CHAPTER IV

Oil Loss Simulation and Example

Oil loss simulation program is a developed simulator for calculating loss of oil in the terminal. The simulation can calculate oil loss which is stored in three kinds of storage tanks; fixed roof tank, internal floating roof tank and external floating roof tank. This chapter presents oil loss simulation program which was written in Microsoft Visual Basic language in detail.

4.1 Simulation Procedures

The procedures used to develop the oil loss simulation in this work are the same procedures as API principle. These procedures are useful for estimating typical losses from each tank type that is properly maintained in normal working condition. Loss from poorly maintained equipment could be higher. It is difficult to determine precise values of the loss related parameters for any individual tanks. In all cases the tank rim seal, deck fittings, and deck seam conditions may vary with time, and in some cases no tank construction details is available. The simulation will cover for liquids that are not boiling, with a true vapor pressure ranging from approximately 6 to 10 pounds per square inch absolute, average wind speeds ranging from 1.5 to 15 miles per hour, and tank diameters greater than 20 to 120 feet.

The following procedures are used in this simulation :-

a) Studying and analyse loss equation on all parameters and variables involved

b) Classify parameters and variables into an appropriate group of database for calculation in the simulation

c) Create or select data file of terminal data, tank data and product data

d) Create calculating loop to determine total loss by using data file and loss equation of each tank type

e) Show the calculation results of loss occurred from each tank type in report

4.2 Simulaltion Data

There are a lot of essentail data that are collected for calculation in this simulation. They can be classified to three groups of data as presented below.

The first group of data is the terminal data that depend on the location of terminal. The terminal data base of this simulation consists of sixteen terminal location in Thailand and their meteorological data such as average temperature, average minimum temperature, average maximum temperature, heat radiation and wind speed.

The second group is tank data which are tank diameter, tank color, rim seal system, type of support, deck fitting data, type and size of deck seam, type and size of column perimeter, clingage factor, etc.

The last group of data is product data such as annual net throughput of product, ambient temperature, Reid vapor pressure, etc.

These data input are useful for calculating each kind of loss taking place in each tank type by using loss equation from Chapter III.

4.3 Simulation Flow Diagram

4.3.1 Internal and External Floating Roof Tanks

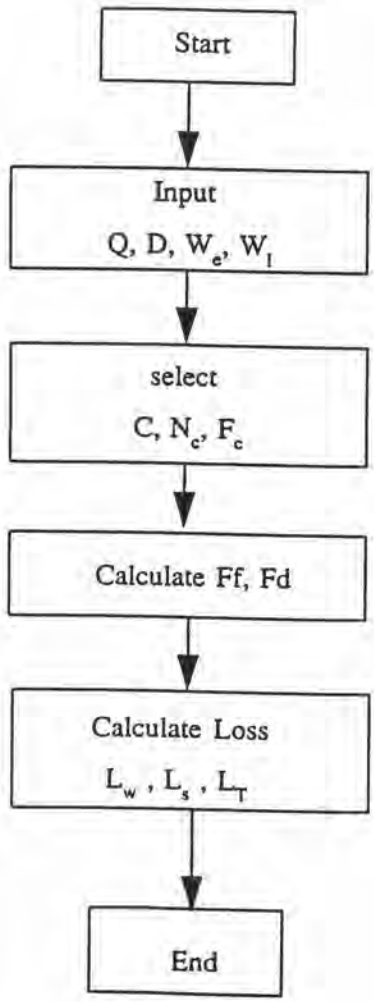

Figure 4.1 Flow Diagram for Internal and External Floating Roof Tanks

4.3.2 Fixed Roof Tank

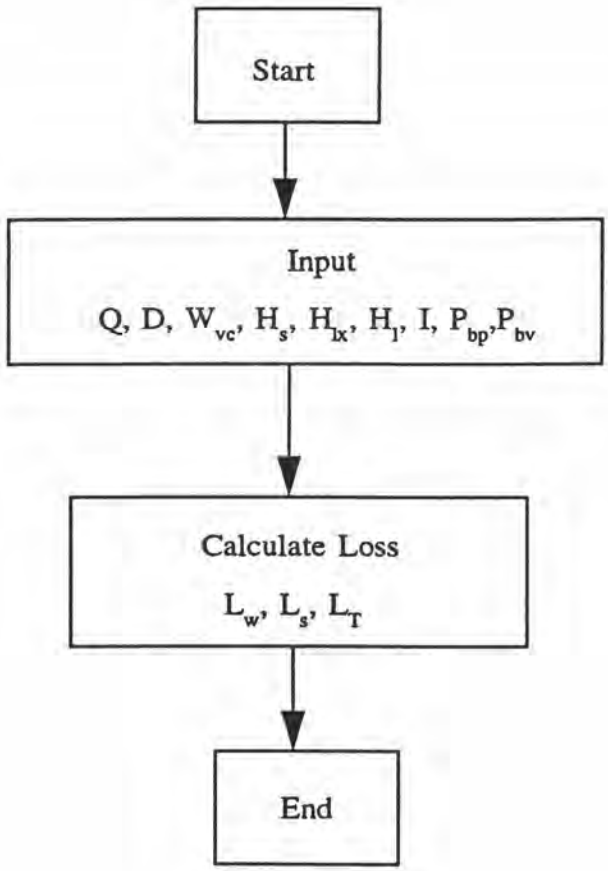

Figure 4.2 Flow Diagram for Fixed Roof Tank

4.4 Simulation Program Menu

4.4.1 Main Menu

The program starts from **Main** menu as shown in Figure 4.3. There are three types of storage tanks in this menu. Select tank types and then click **Next** button to continue to input data for calculation.

