT
C     JJ    =  SUBSCRIPT
C     KK    =  SUBSCRIPT
C     NSM   =  FREQUENCY
C     NSP   =  NUMBER OF SIMULATION PASSES
C     SMV   =  SIMULATED VALUE
C     XOIL  =  MIDPOINT OF INTERVAL
C     YOIL  =  PROBABILITY
C
C**********************************************************************:
C
      DIMENSION SMV(101),NSM(100),XOIL(5,100),YOIL(5,100)
C
      ENSP=NSP
C
C          INITIALIZE ARRAYS
C
      DO 10 J=1,100
      XOIL(KK,J) = 0.0
      YOIL(KK,J) = 0.0
   10 CONTINUE
      JJ=0
      DO 40 J=1,100
      JJ=JJ+1
      YOIL(KK,JJ) = 1.0 - (NSM(J)/ENSP)
      XOIL(KK,JJ) = (SMV(J) + SMV(J+1)) / 2.
   40 CONTINUE
      DO 50 I=1,100
      IF(YOIL(KK,I).LE.0.95) GO TO 60
   50 CONTINUE
   60 C95=XOIL(KK,I-1)+((0.95-YOIL(KK,I))/(YOIL(KK,I-1)-YOIL(KK,I))*
     +(XOIL(KK,I)-XOIL(KK,I-1)))
      DO 70 I=1,100
      IF(YOIL(KK,I).LE.0.80) GO TO 80
   70 CONTINUE
   80 C80=XOIL(KK,I-1)+((0.80-YOIL(KK,I))/(YOIL(KK,I-1)-YOIL(KK,I))*
     +(XOIL(KK,I)-XOIL(KK,I-1)))
```

```
      DO 90 I=1,100
      IF(YOIL(KK,I).LE.0.20) GO TO 100
   90 CONTINUE
  100 C20=XOIL(KK,I-1)+((0.20-YOIL(KK,I))/(YOIL(KK,I-1)-YOIL(KK,I))*
     +(XOIL(KK,I)-XOIL(KK,I-1)))
      DO 110 I=1,100
      IF(YOIL(KK,I).LE.0.05) GO TO 120
  110 CONTINUE
  120 C5=XOIL(KK,I-1)+((0.05-YOIL(KK,I))/(YOIL(KK,I-1)-YOIL(KK,I))*
     +(XOIL(KK,I)-XOIL(KK,I-1)))
      RETURN
      END
```

```
      SUBROUTINE RASH(NSP,NS,ER,SOIL,NOIL,XOIL,YOIL)
C***********************************************************************
C
C          'RASH' RISKS AND SUMS THE INDIVIDUAL PROSPECTS.
C
C          VARIABLES
C          ---------
C
C     A     =  INDIVIDUAL SIMULATED VALUES
C     CI    =  CLASS INTERVAL
C     CI2   =  ONE-HALF CLASS INTERVAL
C     DUM   =  DUMMY VARIABLE
C     ER    =  EXISTENCE RISK
C     GTOT  =  GRAND TOTAL
C     I     =  LOOP COUNTER
C     J     =  LOOP COUNTER
C     K     =  LOOP COUNTER
C     M     =  SUBSCRIPT
C     MAX   =  MAXIMUM VALUE IN ARRAY
C     MIN   =  MINIMUM VALUE IN ARRAY
C     NOIL  =  CUMULATIVE FREQUENCY
C     NS    =  NUMBER OF INDIVIDUAL PROSPECTS
C     NSP   =  NUMBER OF SIMULATION PASSES
C     RN    =  RANDOM NUMBER
C     SOIL  =  VALUES
C     SUM   =  TOTAL VOLUME FROM EACH PASS
C     VO    =  VOLUME FROM EACH PROSPECT
C     XOIL  =  VALUE FROM DISTRIBUTION
C     YOIL  =  PROBABILITY FROM DISTRIBUTION
C
C          EXTERNAL
C          --------
C
C
C     RANF  = RANDOM NUMBER FUNCTION
C
C***********************************************************************
C
      DIMENSION ER(5),SOIL(101),NOIL(100)
      DIMENSION XOIL(5,100),YOIL(5,100),A(10000)
      REAL MAX,MIN
C
C          INITIALIZE ARRAYS
C
      DO 10 J=1,100
      SOIL(J)=0.0
      NOIL(J)=0
   10 CONTINUE
      SOIL(101)=0.0
C
C          DO SIMULATION
C
```

```
      DO 200 I=1,NSP
      SUM=0.0
      DO 100 J=1,NS
      RN=RANF(DUM)
      IF(RN.GT.ER(J)) GO TO 100
      RN = RANF(DUM)
      DO 110 K=2,101
      IF(RN.GE.YOIL(J,K)) GO TO 120
  110 CONTINUE
      GO TO 2000
  120 VO = XOIL(J,K-1) + ((YOIL(J,K-1)-RN)*(XOIL(J,K)-XOIL(J,K-1)))/
     +  (YOIL(J,K-1) - YOIL(J,K))
      SUM=SUM+VO
  100 CONTINUE
      IF(SUM.LE.0.0) GO TO 200
      GTOT=GTOT+SUM
      M=M+1
      A(M)=SUM
  200 CONTINUE
      MAX=0.0
      MIN=99999999.
      DO 300 I=1,M
      IF(A(I).GE.MAX) MAX=A(I)
      IF(A(I).LE.MIN) MIN=A(I)
  300 CONTINUE
      CI=(MAX-MIN)/99.
      CI2=CI/2.
      SOIL(1)=MIN-CI2
      DO 400 I=2,101
      SOIL(I)=SOIL(I-1)+CI
  400 CONTINUE
      DO 500 I=1,M
      DO 500 J=2,101
      IF(A(I).LE.SOIL(J)) NOIL(J-1)=NOIL(J-1)+1
  500 CONTINUE
      GO TO 1000
 2000 WRITE 2100
 2100 FORMAT(1X,*ERROR IN SUBROUTINE RASH*)
      STOP
 1000 RETURN
      END
```

```
      SUBROUTINE STAT(NSP,SVAL,N,MEAN,MD,MODE,VAR,STD)
C**********************************************************************
C
C          'STAT' CALCULATES THE MEAN, MEDIAN, MODE,
C          VARIANCE AND STANDARD DEVIATION
C          OF THE CUMULATIVE FREQUENCY DISTRIBUTIONS GENERATED
C          IN THE SIMULATION PHASE.
C
C          VARIABLES
C          ---------
C
C     DEV    = DEVIATION FROM MEAN OF EACH INTERVAL
C     EM     = TEMPORARY HOLDER OF REAL EQUIVALENT OF N
C     EN     = TEMPORARY HOLDER OF REAL EQUIVALENT OF N
C     ENSP   = REAL EQUIVALENT OF NSP
C     ENSP2  = REAL EQUIVALENT OF NSP2
C     I      = LOOP COUNTER AND SUBSCRIPT
C     IND    = INDICATOR OF THE SIGNIFICANCE OF THE FIRST INTERVAL
C              IN ARRAY 'SVAL'
C     J      = LOOP COUNTER AND SUBSCRIPT
C     M      = INCREMENTAL VALUE OF 'N' IN CALCULATION OF MODE
C     MD     = MEDIAN
C     MEAN   = MEAN
C     MODE   = MODE
C     MUN    = INCREMENTAL VALUE OF 'N' IN CALCULATION OF MODE
C     N      = ARRAY CONTAINING CUMULATIVE FREQUENCIES ASSOCIATED
C              WITH ARRAY 'SVAL'
C     NSP    = NUMBER OF SIMULATION PASSES
C     NSP2   = HALF THE NUMBER OF SIMULATION PASSES
C     PROP   = PROPORTIONAL PART IN CALCULATION OF MEDIAN
C     STD    = STANDARD DEVIATION
C     SUM    = SUM OF THE GROUPED DATA
C     SVAL   = ARRAY CONTAINING VALUES ASSOCIATED WITH CUMULATIVE
C              FREQUENCIES IN ARRAY 'N'
C     VAR    = VARIANCE
C
C          EXTERNAL
C          --------
C
C     SQRT = SQUARE ROOT FUNCTION
C
C**********************************************************************
C
      DIMENSION SVAL(101),N(100)
      REAL MEAN,MD,MODE
C
C          INITIALIZE VARIABLES.
C
      IND=0
      SUM=0.
      MEAN=0.
```

```
      DEV=0.
      VAR=0.
      STD=0.
      MD=0.
      MODE=0.
      ENSP=NSP
C
C          CALCULATE THE MEAN
C
      SUM=SUM+(((SVAL(2)+SVAL(1))/2.)*N(1))
      DO 50 J=2,100
      SUM = SUM + (((SVAL(J+1) + SVAL(J)) / 2.) * (N(J) - N(J-1)))
   50 CONTINUE
      MEAN = SUM / ENSP
C
C          CALCULATE THE VARIANCE AND STANDARD DEVIATION
C
      DEV=((((SVAL(1)+SVAL(2))/2.)-MEAN)**2)*N(1)
      VAR=VAR+DEV
      DO 60 J=2,100
      DEV=((((SVAL(J)+SVAL(J+1))/2.)-MEAN)**2)*(N(J)-N(J-1))
      VAR=VAR+DEV
   60 CONTINUE
      VAR=VAR/ENSP
      STD=SQRT(VAR)
C
C          CALCULATE THE MEDIAN
C
      NSP2=NSP/2
      ENSP2=NSP2
      DO 70 J=1,100
      IF(N(J).LT.NSP2) GO TO 70
      EN=N(J)
      EM=N(J-1)
      PROP = (ENSP2-EM)/(EN-EM)
      MD = SVAL(J) + (PROP * (SVAL(J+1) - SVAL(J)))
      GO TO 80
   70 CONTINUE
C
C          CALCULATE THE MODE
C
      IND=1
   80 MUN = N(1)
      DO 90 I=1,100
      M=N(I+1) - N(I)
      IF(MUN.GT.M) GO TO 90
      MUN = M
      IND=I+1
   90 CONTINUE
      MODE=(SVAL(IND+1) + SVAL(IND))/2.
  100 RETURN
```

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END

