CHAPTER V

Model and Actual Work Verification

This chapter presents the results of loss calculation from developed simulation to also show the comparison of loss result calculated from currently used program and reported loss data from actual plant. This simulation is useful for estimating oil loss in storage tanks in various variation of storage condition. All data for siumulation running are gathered from data records of each storing terminal in each distrubuted location in Thailand. The significant change of the essential data input that mentioned in Chapter IV is analysed in this chapter in each tank type condition.

5.1 Developed Program Characteristic

The simulation program developed herein is helpful for the selection and design of storage facilities. Oil loss value calculated from the program can indicate some situation of operation such as some equipment maintenance or tank cleaning requirements. The program for calculating oil loss in petroleum companies (herein called currently used program) is used to run to obtain results for comparison to those obtained from the simulation program. Althrough the objective of both programs, the developed and the currently used program is to estimate loss in storage tanks, they have some different characteristics. The developed program is written in Visual Basic language run on Windows but the currently used program is written in Clipper operated on Dos. The main principle of calculation is the same concept but the calculated equations for the developed program is based on updated version API publication. Therefore, some variables and factors used for calculation in both programs are different. These difference was due to an awareness of more factors in

loss occuring. Calculation equations in the developed program cover more parameters that make the estimation more practical. The developed program can provide more flexibility in parameters and variables selection. It contains a reliable database for selection which can be changed in wide range. It also provide the default values such as climate condition in Thailand to guide and help the estimation.

The currently used program does not provide these kinds of input database and default figures. It has only the blank box to fill in these kinds of data. Besides the developed program has provided database feature, users can save calculation results and all selection in order to retreive data easily for correction estimating results

In this work, oil loss value in each kind of tank was calculated from the developed program in order to compare with the calculated value of the currently used program and reported data. The same figures of input data and three product types; premium gasoline, regular gasoline and unleaded gasoline were used in calculation.

After input necessary data such as describing terminal, products and tank data for estimation, the developed program was used to calculate losses that are standing storage loss and withdrawal loss for internal floating roof tank and standing storage loss and working loss for fixed roof tank. Calculation results are presented in programming report and shown in Table 5.1, Table 5.2 and Table 5.3 for internal floating roof tank, external floating roof tank and fixed roof tank, respectively.

Table 5.1 Loss of Internal Floating Roof Tank

Terminal	Tank No.	Product	Calculation from Developed Program				Calculation from Currently Used Program				Reported Total Loss (Bbls/yr)
			Standing Storage Loss (Bbls/yr)	Withdrawal Loss (Bbls/yr)	Loading Loss (Bbls/yr)	Total Loss (Bbls/yr)	Standing Storage Loss (Bbls/yr)	Withdrawal Loss (Bbls/yr)	Loading Loss (Bbls/yr)	Total Loss (Bbls/yr)	
Lampang	6	ULG	15.12	0.65	78.6	94.37	13.30	0.60	78.6	92.50	84
	9	GP	19.73	0.74	124.8	145.27	17.70	0.70	124.8	143.20	78
Denchai	7	GP	14.03	0.52	56.8	71.35	12.20	0.50	56.8	69.50	119
	8	GR	18.69	0.37	57.6	76.66	16.70	0.40	57.6	74.70	4
Udornthani	10	GR	20.76	0.32	54.9	75.98	18.70	0.30	54.9	73.90	197
Phuket	3	GP	40.15	0.22	69.9	110.27	36.70	0.20	69.9	106.80	351
	2	GP	18.75	0.13	17.3	36.18	17.10	0.10	17.3	34.50	100
	7	ULG	32.84	0.17	45.4	78.41	29.90	0.20	45.4	75.50	173
	5	GR	20.35	0.22	37.2	57.77	18.20	0.20	37.2	55.60	221
Bandon	7	GR	35.47	0.84	243.6	279.91	32.3	0.8	243.6	276.70	535
	3	ULG	20.83	0.19	33.9	54.92	18.7	0.2	33.9	52.80	158
	5	ULG	17.65	0.16	24.4	42.21	16.1	0.2	24.4	40.70	114
Chongnonsri	51	ULG	17.40	3.84	1365.1	1386.34	41.80	3.90	1365.1	1410.80	1370.2