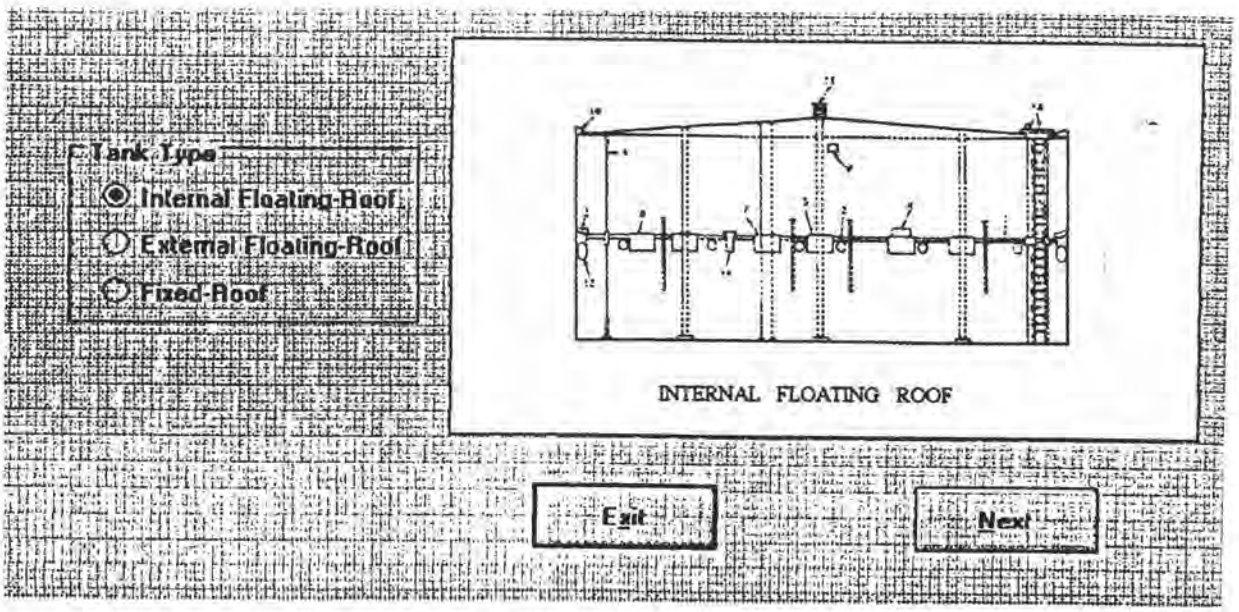

Figure 4.3 Main Menu

4.4.2 Terminal Data Menu

This menu consists of the following items of data for selection and input. (see Figure 4.4)

a) Terminal name

b) Tank number

c) Type of product

d) Terminal location

e) Thailand climate condition

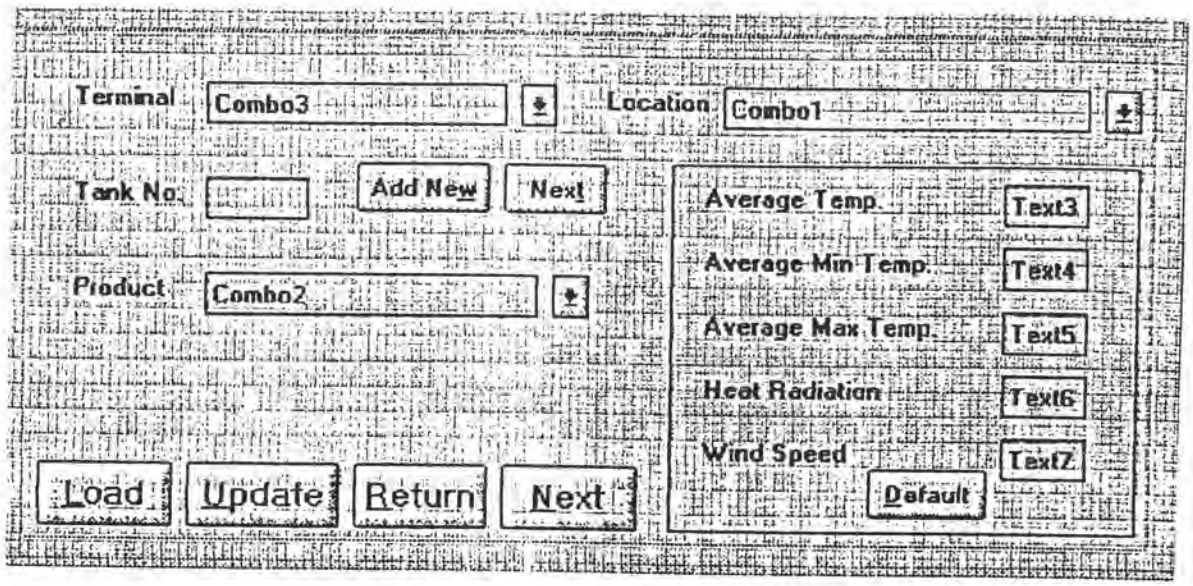

Figure 4.4 Terminal Data Menu

The calculation of this simulation will be started from retrieving or **OK** database of terminal names, tank numbers and selecting types of products and locations. Click **Add New** button to enter new terminal name in the **Enter New Terminal** menu (see Figure 4.5).