```
      SUBROUTINE TEMP(L,UNIT,T)
C*****************************************************************************
C
C            'TEMP' CONVERTS TEMPERATURE IN DEGREES CELSIUS OR
C            DEGREES FAHRENHEIT TO DEGREES RANKINE
C
C            VARIABLES
C            ---------
C
C       I      = LOOP COUNTER AND SUBSCRIPT
C       L      = NUMBER OF DATA VALUES
C       T      = TEMPERATURE
C       UNIT   = UNIT OF TEMPERATURE
C
C*****************************************************************************
C
      DIMENSION T(10)
      IF(UNIT.NE.1HC) GO TO 10
C
C            TEMPERATURE HAS BEEN INPUT AS DEGREES CELSIUS
C            DEGREES RANKINE = 1.8 * DEGREES CELSIUS +32 + 459.69
C
      DO 5 I=1,L
      T(I) = 1.8 * T(I) + 491.69
    5 CONTINUE
      GO TO 300
   10 IF(UNIT.NE.1HF) GO TO 20
C
C            TEMPERATURE HAS BEEN INPUT AS DEGREES FAHRENHEIT
C            DEGREES RANKINE = DEGREES FAHRENHEIT + 459.69
C
      DO 15 I=1,L
      T(I) = T(I) + 459.69
   15 CONTINUE
      GO TO 300
   20 IF(UNIT.NE.1HR) GO TO 200
C
C            TEMPERATURE HAS BEEN INPUT AS DEGREES RANKINE
C
      GO TO 300
  200 WRITE 201
  201 FORMAT(1H1,///,*   YOU HAVE NOT INDICATED THE TEMPERATURE UNIT*)
      STOP
  300 RETURN
      END
```

```
      SUBROUTINE TYPER(TYPE,L,VAL,RELF)
C***********************************************************************
C
C           'TYPER' FINDS OUT WHAT KIND OF DISTRIBUTION IS BEING
C           HANDLED AND WRITES ITS DESCRIPTION
C
C           VARIABLES
C           ---------
C
C     I       =  SUBSCRIPT
C     L       =  NUMBER OF VALUES IN ARRAY
C     RELF    =  PROBABILITY
C     TYPE    =  TYPE OF DISTRIBUTION
C     VAL     =  VALUE
C
C***********************************************************************
      DIMENSION VAL(L),RELF(L)
      INTEGER TYPE
      IF(TYPE.EQ.1HK) GO TO 10
      IF(TYPE.EQ.1HU) GO TO 20
      IF(TYPE.EQ.1HT) GO TO 30
      IF(TYPE.EQ.1HC) GO TO 40
      IF(TYPE.EQ.1HN) GO TO 50
      IF(TYPE.EQ.1HL) GO TO 60
   10 WRITE 110
  110 FORMAT(1X,*CONSTANT*)
      GO TO 1000
   20 WRITE 120
  120 FORMAT(1X,*UNIFORM DISTRIBUTION*)
      GO TO 1000
   30 WRITE 130
  130 FORMAT(1X,*TRIANGULAR DISTRIBUTION*)
      GO TO 1000
   40 WRITE 140,(RELF(I),I=1,L)
  140 FORMAT(1X,*CUMULATIVE DISTRIBUTION *,10F10.3)
      GO TO 1000
   50 WRITE 150
  150 FORMAT(1X,*NORMAL DISTRIBUTION*)
      GO TO 1000
   60 WRITE 160
  160 FORMAT(1X,*LOGNORMAL DISTRIBUTION*)
 1000 RETURN
      END
```

```
      SUBROUTINE VET(TYPE,L,VAL,RELF)
C************************************************************************
C
C          'VET' VALIDATES THE INPUT DATA.
C
C          VARIABLES
C          ---------
C
C     I     = LOOP COUNTER AND SUBSCRIPT
C     L     = NUMBER OF VALUES IN EACH DISTRIBUTION
C     RELF  = RELATIVE FREQUENCY
C     TOTL  = TOTAL FREQUENCY, TOTAL RELATIVE FREQUENCY OR
C               TOTAL OF VALUES -- IN VARIOUS TESTS
C     TYPE  = TYPE OF DISTRIBUTION
C     VAL   = PARAMETER VALUES
C
C          EXTERNAL
C          --------
C
C    ORDER = SUBROUTINE 'ORDER' SORTS DISTRIBUTIONS INTO INCREASING
C              NUMERICAL ORDER
C
C************************************************************************
C
      DIMENSION VAL(12),RELF(12)
C
C          TEST TO SEE IF 'L' HAS BEEN GIVEN FOR DISTRIBUTIONS
C          WITH DISCRETE DATA.
C
      IF(TYPE.EQ.1HN.OR.TYPE.EQ.1HL) GO TO 300
      IF(TYPE.EQ.1HK) GO TO 80
      IF(TYPE.EQ.1HU) GO TO 85
      IF(TYPE.EQ.1HT) GO TO 90
      IF(L.EQ.0) GO TO 100
      GO TO 1
   80 L=1
      GO TO 5
   85 L=2
      GO TO 5
   90 L=3
      GO TO 5
C
C          CHECK TO SEE IF THE NUMBER OF VALUES GIVEN EXCEEDS
C          THE MAXIMUM ARRAY SIZE
C
    1 IF(L.GT.10) GO TO 101
    5 TOTL=0.
C
C          CHECK TO SEE THAT WE DO NOT HAVE ALL ZERO VALUES FOR
C          THE FACTOR AND THAT NONE OF THE RELATIVE FREQUENCIES
C          ARE NEGATIVE
```

```
C
      DO 10 I=1,L
      TOTL=TOTL+VAL(I)
      IF(RELF(I).LT.0.) GO TO 102
   10 CONTINUE
      IF(TOTL.LE.0.) GO TO 103
      IF(L.EQ.1) GO TO 300
      TOTL=0.
      DO 30 I=1,L
      TOTL = TOTL + RELF(I)
   30 CONTINUE
      IF(TOTL.LE.0.) GO TO 104
C
C           REARRANGE FACTOR VALUES INTO ASCENDING ORDER IF NECESSARY
C           AND REPOSITION THEIR ASSOCIATED RELATIVE FREQUENCIES
C
   20 CALL ORDER(L,VAL,RELF)
      IF(TYPE.EQ.1HC) GO TO 60
      GO TO 300
   60 IF(RELF(1).GT.0.0) GO TO 105
      IF(RELF(L).NE.1.0) GO TO 106
      DO 70 I=2,L
      IF(RELF(I-1).GE.RELF(I)) GO TO 107
   70 CONTINUE
      GO TO 300
  100 WRITE 110
  110 FORMAT(5X,*YOU HAVE NOT PUT IN A COUNTER FOR THE NUMBER OF
     + DATA VALUES AND RELATIVE FREQUENCIES.*)
      GO TO 200
  101 WRITE 111
  111 FORMAT(5X,*YOU HAVE EXCEEDED THE ALLOWABLE NUMBER OF POINT
     +S TO DESCRIBE THE DISTRIBUTION.*)
      GO TO 200
  102 WRITE 112,I
  112 FORMAT(5X,*RELATIVE FREQUENCY VALUE*,2X,I2,2X,*IS NEGATIVE.*)
      GO TO 200
  103 WRITE 113
  113 FORMAT(5X,*ALL DATA VALUES FOR THIS FACTOR ARE ZERO.  COMPUTATION IS
     + IMPOSSIBLE.*)
      GO TO 200
  104 IF(TYPE.EQ.1HU.OR.TYPE.EQ.1HT) GO TO 20
      IF(L.EQ.2) GO TO 400
      IF(L.EQ.3) GO TO 410
      WRITE 114
      GO TO 200
  400 TYPE = 1HU
      GO TO 20
  410 TYPE = 1HT
      GO TO 20
  114 FORMAT(5X,*THE PROGRAM REQUIRES THAT DISTRIBUTIONS CONTAINING FOUR
     + OR MORE VALUES HAVE ABSOLUTE OR RELATIVE*,/,5X,*FREQUENCIES ASSOC
```

```
     +IATED WITH AT LEAST TWO OF THE VALUES.*)
  105 WRITE 115
  115 FORMAT(5X,*YOUR CUMULATIVE PROBABILITY DISTRIBUTION DOES NOT START
     + WITH A CUMULATIVE PROBABILITY OF ZERO.*)
      GO TO 200
  106 WRITE 116
  116 FORMAT(5X,*YOUR CUMULATIVE PROBABILITY DISTRIBUTION DOES NOT END
     +WITH A CUMULATIVE PROBABILITY OF ONE.*)
      GO TO 200
  107 WRITE 117
  117 FORMAT(5X,*TWO CUMULATIVE PROBABILITIES HAVE THE SAME VALUE, OR TH
     +E CUMULATIVE PROBABILITY IS DECREASING.*)
  200 STOP
  300 RETURN
      END
```