Table 5.2 Loss of External Floating Roof Tank

Year SRIRACHA	Tank No.	Product	Calculation from Developed Program				Calculation from Currently Used Program				Reported Total Loss (Bbls/yr)
			Standing Storage Loss (Bbls/yr)	Withdrawal Loss (Bbls/yr)	Loading Loss (Bbls/yr)	Total Loss (Bbls/yr)	Standing Storage Loss (Bbls/yr)	Withdrawal Loss (Bbls/yr)	Loading Loss (Bbls/yr)	Total Loss (Bbls/yr)	
1994	906	GR	41.3	1.1	246.5	288.9	17.8	1.1	246.5	265.4	864.0
	1919	GP	36.3	1.2	226.2	263.7	16.3	1.2	226.2	243.7	840.0
	1918	ULG	36.9	1.1	111.3	148.8	16.6	0.6	111.3	128.5	252.4
1993	906	GR	41.3	1.0	250.3	292.7	17.8	1.1	250.3	269.3	156.3
1992	1919	GP	36.3	0.9	177.4	214.7	16.3	1.0	177.4	194.6	338.6

Table 5.3 Loss of Fixed Roof Tank

Terminal/Year Chongnonsri	Tank No.	Product	Calculation from Developed Program				Calculation from Currently Used Program				Reported Total Loss (Bbls/yr)
			Standing Storage Loss (Bbls/yr)	Working Loss (Bbls/yr)	Loading Loss (Bbls/yr)	Total Loss (Bbls/yr)	Standing Storage Loss (Bbls/yr)	Working Loss (Bbls/yr)	Loading Loss (Bbls/yr)	Total Loss (Bbls/yr)	
1994	61	GR	54.55	490.68	850.20	1395.43	765.80	1776.50	850.2	3392.50	2632.50
	17	GR	77.53	478.60	829.30	1385.43	730.10	1732.70	829.3	3292.10	2529.20
1992	17	GR	90.41	877.57	1696.90	2664.88	798.30	3546.40	1696.9	6041.60	2447.90
	12	GR	53.78	287.08	596.40	937.26	396.60	1246.30	596.4	2239.30	860.10
1992	78	GP	60.49	580.03	1369.30	2009.82	559.80	2861.60	1369.3	4790.70	1756.10
	10	GP	54.12	282.43	674.40	1010.95	364.50	1409.50	674.4	2448.40	864.90
1991	17	GR	93.23	850.91	1726.00	2670.14	760.20	3607.10	1726	6093.30	1611.70
	12	GR	55.73	288.88	606.40	951.01	383.40	1267.30	606.4	2257.10	566.30