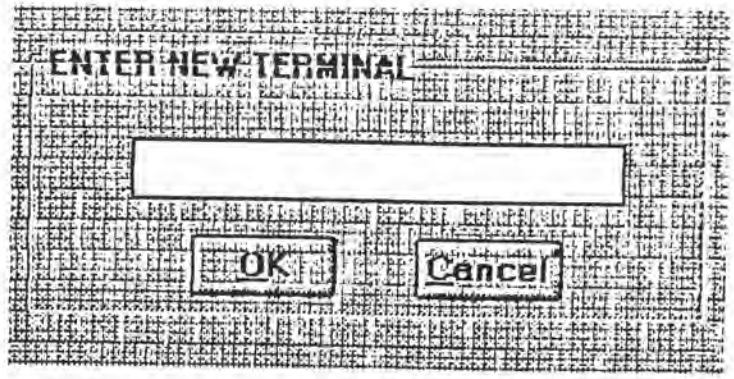

Figure 4.5 Enter New Terminal Menu

The climate conditions of each location which is shown in the right hand box of this menu are brought from the ten year statistic record data of average temperature, average minimum temperature, average maximum temperature, heat radiation and wind speed (see Appendix D). Each location will show different default figures of Thailand climate conditions. These figures can be changed to update for calculation. When all data in this menu is selected and input, click **Next** button to continue.