```
      SUBROUTINE WRITER(KK,TITLE,C,CD,CR,OER,MODE,MOA,MIN,MAX,
     +C95,C80,C20,C5,MD,MDA,RES)
C***************************************************************************
C
C          'WRITER' WRITES THE SUMMARY REPORTS ON THE PROSPECT'S
C           POTENTIAL
C
C          VARIABLES
C          ---------
C
C     AU    =  TEXT -- UNITS OF RESOURCE VOLUME
C     C     =  DATA COMPILED BY
C     CD    =  COMPILATION DATE
C     CR    =  DATE OF COMPUTER RUN
C     C5    =  FIFTH CENTILE VALUE
C     C5A   =  FIFTH CENTILE VALUE IN AMERICAN UNITS
C     C20   =  TWENTIETH CENTILE VALUE
C     C20A  =  TWENTIETH CENTILE VALUE IN AMERICAN UNITS
C     C80   =  EIGHTIETH CENTILE VALUE
C     C80A  =  EIGHTIETH CENTILE VALUE IN AMERICAN UNITS
C     C95   =  NINETY-FIFTH CENTILE VALUE
C     C95A  =  NINETY-FIFTH CENTILE VALUE IN AMERICAN UNITS
C     I     =  LOCAL SUBSCRIPT
C     K     =  LOCAL SUBSCRIPT
C     KK    =  DATA SET INDEX
C     LHOOD =  TEXT -- INTERPRETATION OF LIKELIHOOD
C     MAX   =  MAXIMUM RESOURCE VOLUME
C     MAXA   =  MAXIMUM RESOURCE VOLUME IN AMERICAN UNITS
C     MD    =  MEDIAN
C     MDA   =  MEDIAN IN AMERICAN UNITS
C     MIN   =  MINIMUM RESOURCE VOLUME
C     MINA   =  MINIMUM RESOURCE VOLUME IN AMERICAN UNITS
C     MOA   =  MODE IN AMERICAN UNITS
C     MODE  =  MODE
C     OER   =  EXISTENCE RISK (PROBABILITY)
C     PER   =  EXISTENCE RISK (PERCENT PROBABILITY)
C     RES   =  TEXT -- NAME OF RESOURCE
C     TITLE =  TITLE
C
C          EXTERNAL
C          --------
C
C     DATE  =  DATE FUNCTION
C
C**************************************************************************
      DIMENSION TITLE(5,8),C(8),CD(8),OER(5),AU(2),LHOOD(2)
      INTEGER AU
      REAL MIN,MAX,MINA,MAXA
C
C          CONVERT EXISTENCE RISK TO PERCENT PROBABILITY
C
```

```
      PER=OER(KK)*100.
C
C          INTERPRET THE EXISTENCE RISK
C
      IF(PER.LT.5.0) GO TO 30
      IF(PER.LT.20.0) GO TO 35
      IF(PER.LT.50.0) GO TO 40
      IF(PER.LT.80.0) GO TO 45
      IF(PER.LT.95.0) GO TO 50
      LHOOD(1)=10H AN EXTREM
      LHOOD(2)=10HELY HIGH [
      GO TO 5
   30 LHOOD(1)=10H AN EXTREM
      LHOOD(2)=9HELY LOW [
      GO TO 5
   35 LHOOD(1)=10H A VERY LO
      LHOOD(2)=3HW [
      GO TO 5
   40 LHOOD(1)=10H A MODERAT
      LHOOD(2)=9HELY LOW [
      GO TO 5
   45 LHOOD(1)=10H A MODERAT
      LHOOD(2)=10HELY HIGH [
      GO TO 5
   50 LHOOD(1)=10H A VERY HI
      LHOOD(2)=4HGH [
C
C          TEST TO SEE WHETHER IT IS GAS OR OIL
C
    5 IF(RES.EQ.3HOIL) GO TO 10
C
C          CALCULATE AMERICAN UNIT EQUIVALENTS FOR GAS
C
      C95A=C95*0.0353147
      C80A=C80*0.0353147
      C20A=C20*0.0353147
      C5A =C5 *0.0353147
      MINA=MIN*0.0353147
      MAXA=MAX*0.0353147
      AU(1)=10HBILLION CU
      AU(2)=8HBIC FEET
      GO TO 20
C
C          CALCULATE AMERICAN UNIT EQUIVALENTS FOR OIL
C
   10 AU(1)=10HMILLION BA
      AU(2)=5HRRELS
      C95A=C95*6.2898106
      C80A=C80*6.2898106
      C20A=C20*6.2898106
      C5A =C5 *6.2898106
```

```
      MINA=MIN*6.2898106
      MAXA=MAX*6.2898106
C
C          WRITE THE REPORT
C
   20 WRITE 2005
 2005 FORMAT(1H1)
      WRITE 2015
 2015 FORMAT(19X,43H* * * * * C O N F I D E N T I A L * * * * *,//)
      WRITE 2010,RES
 2010 FORMAT(31X,*PROSPECT POTENTIAL*,/,31X,18(*-*),//,29X,*SUMMARY REPO
     +RT FOR *,A3,/,29X,22(*-*),//)
      WRITE 2020,(TITLE(KK,K),K=1,8)
 2020 FORMAT(5X,*PROSPECT TITLE:*,9X,8A10,/,5X,14(*-*))
      WRITE 2030,(C(I),I=1,8)
 2030 FORMAT(5X,*DATA COMPILED BY:*,7X,8A10)
      WRITE 2031
 2031 FORMAT(5X,16(*-*))
      CALL DATE(CR)
      WRITE 2040,(CD(I),I=1,8)
 2040 FORMAT(5X,*COMPILATION DATE:*,7X,8A10,/,5X,16(*-*))
      WRITE 2045,CR
 2045 FORMAT(5X,*DATE OF COMPUTER RUN:  *,A10,/,5X,20(*-*),//)
      WRITE 2050,LHOOD(1),LHOOD(2),PER,RES
 2050 FORMAT(5X,*CONCLUSIONS*,/,5X,11(*-*),//,5X,*THERE IS*,2A10,F6.2,
     +*%] PROBABILITY THAT THE STRUCTURE*,/,5X,*CONTAINS *,A3,*.*,/)
      WRITE 2055,RES,MODE,MOA,AU(1),AU(2)
 2055 FORMAT(5X,*IF *,A3,* OCCURS, THE MOST LIKELY RECOVERABLE VOLUME IS
     + ESTIMATED TO BE*,/,5X,F16.3,* MILLION CUBIC METRES*,/,4X,* [*,F15
     +.3,* *,2A10,*].*,//)
      WRITE 2060,RE^,MIN,MINA,AU(1),AU(2),MAX,MAXA,AU(1),AU(2)
 2060 FORMAT(5X,*THE ESTIMATED POTENTIAL RECOVERABLE *,A3,* RESOURCES OF
     + THE STRUCTURE*,/,5X,*RANGE FROM A MINIMUM OF*,F15.3,* MILLION CUB
     +IC METRES*,/,27X,*[*,F15.3,* *,2A10,*]*,//,4X,* TO A MAXIMUM OF*,8
     +X,F15.3,* MILLION CUBIC METRES*,/,27X,*[*,F15.3,* *,2A10,*].*,//)
      WRITE 2070,AU(1),AU(2)
 2070 FORMAT(7X,*PERCENT*,/,5X,*PROBABILITY*,/,5X,*GREATER THAN*,9X,*MIL
     +LION CUBIC METRES*,10X,2A10,
     +/,5X,12(*-*),9X,20(*-*),8X,20(*-*),/)
      WRITE 2075,MIN,MINA
 2075 FORMAT(8X,*100%*,18X,F15.3,11X,F15.3)
      WRITE 2080,C95,C95A
 2080 FORMAT(9X,*95%*,18X,F15.3,11X,F15.3)
      WRITE 2090,C80,C80A
 2090 FORMAT(9X,*80%*,18X,F15.3,11X,F15.3)
      WRITE 2100,MD,MDA
 2100 FORMAT(9X,*50%*,18X,F15.3,11X,F15.3)
      WRITE 2110,C20,C20A
 2110 FORMAT(9X,*20%*,18X,F15.3,11X,F15.3)
      WRITE 2120,C5,C5A
 2120 FORMAT(9X,* 5%*,18X,F15.3,11X,F15.3)
```

```
      WRITE 2130,MAX,MAXA
 2130 FORMAT(10X,%0%%,18X,F15.3,11X,F15.3,////)
      WRITE 2015
      RETURN
      END
```

APPENDIX 2