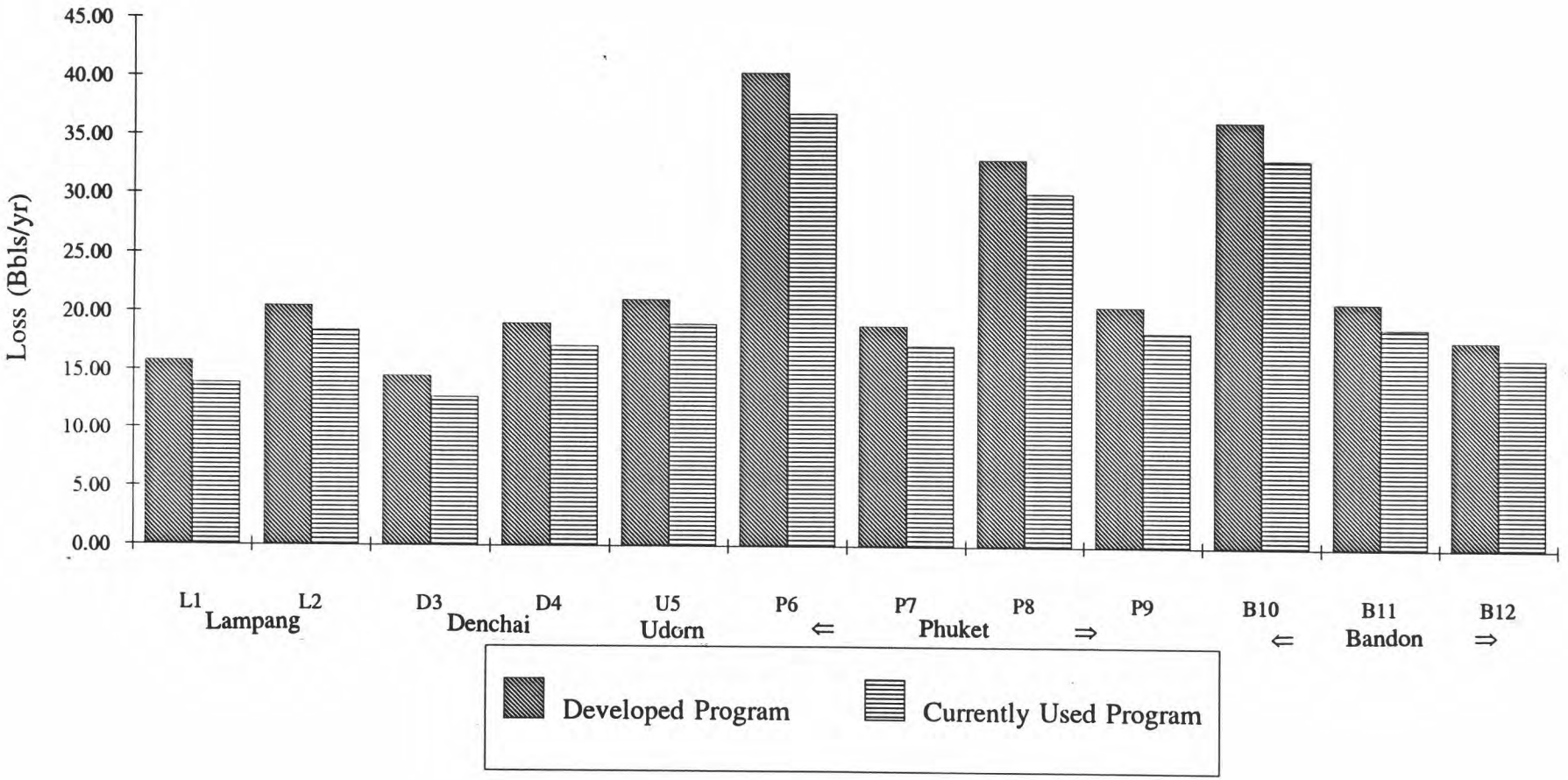
The graphical comparison of oil loss estimation calculated from two programs and reported loss data are also demonstrated in Figure 5.1 to Figure 5.6 for internal floating roof tank, external floating tank and fixed roof tank.

5.2 The Analysis of Loss in Each Tank Type

5.2.1 Internal Floating Roof Tank

Calculation results in Table 5.1 and Figure 5.1 show the loss occured in internal floating roof tank. Figure 5.1 show the comparison of loss figure calculated from the developed program and the currently used program to those from in the form of combination of standing storage loss and working loss in barrels per year for each tank number in terminal. These figures are in the same range but the developed program reports higher loss value than the currently used program does. As mentioned in section 5.1, the developed program calculation takes more consideration on updated API equation. It provides deck fitting selection while the currently used program does not consider these information. These included data will affect on loss result increasing as compared to the currently used program in Figure 5.1