4.4.3 Tank Data Menu

This Simulation has three tank data menu as the following :-

a) Internal floating roof tank

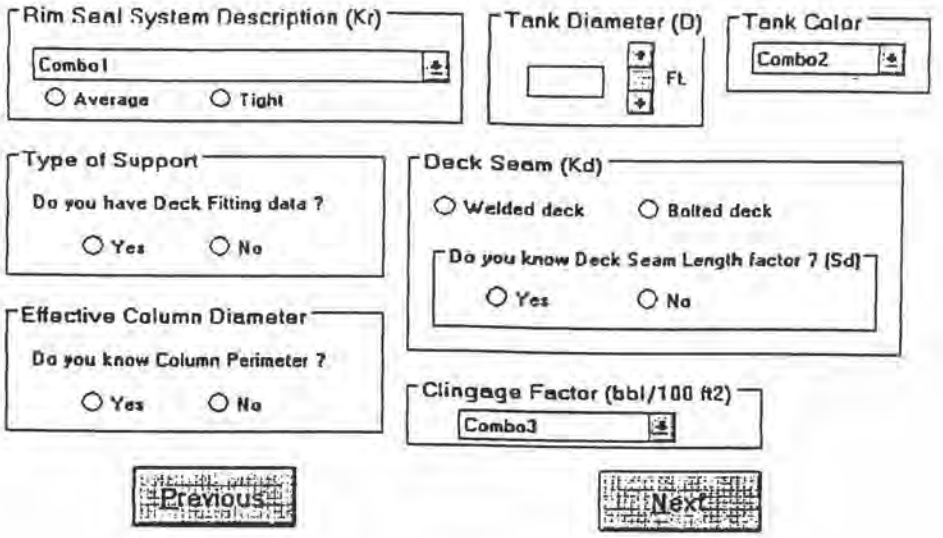

Figure 4.6 Internal Floating Roof Tank Data Menu

b) External floating roof tank

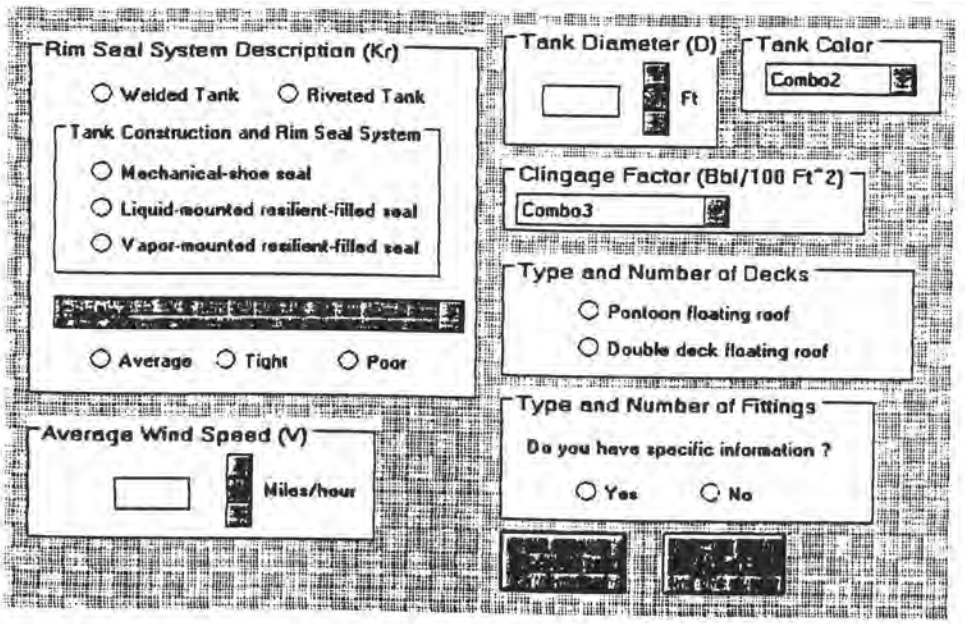

Figure 4.7 External Floating Roof Tank Data Menu

c) Fixed roof tank

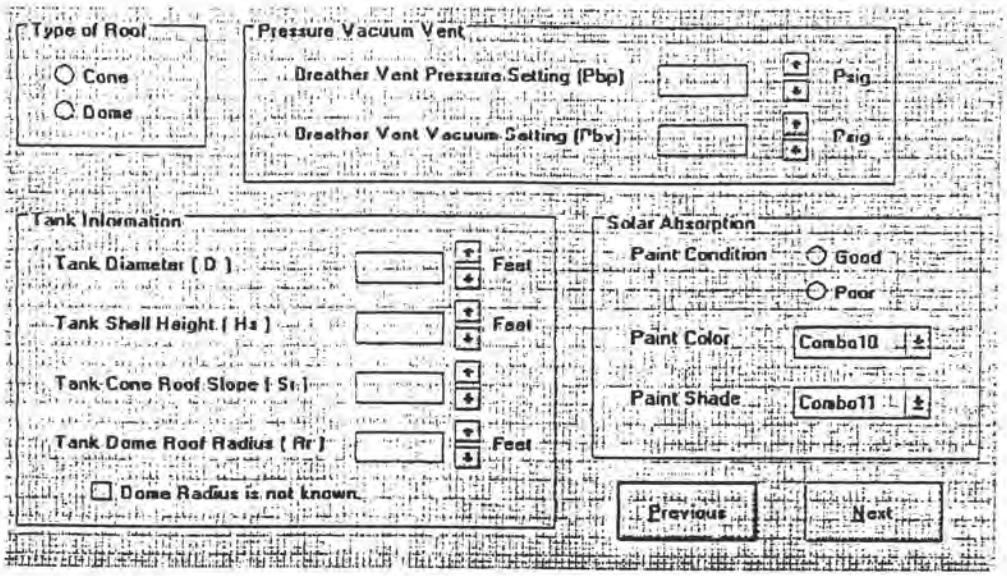

Figure 4.8 Fixed Roof Tank Data Menu

4.4.4 Product Data Menu

There are two menus of product data entry. One is used for internal and external floating roof tanks. The other is used for fixed roof tank. The information of annual net throughput, average annual ambient temperature and Reid vapor pressure value of three kinds of products which are regular gasoline, premium gasoline and unleaded gasoline as shown in Figure 4.9 is enough for loss calculation in Internal and External floating roof tanks. For Fixed roof tank, some more data are requested in the menu (see Figure 4.10).