```
NO
 2
NO
EXAMPLE NO. 1 -- PRIMARY OBJECTIVE
EUGENE L. SMITH
SEPTEMBER 1981
STRUCTURAL/STRATIGRAPHIC
-2350, -2400, -2450
20, 50, 98
2550
OFFSHORE
880
T 3       1200.0                30000.0               58800.0
T 3       0.20                  0.25                  0.30
T 3       0.5                   0.8                   0.9
  4       0.10       3.0        0.15       2.0        0.2       3.0       0.25
 2.0
T 3       0.10                  0.25                  0.40
T 3       0.2                   0.35                  0.4
T 3       0.5                   0.6                   0.75
K 1R      615.0
K 1       3750.0
K 1       0.95
T 3       1.2                   1.5                   2.2
0.8       0.8        0.75       0.7        0.9        1.0       0.2       0.8
EXAMPLE NO. 1 -- SECONDARY OBJECTIVE
EUGENE L. SMITH
SEPTEMBER 1981
STRUCTURAL/STRATIGRAPHIC
-2350, -2400, -2450 APPROXIMATE SIZE OF CLOSURES.  NO MAPPED HORIZONS.
20, 50, 98
4000
OFFSHORE
880
T 3       2500.0                7000.0                14000.0
T 3       0.20                  0.25                  0.3
T 3       0.5                   0.8                   0.9
T 3       0.15                  0.20                  0.3
T 3       0.10                  0.25                  0.40
T 3       0.2                   0.35                  0.4
T 3       0.50                  0.6                   0.75
K 1R      670.0
K 1       6000.0
K 1       0.95
T 3       1.2                   1.5                   2.2
0.8       0.8        0.8        0.6        0.9        1.0       0.2       0.8
```

APPENDIX 3

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE:	FIRST EXAMPLE -- PRIMARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81
TRAP:	STRUCTURAL/STRATIGRAPHIC
CONTOURS USED:	-2350, -2400, -2450
AREA (SQUARE KILOMETRES):	20, 50, 98
DEPTH (METRES):	2550
LOCATION:	OFFSHORE
WATER DEPTH (METRES):	880

RESERVOIR PARAMETERS

TRAP VOLUME TRIANGULAR DISTRIBUTION	12000.000	30000.000	58800.000	
FRACTION NET PAY TRIANGULAR DISTRIBUTION	.200	.250	.300	
FRACTION TRAP FILL TRIANGULAR DISTRIBUTION	.500	.800	.900	
POROSITY FREQUENCY DISTRIBUTION	.100 3.000	.150 2.000	.200 3.000	.250 2.000
WATER SATURATION TRIANGULAR DISTRIBUTION	.100	.250	.400	
OIL RECOVERY FACTOR TRIANGULAR DISTRIBUTION	.200	.350	.400	
GAS RECOVERY FACTOR TRIANGULAR DISTRIBUTION	.500	.600	.750	
TEMPERATURE IN DEGREES R CONSTANT	615.000			
PRESSURE (P.S.I.G.) CONSTANT	3750.000			
GAS DEVIATION FACTOR CONSTANT	.950			
FORMATION VOLUME FACTOR TRIANGULAR DISTRIBUTION	1.200	1.500	2.200	

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE:	FIRST EXAMPLE -- PRIMARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81

EXISTENCE RISK FACTORS

PROBABILITY THAT SOURCE ROCKS ARE PRESENT	.800
PROBABILITY THAT THERMAL HISTORY WAS ADEQUATE	.800
PROBABILITY THAT RESERVOIR FACIES ARE PRESENT	.750
PROBABILITY THAT STRUCTURE & SEAL ARE PRESENT	.700
PROBABILITY THAT TIMING WAS ADEQUATE	.900
PROBABILITY THAT PRESERVATION WAS ADEQUATE	1.000
CHANCE OF HYDROCARBON OCCURRENCE	.302

RELATIVE LIKELIHOOD OF OIL OCCURRING	.200	OIL EXISTENCE RISK=	.060
RELATIVE LIKELIHOOD OF GAS OCCURRING	.800	GAS EXISTENCE RISK=	.242

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- PRIMARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

CUMULATIVE PROBABILITY DISTRIBUTIONS FOR BASE DATA

TRAP VOLUME	12000.000	14340.000	16680.000	19020.000	21360.000	23700.000	26040.000	28380.000	30000.000	30720.000	33060.000	35400.000
	37740.000	40080.000	42420.000	44760.000	47100.000	49440.000	51780.000	54120.000	56460.000	58800.000		
CUM. PROB.	0.000	.007	.026	.059	.104	.163	.234	.319	.385	.415	.508	.594
	.671	.740	.801	.854	.898	.935	.963	.984	.996	1.000		
FRAC NETPAY	.200	.205	.210	.215	.220	.225	.230	.235	.240	.245	.250	.255
	.260	.265	.270	.275	.280	.285	.290	.295	.300			
CUM. PROB.	0.000	.005	.020	.045	.080	.125	.180	.245	.320	.405	.500	.595
	.680	.755	.820	.875	.920	.955	.980	.995	1.000			
F.TRAP FILL	.500	.520	.540	.560	.580	.600	.620	.640	.660	.680	.700	.720
	.740	.760	.780	.800	.820	.840	.860	.880	.900			
CUM. PROB.	0.000	.003	.013	.030	.053	.083	.120	.163	.213	.270	.333	.403
	.480	.563	.653	.750	.840	.910	.960	.990	1.000			
POROSITY	.075	.125	.175	.225	.275							
CUM. PROB.	0.000	.346	.500	.846	1.000							
WATER SAT'N	.100	.115	.130	.145	.160	.175	.190	.205	.220	.235	.250	.265
	.280	.295	.310	.325	.340	.355	.370	.385	.400			
CUM. PROB.	0.000	.005	.020	.045	.080	.125	.180	.245	.320	.405	.500	.595
	.680	.755	.820	.875	.920	.955	.980	.995	1.000			
OIL REC FAC	.200	.210	.220	.230	.240	.250	.260	.270	.280	.290	.300	.310
	.320	.330	.340	.350	.360	.370	.380	.390	.400			
CUM. PROB.	0.000	.003	.013	.030	.053	.083	.120	.163	.213	.270	.333	.403
	.480	.563	.653	.750	.840	.910	.960	.990	1.000			
GAS REC FAC	.500	.513	.525	.538	.550	.563	.575	.588	.600	.613	.625	.638
	.650	.662	.675	.687	.700	.712	.725	.737	.750			
CUM. PROB.	0.000	.006	.025	.056	.100	.156	.225	.306	.400	.496	.583	.662
	.733	.796	.850	.896	.933	.962	.983	.996	1.000			
TEMPERATURE	615.000											
CUM. PROB.	1.000											
PRESSURE	3750.000											
CUM. PROB.	1.000											
GAS DEV FAC	.950											
CUM. PROB.	1.000											
FM VOL FAC	1.200	1.250	1.300	1.350	1.400	1.450	1.500	1.550	1.600	1.650	1.700	1.750
	1.800	1.850	1.900	1.950	2.000	2.050	2.100	2.150	2.200			
CUM. PROB.	0.000	.008	.033	.075	.133	.208	.300	.396	.486	.568	.643	.711
	.771	.825	.871	.911	.943	.968	.986	.996	1.000			