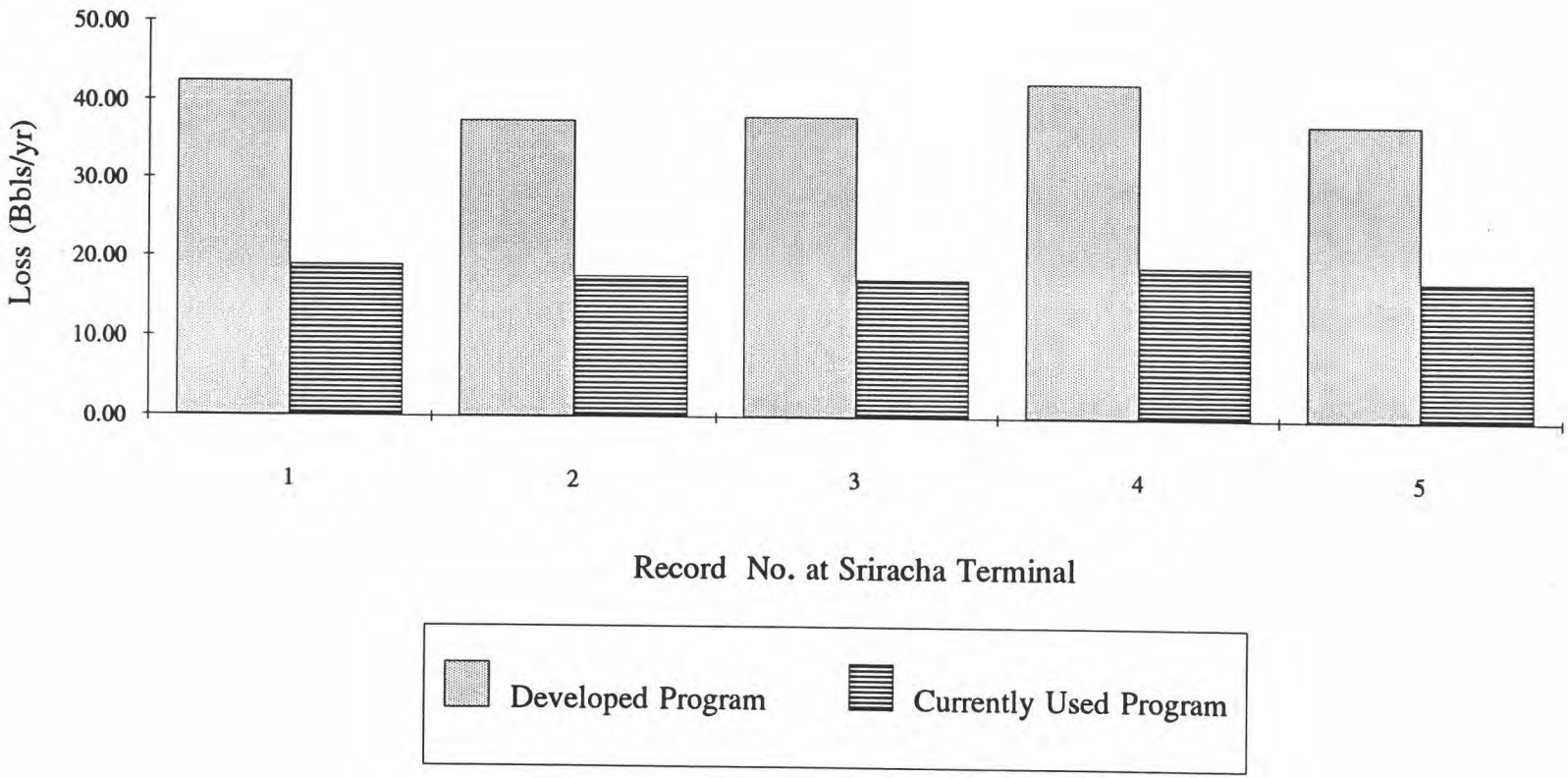
Figure 5.1 Standing Storage and Withdrawal Loss in Internal Floating Roof Tank



5.2.2 External Floating Roof Tank

Table 5.2 and Figure 5.2 show the results of loss for external floating tank. Results from the developed program estimate loss in this tank type higher than currently used program does because the developed program gathers loss figures taking place from seal damage in the plant in order to get more precise loss value. The developed program offers a number of seal condition to be a good representative factor for calculation. Therefore, this factor shows an significant influence on loss estimation in external floating tank. The information of each equipment in tank could affect the estimation, therefore it could be considered that the developed program can provide more precise results. The similarity of graphs in Figure 5.2 indicate that developed program show practical value as the currently used program but it could be better representation than the currently used program.