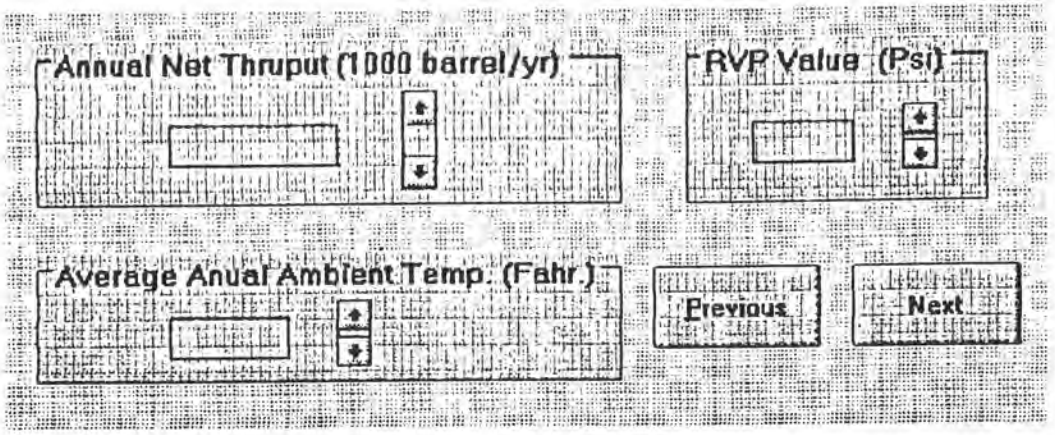

Figure 4.9 Product Data Menu for Internal and External Floating Roof Tanks

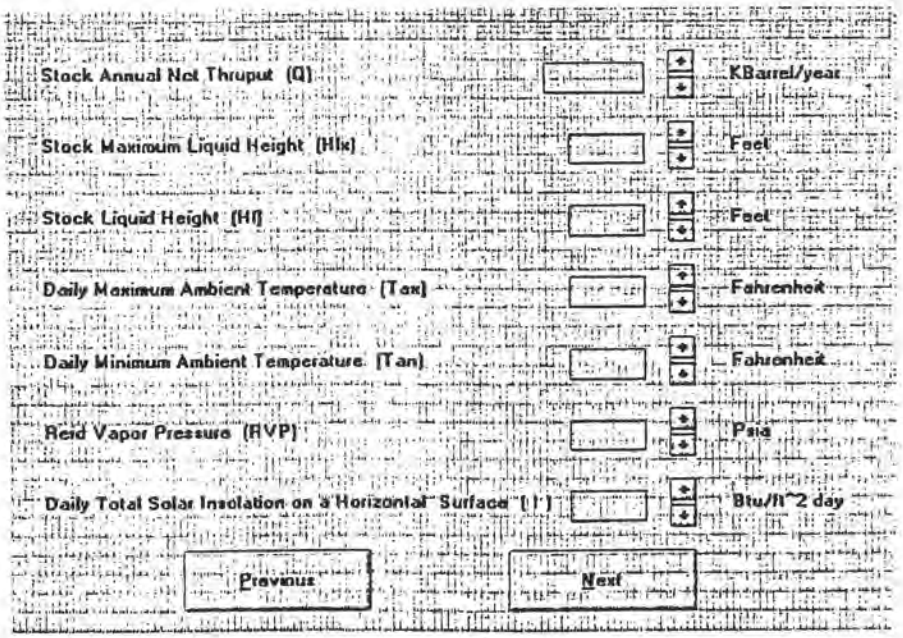

Figure 4.10 Product Data Menu for Fixed Roof Tank

4.4.5 Loss Result Menu

This menu is the last menu which shows two kinds of losses that occured in each tank type and then sum them to give total loss.

4.4.6 Oil Loss Result Report

After calculation, the results will be presented in a report.

4.5 Program Running

When the simulation is selected to calculate loss from one of the above tank types in **Main** menu, the following menu of data entry will appear consecutively.

4.5.1 Simulation of Oil Loss in Internal Floating Roof Tank

The program has run from selection internal floating roof tank button from **Main** menu, followed with input terminal data as mentioned in 4.4.2 and then continued with internal floating roof tank data menu. This menu has seven boxes of tank data entry as follows :

- Rim seal system description
- Tank diameter
- Tank color
- Type and length of deck seam
- Clingage factor
- Type of support and deck fitting data
- Effective column diameter

Three of these boxes are the question boxes. In type of support box, If the answer is No, the consecutive box (see Figure 4.11) of selecting typical deck fitting in tanks will appear by double click of No button.

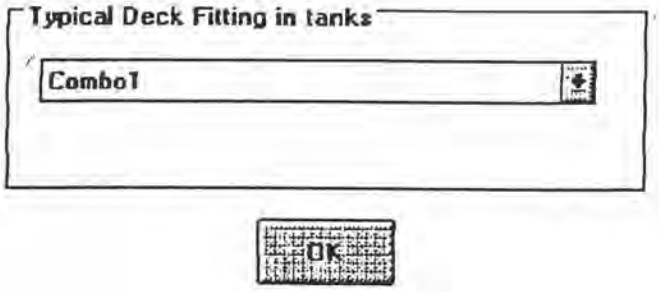

Figure 4.11 Typical Deck Fitting Menu for Internal Floating Roof Tank

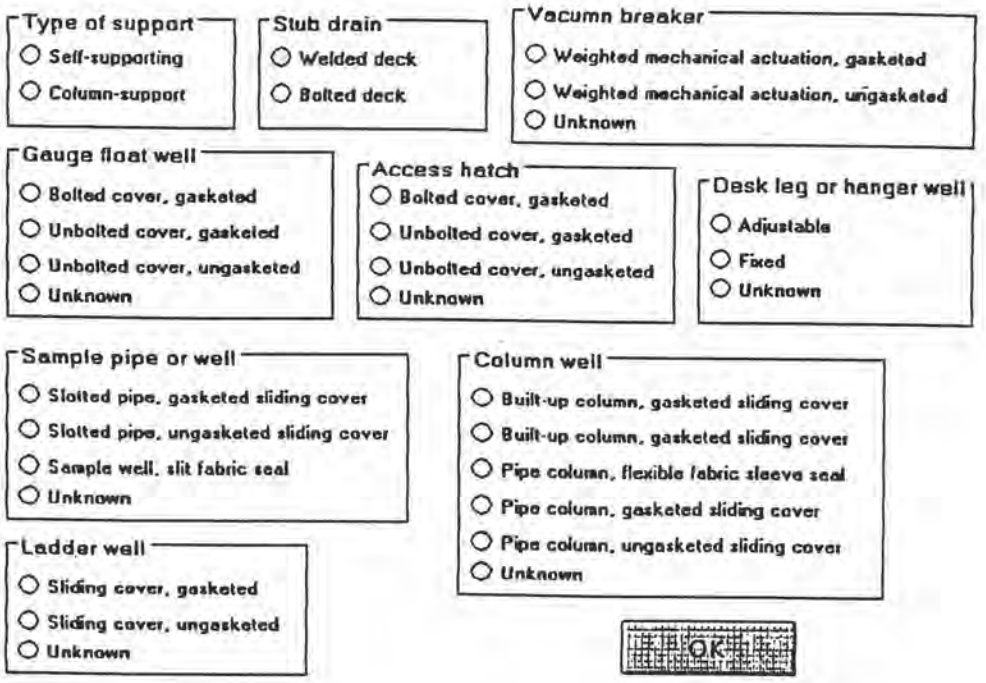

Figure 4.12 Deck Fitting Data Menu for Internal Floating Roof Tank

If the answer is **Yes**, select type of support and fitting deck as shown in Figure 4.12. Input effective column perimeter (Figure 4.13) after select **Yes** by double click in effective column diameter box or select assumed column perimeter (Figure 4.14) after double click **No**.