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- PRIMARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

10.880	1	275.998	4599
16.182	3	281.300	4628
21.485	11	286.602	4653
26.787	29	291.905	4680
32.089	63	297.207	4708
37.392	115	302.509	4723
42.694	184	307.812	4752
47.997	261	313.114	4772
53.299	374	318.416	4796
58.601	505	323.719	4823
63.904	635	329.021	4835
69.206	784	334.323	4852
74.508	928	339.626	4865
79.811	1106	344.928	4880
85.113	1257	350.231	4890
90.415	1415	355.533	4898
95.718	1572	360.835	4907
101.020	1742	366.138	4912
106.322	1891	371.440	4923
111.625	2042	376.742	4927
116.927	2196	382.045	4934
122.229	2332	387.347	4939
127.532	2476	392.649	4941
132.834	2615	397.952	4946
138.136	2725	403.254	4950
143.439	2844	408.556	4956
148.741	2941	413.859	4959
154.044	3059	419.161	4963
159.346	3185	424.463	4969
164.648	3282	429.766	4972
169.951	3383	435.068	4974
175.253	3490	440.370	4978
180.555	3570	445.673	4979
185.858	3648	450.975	4985
191.160	3725	456.278	4987
196.462	3817	461.580	4988
201.765	3916	466.882	4990
207.067	3994	472.185	4992
212.369	4058	477.487	4994
217.672	4119	482.789	4994
222.974	4179	488.092	4997
228.276	4235	493.394	4997
233.579	4280	498.696	4997
238.881	4319	503.999	4997
244.183	4368	509.301	4997
249.486	4416	514.603	4997
254.788	4448	519.906	4998
260.091	4485	525.208	4998
265.393	4527	530.510	4998
270.695	4564	535.813	5000

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- PRIMARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

STATISTICS DESCRIBING THE DISTRIBUTION GENERATED BY SIMULATION.

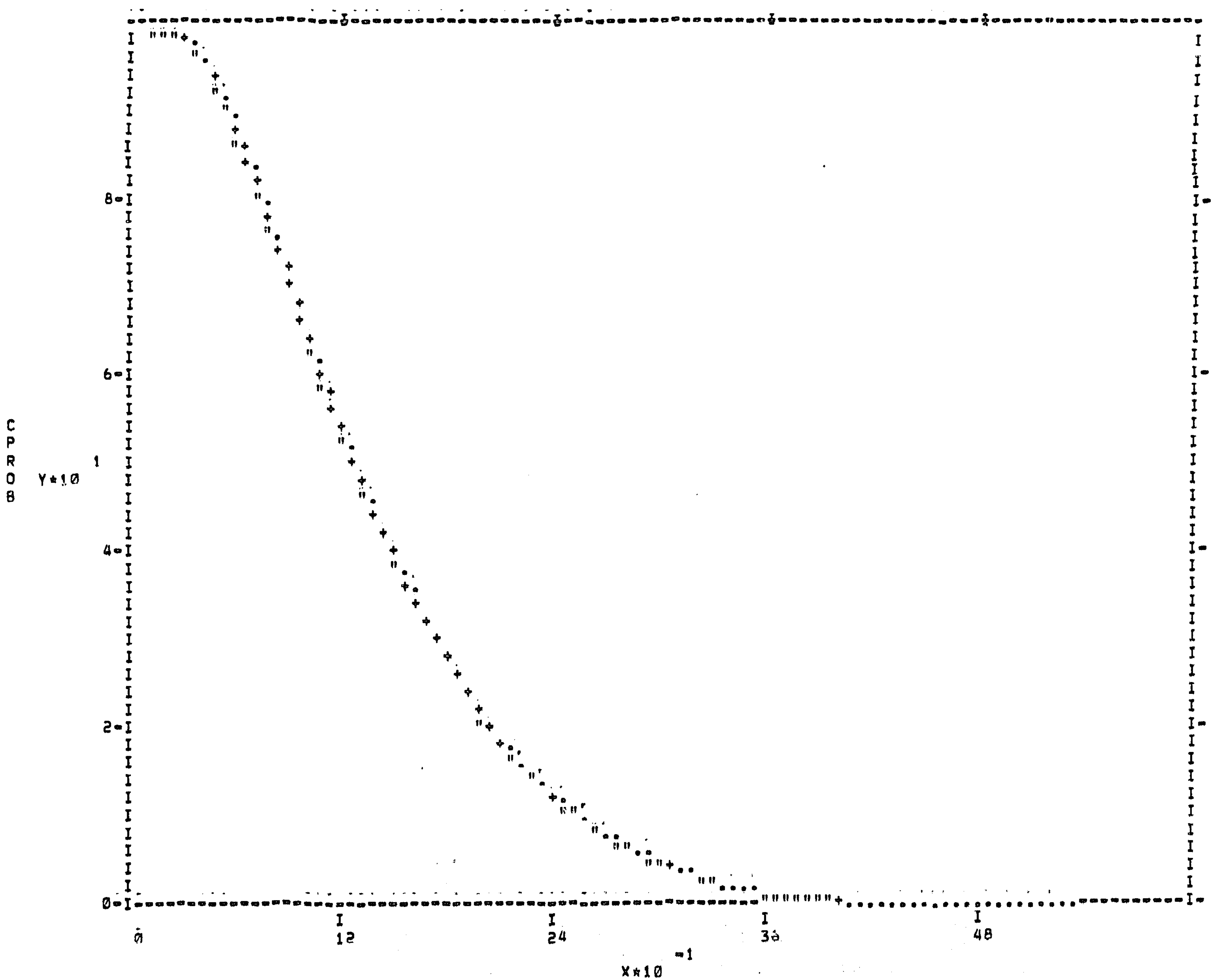
	MILLION CUBIC METRES OF OIL	MILLION BARRELS OF OIL		
MEAN VALUE =	151.919	955.544	STANDARD DEVIATION =	81.69432
MEDIAN VALUE =	133.750	841.260	VARIANCE =	6673.96256
MODAL VALUE =	82.462	518.669		

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE:	FIRST EXAMPLE -- PRIMARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81

13.531	1.000	278.649	.080
18.834	.999	283.951	.074
24.136	.998	289.253	.069
29.438	.994	294.556	.064
34.741	.987	299.858	.058
40.043	.977	305.161	.055
45.345	.963	310.463	.050
50.648	.948	315.765	.046
55.950	.925	321.068	.041
61.252	.899	326.370	.035
66.555	.873	331.672	.033
71.857	.843	336.975	.030
77.159	.814	342.277	.027
82.462	.779	347.579	.024
87.764	.749	352.882	.022
93.067	.717	358.184	.020
98.369	.686	363.486	.019
103.671	.652	368.789	.018
108.974	.622	374.091	.015
114.276	.592	379.393	.015
119.578	.561	384.696	.013
124.881	.534	389.998	.012
130.183	.505	395.300	.012
135.485	.477	400.603	.011
140.788	.455	405.905	.010
146.090	.431	411.208	.009
151.392	.412	416.510	.008
156.695	.388	421.812	.007
161.997	.363	427.115	.006
167.299	.344	432.417	.006
172.602	.323	437.719	.005
177.904	.302	443.022	.004
183.206	.286	448.324	.004
188.509	.270	453.626	.003
193.811	.255	458.929	.003
199.114	.237	464.231	.002
204.416	.217	469.533	.002
209.718	.201	474.836	.002
215.021	.188	480.138	.001
220.323	.176	485.440	.001
225.625	.164	490.743	.001
230.928	.153	496.045	.001
236.230	.144	501.347	.001
241.532	.136	506.650	.001
246.835	.126	511.952	.001
252.137	.117	517.255	.001
257.439	.110	522.557	.000
262.742	.103	527.859	.000
268.044	.095	533.162	.000
273.346	.087	538.464	0.000

UNRISKED OIL



* * * * * C O N F I D E N T I A L * * * * *

PROSPECT POTENTIAL

SUMMARY REPORT FOR OIL

PROSPECT TITLE: FIRST EXAMPLE -- PRIMARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

CONCLUSIONS

THERE IS A VERY LOW [6.05%] PROBABILITY THAT THE STRUCTURE CONTAINS OIL.

IF OIL OCCURS, THE MOST LIKELY RECOVERABLE VOLUME IS ESTIMATED TO BE
82.462 MILLION CUBIC METRES
[518.669 MILLION BARRELS].

THE ESTIMATED POTENTIAL RECOVERABLE OIL RESOURCES OF THE STRUCTURE
RANGE FROM A MINIMUM OF 13.531 MILLION CUBIC METRES
[85.109 MILLION BARRELS]

TO A MAXIMUM OF 538.464 MILLION CUBIC METRES
[3386.836 MILLION BARRELS].

PERCENT PROBABILITY GREATER THAN	MILLION CUBIC METRES	MILLION BARRELS
100%	13.531	85.109
95%	46.103	289.978
80%	80.317	505.179
50%	133.750	841.260
20%	214.523	1349.312
5%	305.526	1921.702
0%	538.464	3386.836

* * * * * C O N F I D E N T I A L * * * * *

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- PRIMARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

16114.274	3	194802.251	4662
19688.034	10	198376.010	4698
23261.793	37	201949.770	4726
26835.553	80	205523.529	4751
30409.312	131	209097.289	4778
33983.072	190	212671.048	4801
37556.831	275	216244.808	4818
41130.591	389	219818.568	4836
44704.350	507	223392.327	4850
48278.110	649	226966.087	4866
51851.869	795	230539.846	4877
55425.629	930	234113.606	4891
58999.389	1080	237687.365	4900
62573.148	1229	241261.125	4909
66146.908	1388	244834.884	4919
69720.667	1550	248408.644	4933
73294.427	1709	251982.403	4941
76868.186	1866	255556.163	4947
80441.946	2003	259129.922	4954
84015.705	2147	262703.682	4962
87589.465	2278	266277.441	4965
91163.224	2413	269851.201	4970
94736.984	2556	273424.961	4970
98310.743	2696	276998.720	4976
101884.503	2800	280572.480	4980
105458.262	2931	284146.239	4983
109032.022	3049	287719.999	4984
112605.782	3166	291293.758	4987
116179.541	3264	294867.518	4988
119753.301	3379	298441.277	4988
123327.060	3488	302015.037	4989
126900.820	3584	305588.796	4990
130474.579	3685	309162.556	4991
134048.339	3771	312736.315	4991
137622.098	3852	316310.075	4992
141195.858	3918	319883.834	4993
144769.617	3991	323457.594	4993
148343.377	4063	327031.354	4994