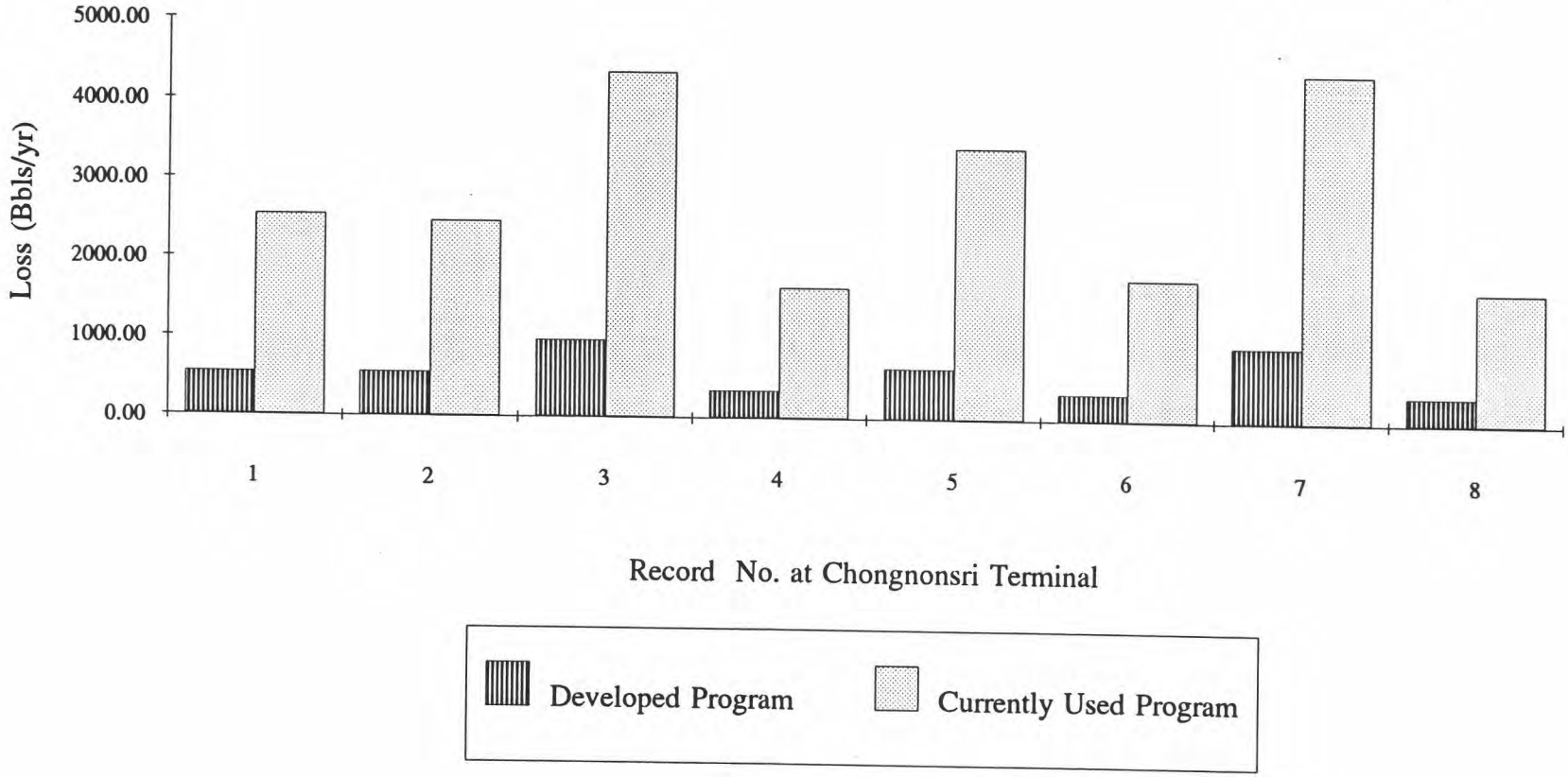
Figure 5.2 Standing Storage and Withdrawal Loss in External Floating Roof Tank



5.2.3 Fixed Roof Tank

Reports of calculation results for fixed roof tank is presented in Table 5.3 and Figure 5.3. The result shows the same characteristic as result calculated from external floating roof tank. It could be explain in the same reason that the developed program offer a number of more operational factor adjustment. In fixed roof tank, pressure vacuum vent and daily total solar insolation of Thailand (this data came from an average of yearly record) are considered to improve loss estimation.

Figure 5.3 Standing Storage and Working Loss in Fixed Roof Tank



5.3 Comparison of Loss Estimation to Reported Data

Comparison graph of loss calculated from two programs and reported data from actual operation are shown in Figure 5.4 to Figure 5.6 for internal floating roof tank ,external floating roof tank and fixed roof tank ,respectively.

In this study, the developed program is aimed to estimate loss in term of standing storage and working loss but the currently used program and reported data are presented as total loss figure. In order to adjust the value to compare with reported data and the currently used program calculated data, the value of loading loss [8] that is calculated from the currently used program is used for this adjustment to get total loss comparison.

The graph of reported data is higher than the graph of both developed program and currently used program. Total loss data reported the recording of total plant loss from stock accounting in each terminal. These loss are included many other factors that are not consider in API calculation equation.