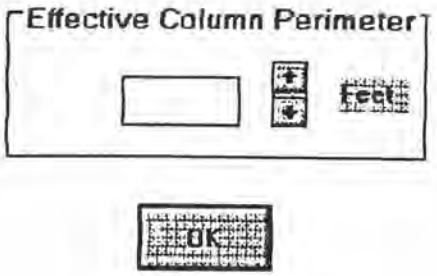

Figure 4.13 Column Perimeter Data Menu for Internal Floating Roof Tank

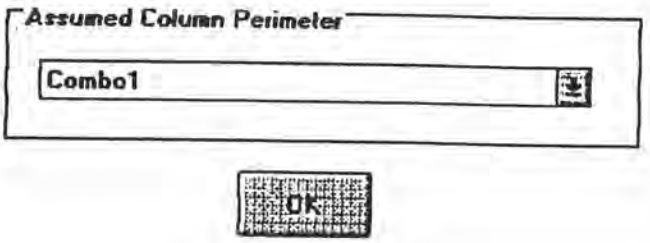

Figure 4.14 Assumed Cloumn Perimeter Menu for Internal Floating Roof Tank

The last question box in this internal tank data menu, answer **Yes** to fill deck seam length as shown in Figure 4.15 and answer No to select type of deck construction (Figure 4.16). When all tank data was entried, click **Next** button to continue to

input the other data for calcuation. The description of internal floating roof tank data are elaborated in Appendix B.

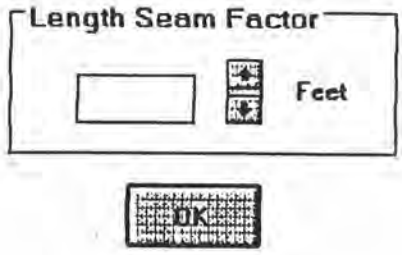

Figure 4.15 Length Seam Factor Menu for Internal Floating Roof Tank

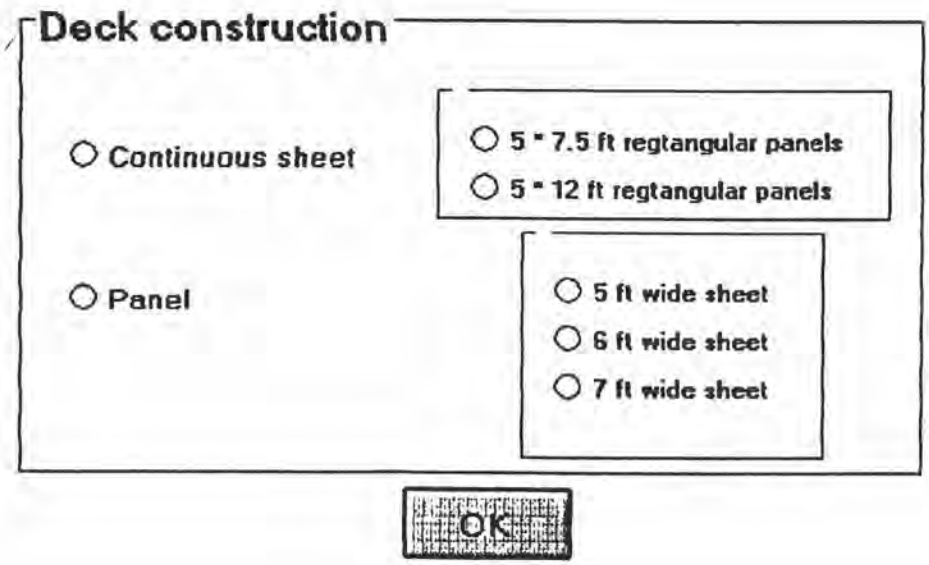

Figure 4.16 Deck Construction Menu for Internal Floating Roof Tank

The further step is the product data input which mentioned in 4.4.4 (Figure 4.9). Click **OK** button to calculate and then standing storage loss, withdrawal loss and total loss result. The results will be shown in the **Loss Result** menu (Figure 4.17) .