151917.136	4131	330605.113	4995
155490.896	4188	334178.873	4996
159064.655	4251	337752.632	4997
162638.415	4297	341326.392	4997
166212.175	4354	344900.151	4997
169785.934	4407	348473.911	4999
173359.694	4455	352047.670	4999
176933.453	4497	355621.430	4999
180507.213	4526	359195.189	4999
184080.972	4565	362768.949	4999
187654.732	4597	366342.708	4999
191228.491	4629	369916.468	5000

★ ★ ★ ★ ★ C O N F I D E N T I A L ★ ★ ★ ★ ★

PROSPECT TITLE: FIRST EXAMPLE -- PRIMARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

STATISTICS DESCRIBING THE DISTRIBUTION GENERATED BY SIMULATION.

	MILLION CUBIC METRES OF GAS	BILLION CUBIC FEET OF GAS		
MEAN VALUE =	106910.638	3775.517	STANDARD DEVIATION =	52934.12750
MEDIAN VALUE =	96911.229	3422.391	VARIANCE =	2802021854.71381
MODAL VALUE =	186745.114	6594.848		

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- PRIMARY OBJECTIVE

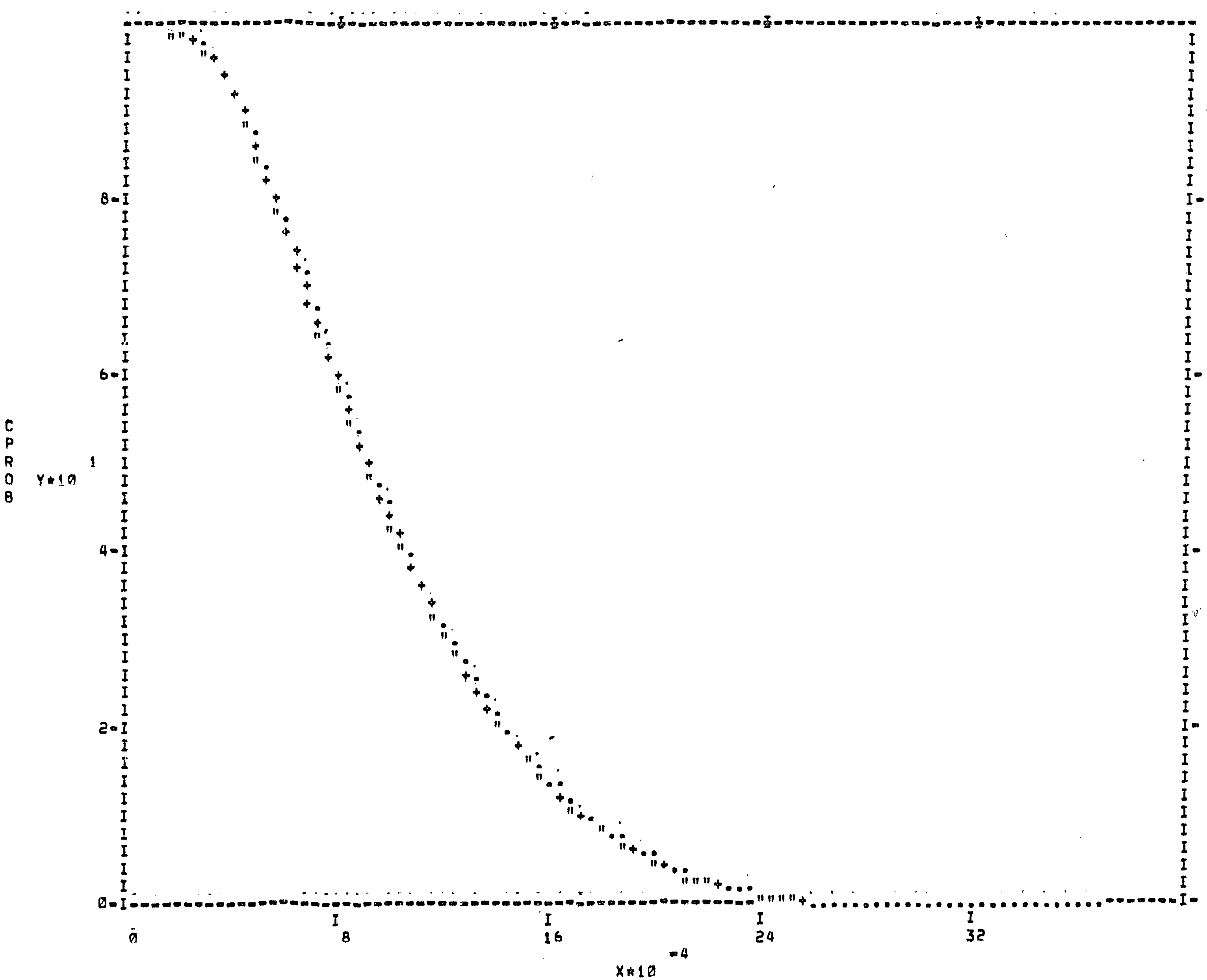
DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

17901.154	.999	196589.131	.068
21474.913	.998	200162.890	.060
25048.673	.993	203736.650	.055
28622.433	.984	207310.409	.050
32196.192	.974	210884.169	.044
35769.952	.962	214457.928	.040
39343.711	.945	218031.688	.036
42917.471	.922	221605.447	.033
46491.230	.899	225179.207	.030
50064.990	.870	228752.966	.027
53638.749	.841	232326.726	.025
57212.509	.814	235900.485	.022
60786.268	.784	239474.245	.020
64360.028	.754	243048.005	.018
67933.787	.722	246621.764	.016
71507.547	.690	250195.524	.013
75081.306	.658	253769.283	.012
78655.066	.627	257343.043	.011
82228.826	.599	260916.802	.009
85802.585	.571	264490.562	.008
89376.345	.544	268064.321	.007
92950.104	.517	271638.081	.006
96523.864	.489	275211.840	.006
100097.623	.461	278785.600	.005
103671.383	.440	282359.359	.004
107245.142	.414	285933.119	.003
110818.902	.390	289506.878	.003
114392.661	.367	293080.638	.003
117966.421	.347	296654.398	.002
121540.180	.324	300228.157	.002
125113.940	.302	303801.917	.002
128687.699	.283	307375.676	.002
132261.459	.263	310949.436	.002
135835.219	.246	314523.195	.002
139408.978	.230	318096.955	.002
142982.738	.216	321670.714	.001
146556.497	.202	325244.474	.001
150130.257	.187	328818.233	.001
153704.016	.174	332391.993	.001
157277.776	.162	335965.752	.001
160851.535	.150	339539.512	.001
164425.295	.141	343113.271	.001
167999.054	.129	346687.031	.001
171572.814	.119	350260.791	.000
175146.573	.109	353834.550	.000
178720.333	.101	357408.310	.000
182294.092	.095	360982.069	.000
185867.852	.087	364555.829	.000
189441.612	.081	368129.588	.000
193015.371	.074	371703.348	0.000

UNRISKED GAS



PROSPECT POTENTIAL

SUMMARY REPORT FOR GAS

PROSPECT TITLE:	FIRST EXAMPLE -- PRIMARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81

CONCLUSIONS

THERE IS A MODERATELY LOW (24.19%) PROBABILITY THAT THE STRUCTURE CONTAINS GAS.

IF GAS OCCURS, THE MOST LIKELY RECOVERABLE VOLUME IS ESTIMATED TO BE
186745.114 MILLION CUBIC METRES
(6594.848 BILLION CUBIC FEET).

THE ESTIMATED POTENTIAL RECOVERABLE GAS RESOURCES OF THE STRUCTURE
RANGE FROM A MINIMUM OF 17901.154 MILLION CUBIC METRES
(632.174 BILLION CUBIC FEET)

TO A MAXIMUM OF 371703.348 MILLION CUBIC METRES
(13126.592 BILLION CUBIC FEET).

PERCENT PROBABILITY GREATER THAN	MILLION CUBIC METRES	BILLION CUBIC FEET
100%	17901.154	632.174
95%	36821.057	1300.325
80%	59118.514	2087.753
50%	96911.229	3422.391
20%	149683.537	5286.029
5%	203879.600	7199.947
0%	371703.348	13126.592

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE:	FIRST EXAMPLE -- SECONDARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81
TRAP:	STRUCTURAL/STRATIGRAPHIC
CONTOURS USED:	-2350, -2400,-2450 APPROXIMATE SIZE OF CLOSURES. NO MAPPED HORIZONS.
AREA (SQUARE KILOMETRES):	20, 50, 98
DEPTH (METRES):	4430
LOCATION:	OFFSHORE
WATER DEPTH (METRES):	880

RESERVOIR PARAMETERS

TRAP VOLUME TRIANGULAR DISTRIBUTION	2500.000	7000.000	14000.000
FRACTION NET PAY TRIANGULAR DISTRIBUTION	.200	.250	.300
FRACTION TRAP FILL TRIANGULAR DISTRIBUTION	.500	.800	.900
POROSITY TRIANGULAR DISTRIBUTION	.150	.200	.300
WATER SATURATION TRIANGULAR DISTRIBUTION	.100	.250	.400
OIL RECOVERY FACTOR TRIANGULAR DISTRIBUTION	.200	.350	.400
GAS RECOVERY FACTOR TRIANGULAR DISTRIBUTION	.500	.600	.750
TEMPERATURE IN DEGREES R CONSTANT	670.000		
PRESSURE (P.S.I.G.) CONSTANT	6000.000		
GAS DEVIATION FACTOR CONSTANT	.950		
FORMATION VOLUME FACTOR TRIANGULAR DISTRIBUTION	1.200	1.500	2.200

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE:	FIRST EXAMPLE -- SECONDARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81

EXISTENCE RISK FACTORS

PROBABILITY THAT SOURCE ROCKS ARE PRESENT	.800
PROBABILITY THAT THERMAL HISTORY WAS ADEQUATE	.800
PROBABILITY THAT RESERVOIR FACIES ARE PRESENT	.800
PROBABILITY THAT STRUCTURE & SEAL ARE PRESENT	.600
PROBABILITY THAT TIMING WAS ADEQUATE	.900
PROBABILITY THAT PRESERVATION WAS ADEQUATE	1.000
CHANCE OF HYDROCARBON OCCURRENCE	.276

RELATIVE LIKELIHOOD OF OIL OCCURRING	.200	OIL EXISTENCE RISK=	.055
RELATIVE LIKELIHOOD OF GAS OCCURRING	.800	GAS EXISTENCE RISK=	.221

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- SECONDARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

CUMULATIVE PROBABILITY DISTRIBUTIONS FOR BASE DATA

TRAP VOLUME	2500.000	3075.000	3650.000	4225.000	4800.000	5375.000	5950.000	6525.000	7100.000	7675.000	8250.000	8825.000
	9400.000	9975.000	10550.000	11125.000	11700.000	12275.000	12850.000	13425.000	14000.000			