The additional factors to cause more loss in plant are mentioned in this section. Meter performance factor has direct effect on discharging volume which causes wrong detection of loss. Water draw-off content, tank cleaning opertion and calibration and other measurement eror are also reported in total plant loss. The other factors that cause reported plant loss variation are dip plate deflection, receiving line packing problem, error measurement of stock temperature, common receiving line, failure PV-vent control and daily total solar insolation. The more opportunity of evaporation loss can occur, the more mistake of estimating loss from such method may occur. Because the objective

Figure 5.4 Total Loss in Internal Floating Roof Tank

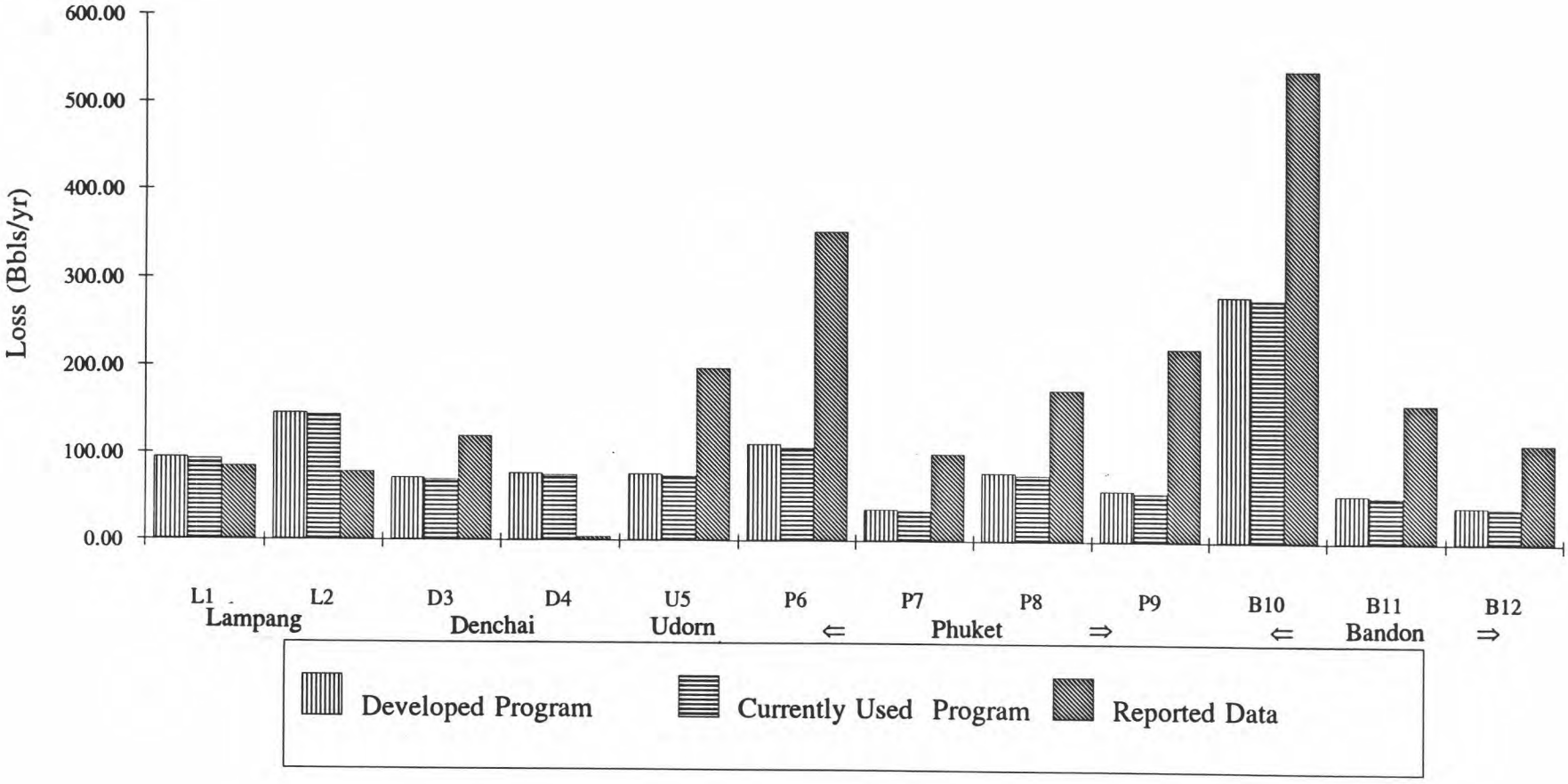


Figure 5.5 Total Loss in External Floating Roof Tank

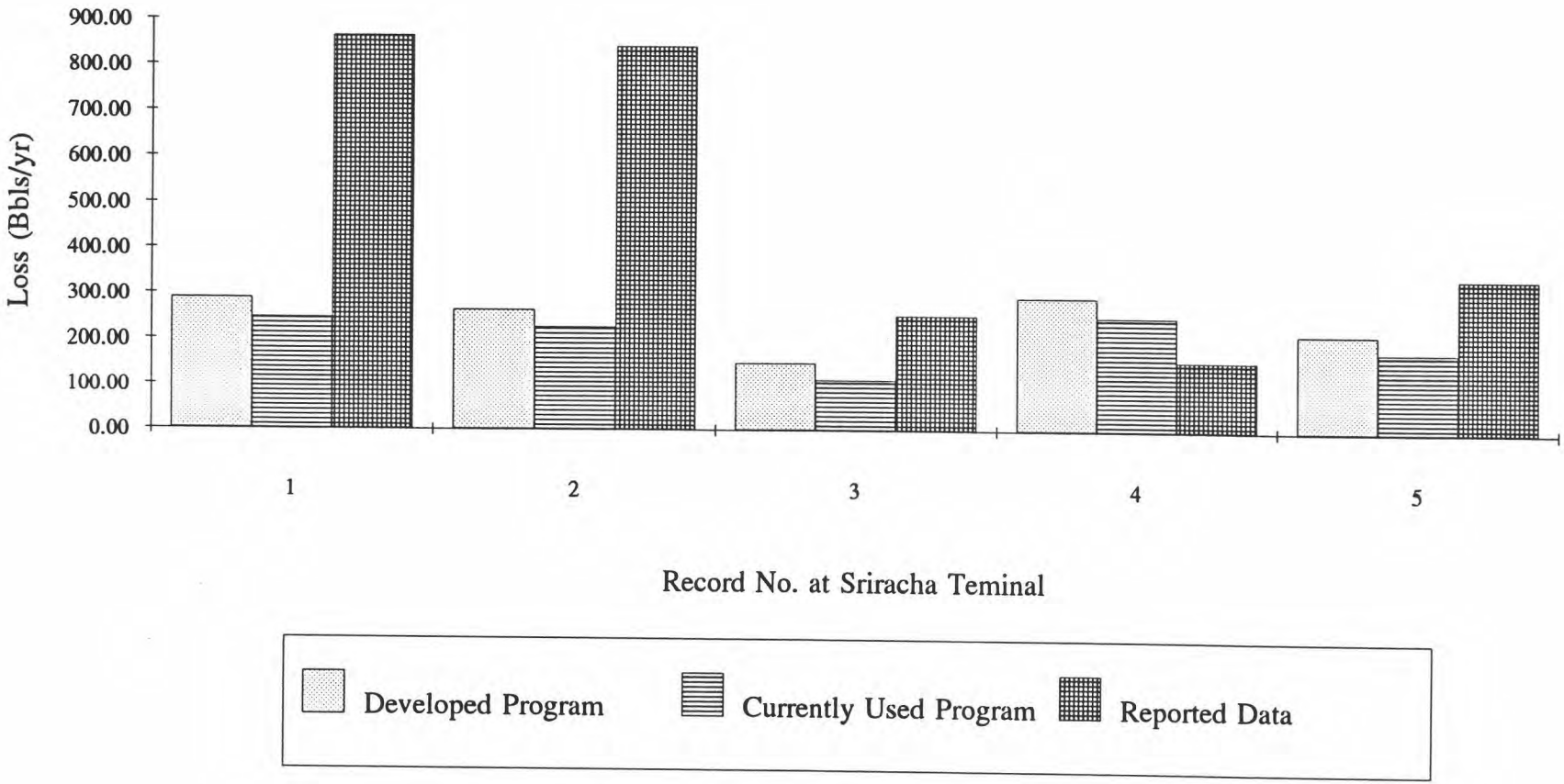
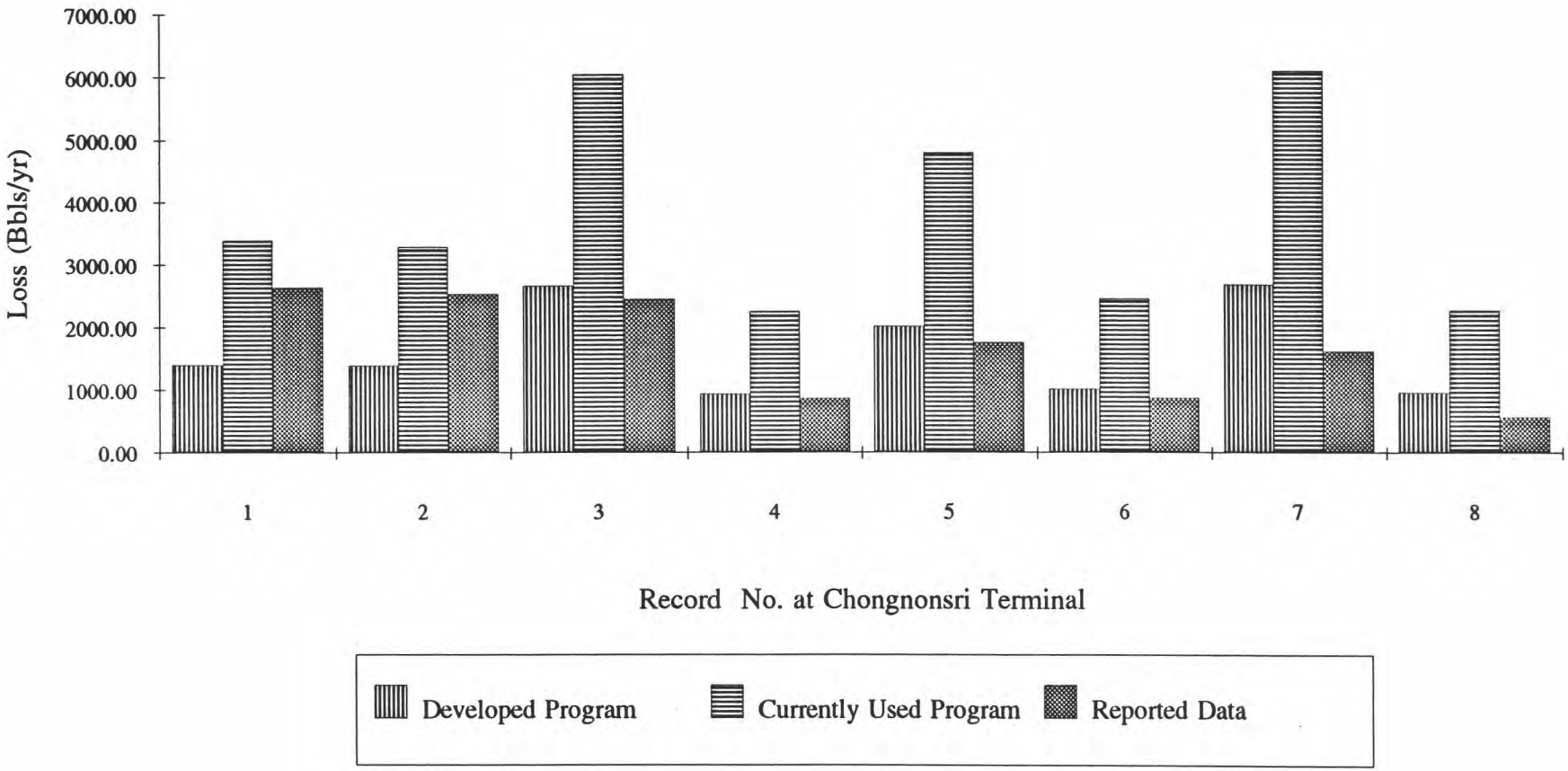


Figure 5.6 Total Loss in Fixed Roof Tank



of loss estimation is to forecast loss occuring and then try to control and minimize losses, this simulation is a useful tool to acheive precise estimation.

At normal working condition, the evaporation loss value is not much for internal and external floating roof tank because it has a floating deck that can be a prevention system of liquid evaporation from storage tank. Loss occured in internal floating roof tank shows the least loss compared to external floating roof tank and fixed roof tank.