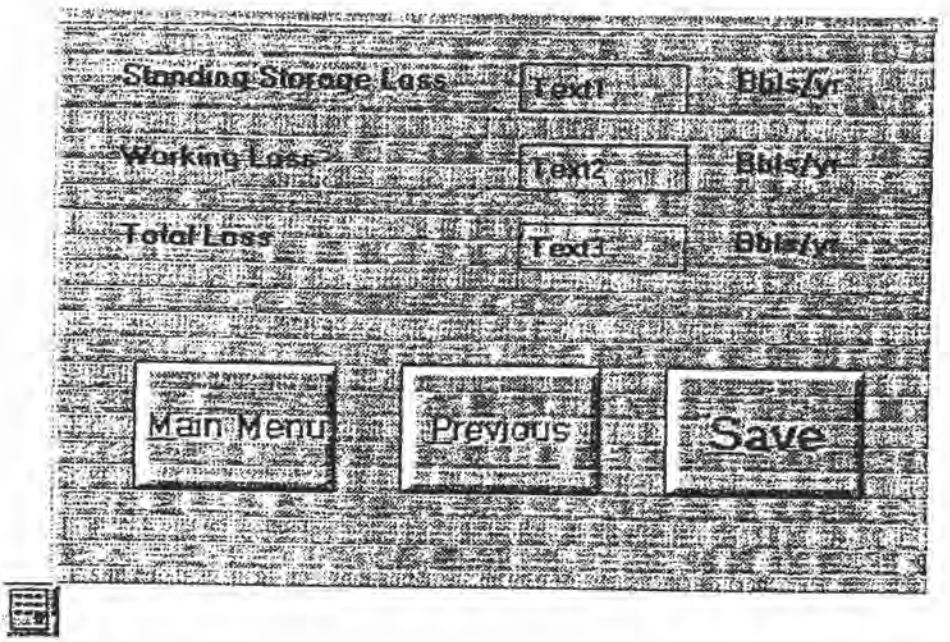

Figure 4.17 Loss Results Menu

4.5.2 Simulation of Oil Loss in External Floating Roof Tank

The calculation start from **Main** menu by selecting external floating roof tank type and then the consecutive step is terminal data input. This input menu is the same menu as 4.5.1. The external floating roof tank data menu (Figure 4.7) appeared after finished terminal data entry. The required tank data are as follows :

- Rim seal system description
- Average wind speed
- Tank diameter

- Tank color
- Clingage factor
- Type and number of decks
- Type and number of fittings

Specific information of fittings can be entried by double click **Yes** button in type and number of fittings box. Fitting information of this tank type (Figure 4.18) consists of :

- Type of acces hatch
- Type of gauge float well
- Type of roof drain
- Type of rim vent
- Type of vacuum breaker
- Size of roof leg
- Type of unslotted guide pole well
- Type of roof leg
- Type of gauge hatch / sample well

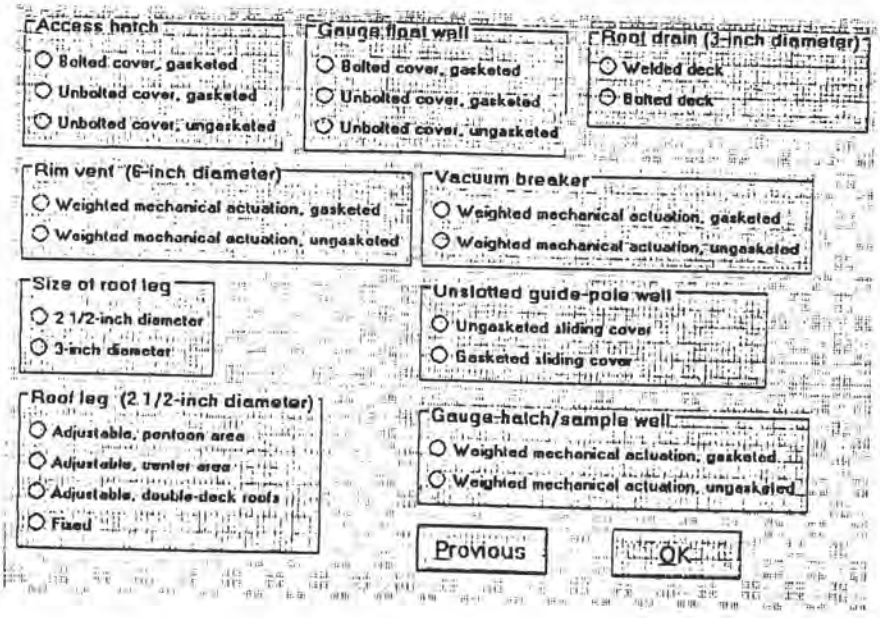

Figure 4.18 Fitting and Tank Data Menu for External Floating Roof Tank

When the selection of fitting data finished, click **OK** button to return to tank data menu. The more explanation of external floating roof tank data are gathered in Appendix C. Click **Next** button in tank data menu to input product data in further menu as shown in Figure 4.9. The simulation will calculate the losses of standing storage and withdrawal and show the results as Figure 4.17.

4.5.3 Simulation of Oil Loss in Fixed Roof Tank

This calculation is processed the same way as 4.5.1 and 4.5.2 until the simulation shows fixed roof tank data menu. In this menu, the following tank data are entried (see detail description of tank data in Appendix A) :-

- Type of roof
- Pressure vacuum vent value
- Tank diameter
- Tank shell height
- Tank cone roof slope
- Tank dome roof radius
- Paint condition
- Paint color
- Paint shade

After click Next button, Input further data of product as requested in Figure 4.10. The results of loss calculation in this tank type are reported in standing storage loss and working loss terms.