CUM. PROB.	0.000	.006	.026	.058	.102	.160	.230	.313	.409	.503	.589	.667
	.737	.799	.852	.897	.934	.963	.984	.996	1.000			
FRAC NETPAY	.200	.205	.210	.215	.220	.225	.230	.235	.240	.245	.250	.255
	.260	.265	.270	.275	.280	.285	.290	.295	.300			
CUM. PROB.	0.000	.005	.020	.045	.080	.125	.180	.245	.320	.405	.500	.595
	.680	.755	.820	.875	.920	.955	.980	.995	1.000			
F.TRAP FILL	.500	.520	.540	.560	.580	.600	.620	.640	.660	.680	.700	.720
	.740	.760	.780	.800	.820	.840	.860	.880	.900			
CUM. PROB.	0.000	.003	.013	.030	.053	.083	.120	.163	.213	.270	.333	.403
	.480	.563	.653	.750	.840	.910	.960	.990	1.000			
POROSITY	.150	.158	.165	.173	.180	.188	.195	.203	.210	.218	.225	.233
	.240	.248	.255	.263	.270	.277	.285	.292	.300			
CUM. PROB.	0.000	.007	.030	.067	.120	.187	.270	.366	.460	.546	.625	.696
	.760	.816	.865	.906	.940	.966	.985	.996	1.000			
WATER SAT'N	.100	.115	.130	.145	.160	.175	.190	.205	.220	.235	.250	.265
	.280	.295	.310	.325	.340	.355	.370	.385	.400			
CUM. PROB.	0.000	.005	.020	.045	.080	.125	.180	.245	.320	.405	.500	.595
	.680	.755	.820	.875	.920	.955	.980	.995	1.000			
OIL REC FAC	.200	.210	.220	.230	.240	.250	.260	.270	.280	.290	.300	.310
	.320	.330	.340	.350	.360	.370	.380	.390	.400			
CUM. PROB.	0.000	.003	.013	.030	.053	.083	.120	.163	.213	.270	.333	.403
	.480	.563	.653	.750	.840	.910	.960	.990	1.000			
GAS REC FAC	.500	.513	.525	.538	.550	.563	.575	.588	.600	.613	.625	.638
	.650	.662	.675	.687	.700	.712	.725	.737	.750			
CUM. PROB.	0.000	.006	.025	.056	.100	.156	.225	.306	.400	.496	.583	.662
	.733	.796	.850	.896	.933	.962	.983	.996	1.000			
TEMPERATURE	670.000											
CUM. PROB.	1.000											
PRESSURE	6000.000											
CUM. PROB.	1.000											
GAS DEV FAC	.950											
CUM. PROB.	1.000											
FM VOL FAC	1.200	1.250	1.300	1.350	1.400	1.450	1.500	1.550	1.600	1.650	1.700	1.750
	1.800	1.850	1.900	1.950	2.000	2.050	2.100	2.150	2.200			

CUM. PROB.	0.000	.008	.033	.075	.133	.208	.300	.396	.486	.568	.643	.711
	.771	.825	.871	.911	.943	.968	.986	.996	1.000			

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- SECONDARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

7.134	1	73.683	4568
8.465	1	75.014	4608
9.796	6	76.345	4644
11.127	15	77.676	4673
12.458	39	79.007	4702
13.789	64	80.338	4731
15.120	95	81.669	4761
16.451	135	83.000	4790
17.782	189	84.331	4806
19.113	253	85.662	4821
20.444	336	86.993	4837
21.775	429	88.324	4850
23.106	532	89.655	4859
24.437	633	90.986	4868
25.768	750	92.317	4879
27.099	896	93.648	4889
28.430	1039	94.979	4901
29.761	1189	96.310	4916
31.092	1355	97.641	4924
32.423	1504	98.972	4930
33.754	1641	100.303	4937
35.085	1800	101.634	4943
36.416	1943	102.965	4948
37.747	2090	104.296	4954
39.078	2226	105.627	4957
40.409	2357	106.958	4961
41.740	2497	108.289	4963
43.071	2634	109.620	4967
44.402	2772	110.951	4969
45.733	2909	112.282	4973
47.064	3065	113.613	4977
48.395	3169	114.944	4982
49.726	3285	116.275	4983
51.057	3392	117.606	4984
52.388	3497	118.937	4988
53.719	3587	120.268	4991
55.050	3682	121.599	4991
56.381	3763	122.930	4992
57.712	3849	124.261	4994
59.043	3935	125.592	4995
60.374	4023	126.923	4996
61.705	4097	128.254	4997
63.036	4156	129.585	4998
64.367	4216	130.916	4998
65.698	4271	132.247	4998
67.029	4327	133.578	4999
68.360	4375	134.909	4999
69.691	4445	136.240	4999
71.021	4493	137.571	4999
72.352	4535	138.901	5000

***** C O N F I D E N T I A L *****

PROSPECT TITLE: FIRST EXAMPLE -- SECONDARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

STATI TICS DESCRIBING THE DISTRIBUTION GENERATED BY SIMULATION.

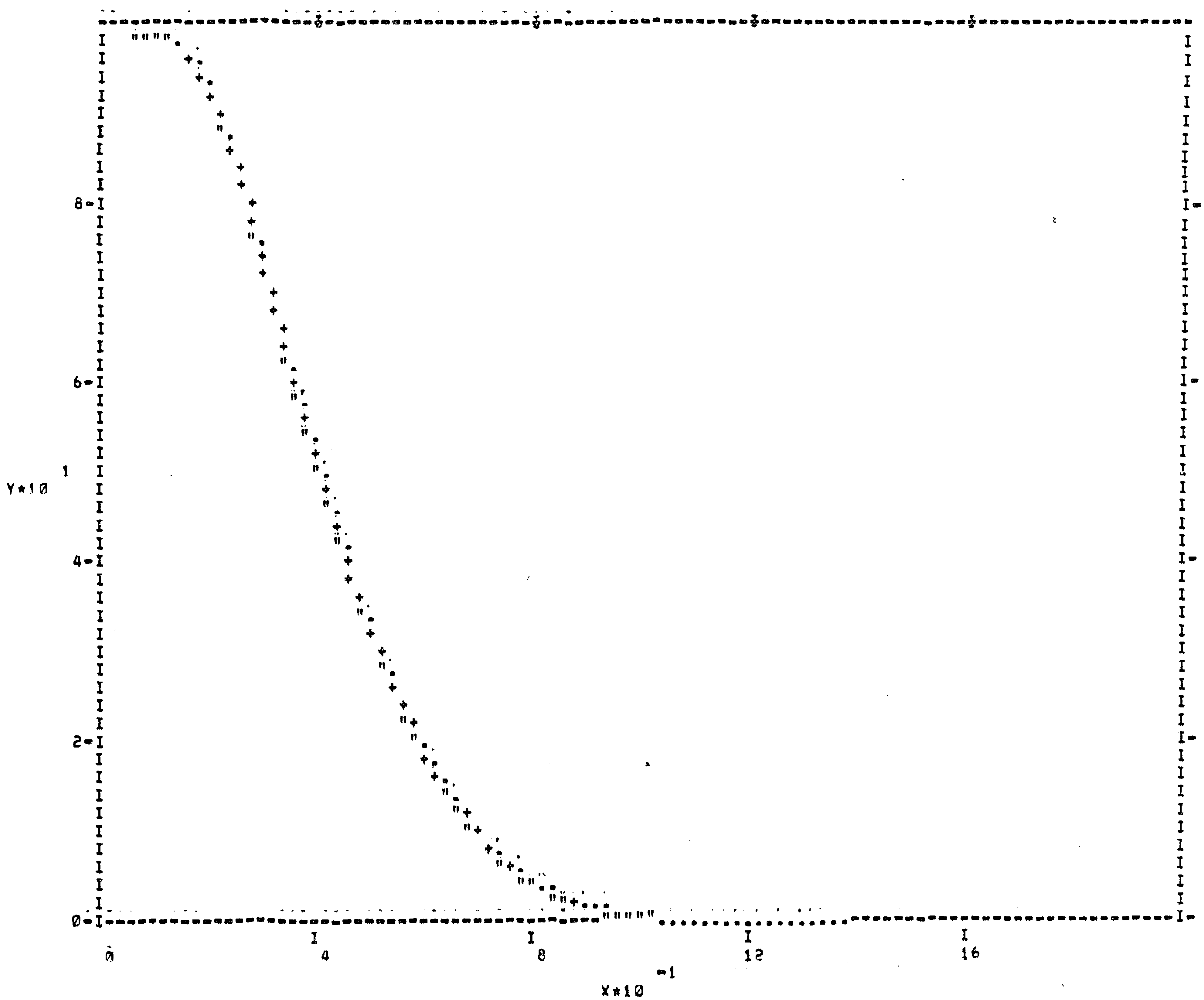
	MILLION CUBIC METRES OF OIL	MILLION BARRELS OF OIL		
MEAN VALUE =	46.164	290.362	STANDARD DEVIATION =	19.54896
MEDIAN VALUE =	43.100	271.091	VARIANCE =	382.16185
MODAL VALUE =	31.758	199.749		

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE:	FIRST EXAMPLE -- SECONDARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81

7.800	1.000	74.349	.086
9.131	1.000	75.680	.078
10.462	.999	77.011	.071
11.793	.997	78.342	.065
13.124	.992	79.673	.060
14.455	.987	81.004	.054
15.786	.981	82.335	.048
17.117	.973	83.666	.042
18.448	.962	84.997	.039
19.779	.949	86.328	.036
21.110	.933	87.659	.033
22.441	.914	88.990	.030
23.772	.894	90.321	.028
25.103	.873	91.652	.026
26.434	.850	92.983	.024
27.765	.821	94.314	.022
29.096	.792	95.645	.020
30.427	.762	96.976	.017
31.758	.729	98.307	.015
33.089	.699	99.638	.014
34.420	.672	100.969	.013
35.751	.640	102.300	.011
37.081	.611	103.631	.010
38.412	.582	104.961	.009
39.743	.555	106.292	.009
41.074	.529	107.623	.008
42.405	.501	108.954	.007
43.736	.473	110.285	.007
45.067	.446	111.616	.006
46.398	.418	112.947	.005
47.729	.387	114.278	.005
49.060	.366	115.609	.004
50.391	.343	116.940	.003
51.722	.322	118.271	.003
53.053	.301	119.602	.002
54.384	.283	120.933	.002
55.715	.264	122.264	.002
57.046	.247	123.595	.002
58.377	.230	124.926	.001
59.708	.213	126.257	.001
61.039	.195	127.588	.001
62.370	.181	128.919	.001
63.701	.169	130.250	.000
65.032	.157	131.581	.000
66.363	.146	132.912	.000
67.694	.135	134.243	.000
69.025	.125	135.574	.000
70.356	.111	136.905	.000
71.687	.101	138.236	.000
73.018	.093	139.567	0.000

UNRISKED OIL



* * * * * C O N F I D E N T I A L * * * * *

PROSPECT POTENTIAL

SUMMARY REPORT FOR OIL

PROSPECT TITLE: FIRST EXAMPLE -- SECONDARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

CONCLUSIONS

THERE IS A VERY LOW (5.53%) PROBABILITY THAT THE STRUCTURE CONTAINS OIL.