4.6 Simulation Examples

4.6.1 Simulation Example of Internal Floating Roof Tank

OIL LOSS REPORT

3/23/96 *INTERNAL FLOATING ROOF*

TERMINAL chula

Tank No 1 Location Bangkok Metropolis

Thruput 400.00 Kbbls/yr Product Type Premium Gasoline RVP Value 8.50 Psi

CLIMATE CONDITION

Average Ambient Temperature	82.80	Degree Fahrenheit
Average Minimum Temperature	76.00	Degree Fahrenheit
Average Maximum Temperature	91.40	Degree Fahrenheit
Average Wind Speed	3.80	Miles/hr

TANK DESCRIPTION

Diameter	40.00	Ft
Color	3	Black
Clingage Type	2	Genite-Lined
Rim Seal System Type	3	Liquid-mounted primary seal plus secondary sea
Seal Condition	0	Average
Deck Fitting Type	0	We know deck fitting data, details as follow :
Type of Support	1	Column support
Access Hatch	0	Bolted cover ,gasketed
Column Well	0	Built-up column ,gasketed sliding cover
Deck Leg or Hanger Well	0	Adjustable
Gauge Float Well	0	Bolted cover, gasketed
Ladder Well	0	Sliding cover, gasketed
Sample Pipe or Well	0	Slotted pipe, gasketed sliding cover
Stub Drain	0	Welded floating deck
Vacuum Breaker	0	Weighted mechanical actuation, gasketed
Deck Construction	1	
Deck Seam Type	0	Welded deck
Panel construction	1	5 * 12 ft rectangular panels

EVAPORATION LOSS

Standing Loss	15.01	**Bbls/yr**
Withdrawal Loss	34.48	**Bbls/yr**
Total Loss	49.49	**Bbls/yr**

Figure 4.19 Oil Loss Results for Internal Floating Roof Tank

4.6.2 Simulation Example of External Floating Roof Tank

OIL LOSS REPORT

EXTERNAL FLOATING ROOF TANK

3/23/96

TERMINAL test

Tank No. 7 Location 6 Ubonratchathani 2

Thruput 706.00 Kbbls/yr Product Type Unleaded Gasoline RVP Value 8.50 Psi

CLIMATE CONDITION

Average Ambient Temperatur	80.70	Degree Fahrenheit
Average Minimum Temperatu	71.70	Degree Fahrenheit
Average Maximum Temperatur	91.00	Degree Fahrenheit
Average Wind Speed	4.60	Miles/hr

TANK DESCRIPTION

Diameter	35.00	Ft
Color	0	White
Clingage Type	0	Light Rust
Tank Type	1	Bolted tank
Deck Type	1	Double deck floating roof
Tank Construction	1	Liquid-mounted resilient-filled seal
Rim seal system descriptior	0	Unknown
Seal condition	0	Average
Deck Fitting Information	0	We know fitting data, details as follow :
Access Hatch	0	Bolted cover ,gasketed
Unslotted Guide Pole Well	0	Ungasketed sliding cover
Gauge Float Well	0	Bolted cover, gasketed
Sample Pipe	0	Weighted mechanical actuation, gasketed
Vacuum Breaker	0	Weighted mechanical actuation, gasketed
Roof Drain	0	Open 0 0
Size of Roof Leg	0	3-inch diameter Type Adjustable, pontoon area
Rim Vent	0	Weighted mechanical actuation, gasketed

EVAPORATION LOSS

Standing Storage Loss	7.51	**Bbls/yr**
Withdrawal Loss	0.00	**Bbls/yr**
Total Loss	7.51	**Bbls/yr**

Figure 4.20 Oil Loss Results for External Floating Roof Tank

4.6.3 Simulation Example of Fixed Roof Tank

OIL LOSS REPORT

FIXED-ROOF TANKS

26/03/1996

TERMINAL fcr

Tank No. 5 Location Nakhonratchasima 7

Thruput 400.00 Bbls/yr Product Type Regular Gasoline RVP Value 8.50 Psi

CLIMATE CONDITION

Average Minimum Temperature	79.00	Degree Fahrenheit
Average Ambient Teperature	81.10	Degree Fahrenheit
Average Maximum Temperature	90.70	Degree Fahrenheit
Average Wind Speed	2.40	Miles/hr

TANK DESCRIPTION

Diameter		65.00	Ft		
Roof Type	1	Dome Roof			
Tank Dome Roof Radis		35.00	Ft	0.07	35.00
Tank Shell Height		57.00	Ft		
Maximum Stock Liquid Heigt		56.00	Ft		
Stock Liquid Height		45.00	Ft		

SOLAR VARIABLE

Daily Total Solar Insolation		1,609.00	Btu/ft^2 day
Paint Condition	0	Good	
Paint Color	2	Aluminum	
Paint Shade	1	Diffuse	

1

PRESSURE VACUUM VENT

PV Vent Pressure	0.040	Psi
PV Vent Vacuum	0.040	Psi

EVAPORATION LOSS

Standing Storage Loss	104.15	**Bbls/yr**
Working Loss	264.29	**Bbls/yr**
Total Loss	368.43	**Bbls/yr**

Figure 4.21 Oil Loss Results for Fixed Roof Tank