IF OIL OCCURS, THE MOST LIKELY RECOVERABLE VOLUME IS ESTIMATED TO BE
31.758 MILLION CUBIC METRES
(199.749 MILLION BARRELS).

THE ESTIMATED POTENTIAL RECOVERABLE OIL RESOURCES OF THE STRUCTURE
RANGE FROM A MINIMUM OF 7.800 MILLION CUBIC METRES
(49.060 MILLION BARRELS)

TO A MAXIMUM OF 139.567 MILLION CUBIC METRES
(877.850 MILLION BARRELS).

PERCENT PROBABILITY GREATER THAN	MILLION CUBIC METRES	MILLION BARRELS
100%	7.800	49.060
95%	18.510	116.425
80%	28.128	176.917
50%	43.100	271.091
20%	60.056	377.741
5%	81.492	512.568
0%	139.567	877.850

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PROSPECT TITLE: FIRST EXAMPLE -- SECONDARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

7815.913	1	87864.312	4836
9416.881	4	89465.280	4859
11017.849	6	91066.248	4878
12618.817	19	92667.216	4898
14219.785	45	94268.184	4908
15820.753	83	95869.152	4916
17421.721	130	97470.120	4930
19022.689	184	99071.088	4936
20623.657	262	100672.056	4949
22224.625	357	102273.024	4961
23825.593	455	103873.992	4965
25426.561	578	105474.960	4968
27027.529	701	107075.928	4971
28628.497	850	108676.896	4976
30229.465	1002	110277.864	4976
31830.433	1188	111878.832	4980
33431.401	1366	113479.800	4986
35032.369	1558	115080.768	4987
36633.337	1738	116681.736	4988
38234.305	1895	118282.704	4991
39835.273	2085	119883.672	4993
41436.241	2252	121484.639	4994
43037.209	2424	123085.607	4994
44638.177	2604	124686.575	4995
46239.144	2746	126287.543	4996
47840.112	2914	127888.511	4996
49441.080	3066	129489.479	4996
51042.048	3208	131090.447	4996
52643.016	3356	132691.415	4997
54243.984	3507	134292.383	4998
55844.952	3629	135893.351	4998
57445.920	3755	137494.319	4998
59046.888	3868	139095.287	4999
60647.856	3984	140696.255	4999
62248.824	4084	142297.223	4999
63849.792	4170	143898.191	4999
65450.760	4246	145499.159	4999
67051.728	4303	147100.127	4999
68652.696	4371	148701.095	4999
70253.664	4432	150302.063	4999
71854.632	4498	151903.031	4999
73455.600	4565	153503.999	4999
75056.568	4609	155104.967	4999
76657.536	4646	156705.935	4999
78258.504	4682	158306.903	4999
79859.472	4721	159907.871	4999
81460.440	4754	161508.839	4999
83061.408	4777	163109.807	4999
84662.376	4799	164710.775	4999
86263.344	4816	166311.743	5000

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE:	FIRST EXAMPLE -- SECONDARY OBJECTIVE
DATA COMPILED BY:	EUGENE L. SMITH
COMPILATION DATE:	SEPTEMBER 1981
DATE OF COMPUTER RUN:	25/11/81

STATISTICS DESCRIBING THE DISTRIBUTION GENERATED BY SIMULATION.

	MILLION CUBIC METRES OF GAS	BILLION CUBIC FEET OF GAS		
MEAN VALUE =	47972.673	1694.141	STANDARD DEVIATION =	18947.91049
MEDIAN VALUE =	45314.141	1600.255	VARIANCE =	359023311.90475
MODAL VALUE =	83956.355	2964.894		

* * * * * C O N F I D E N T I A L * * * * *

PROSPECT TITLE: FIRST EXAMPLE -- SECONDARY OBJECTIVE

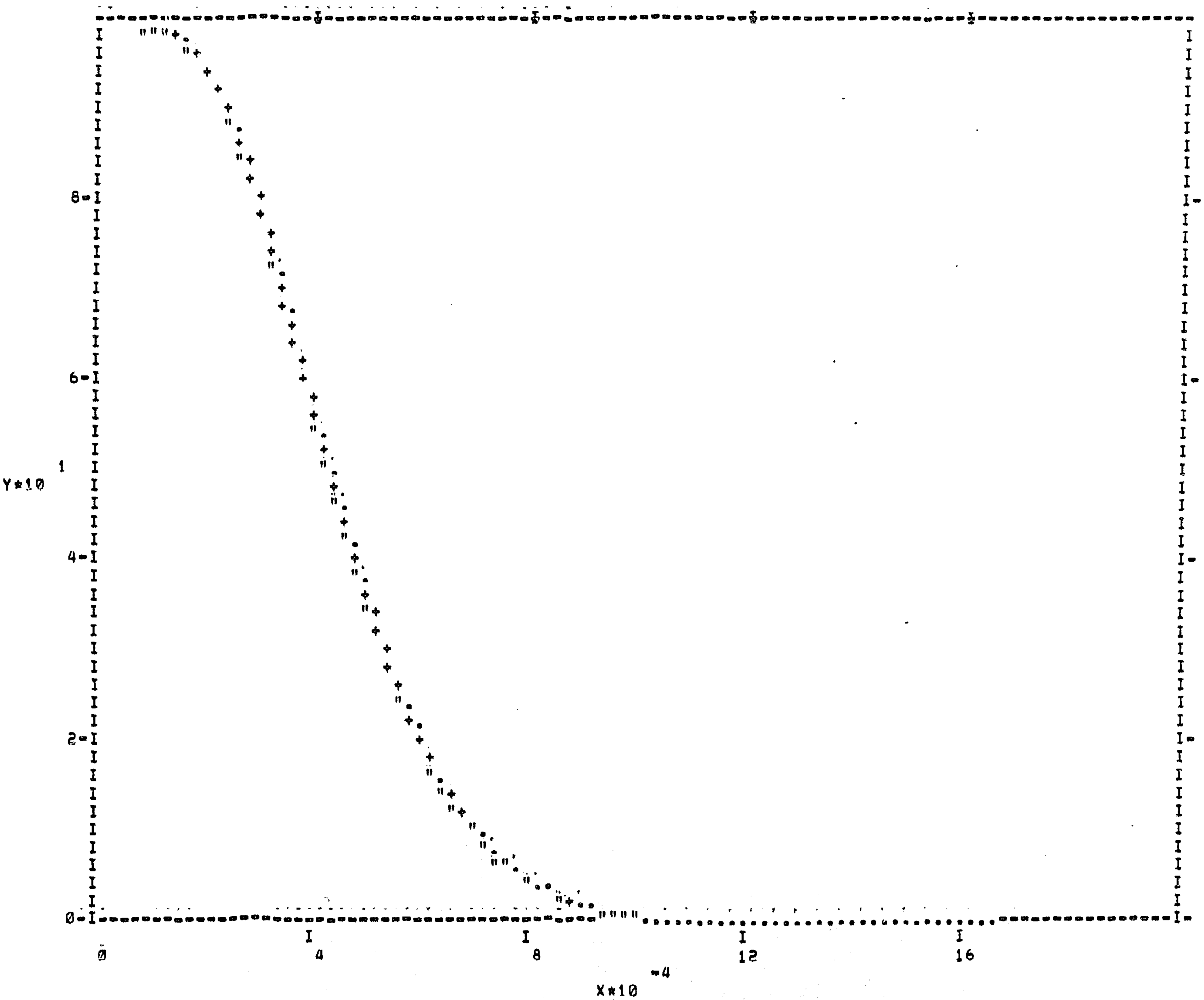
DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

8616.397	1.000	88664.796	.033
10217.365	.999	90265.764	.028
11818.333	.999	91866.732	.024
13419.301	.996	93467.700	.020
15020.269	.991	95068.668	.018
16621.237	.983	96669.636	.017
18222.205	.974	98270.604	.014
19823.173	.963	99871.572	.013
21424.141	.948	101472.540	.010
23025.109	.929	103073.508	.008
24626.077	.909	104674.476	.007
26227.045	.884	106275.444	.006
27828.013	.860	107876.412	.006
29428.981	.830	109477.380	.005
31029.949	.800	111078.348	.005
32630.917	.762	112679.316	.004
34231.885	.727	114280.284	.003
35832.853	.688	115881.252	.003
37433.821	.652	117482.220	.002
39034.789	.621	119083.188	.002
40635.757	.583	120684.156	.001
42236.725	.550	122285.123	.001
43837.693	.515	123886.091	.001
45438.660	.479	125487.059	.001
47039.628	.451	127088.027	.001
48640.596	.417	128688.995	.001
50241.564	.387	130289.963	.001
51842.532	.358	131890.931	.001
53443.500	.329	133491.899	.001
55044.468	.299	135092.867	.000
56645.436	.274	136693.835	.000
58246.404	.249	138294.803	.000
59847.372	.226	139895.771	.000
61448.340	.203	141496.739	.000
63049.308	.183	143097.707	.000
64650.276	.166	144698.675	.000
66251.244	.151	146299.643	.000
67852.212	.139	147900.611	.000
69453.180	.126	149501.579	.000
71054.148	.114	151102.547	.000
72655.116	.100	152703.515	.000
74256.084	.087	154304.483	.000
75857.052	.078	155905.451	.000
77458.020	.071	157506.419	.000
79058.988	.064	159107.387	.000
80659.956	.056	160708.355	.000
82260.924	.049	162309.323	.000
83861.892	.045	163910.291	.000
85462.860	.040	165511.259	.000
87063.828	.037	167112.227	0.000

UNRISKED GAS



* * * * * C O N F I D E N T I A L * * * * *

PROSPECT POTENTIAL

SUMMARY REPORT FOR GAS

PROSPECT TITLE: FIRST EXAMPLE -- SECONDARY OBJECTIVE

DATA COMPILED BY: EUGENE L. SMITH

COMPILATION DATE: SEPTEMBER 1981

DATE OF COMPUTER RUN: 25/11/81

CONCLUSIONS

THERE IS A MODERATELY LOW [22.12%] PROBABILITY THAT THE STRUCTURE CONTAINS GAS.

IF GAS OCCURS, THE MOST LIKELY RECOVERABLE VOLUME IS ESTIMATED TO BE
83956.355 MILLION CUBIC METRES
[2964.894 BILLION CUBIC FEET].

THE ESTIMATED POTENTIAL RECOVERABLE GAS RESOURCES OF THE STRUCTURE
RANGE FROM A MINIMUM OF 8616.397 MILLION CUBIC METRES
[304.285 BILLION CUBIC FEET]

TO A MAXIMUM OF 167112.227 MILLION CUBIC METRES
[5901.518 BILLION CUBIC FEET].

PERCENT PROBABILITY GREATER THAN	MILLION CUBIC METRES	BILLION CUBIC FEET
100%	8616.397	304.285
95%	20069.476	708.748
80%	29450.046	1040.020
50%	45314.141	1600.255
20%	62793.153	2217.521
5%	80854.013	2855.335
0%	167112.227	5901.518

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