



CHAPTER 5

THE RESULT OF MODIFIED FMEA IMPLEMENTATION

5.1 The result of the implementation

According to the previous chapter, the first five potential failure modes are desired to correct. But because the plant was shut down due to the financial problems (see plant shut down schedule in Appendix L), only two failure mode action plans can be completed. The implementation result of the two action plans is the following.

1. *Potential failure mode No. 5: Modify separation lighting switch at dewaxing filter*

After the separation lighting switch is modified, the electricity can be saved around 17,000 Baht/month that causes the severity number is reduced from level 4 (10,000 to 50,000 Baht/month) to level 2 (1,000 – 5,000 Baht/month)¹. For the occurrence of the failure mode, because the design of the switch was change, so, the possibility of the occurrence of the failure mode is lower from level 10 to level 2. But nothing is changed for the detection ability of the failure mode, so, the detection number is still level 7. The recalculation of RPN of this potential failure mode is shown in table 5.1.

2. *Potential failure mode No. 6: Bitumen blowing units' common air line modification*

This modification project is done and the line is already commissioned. The result of this modification is satisfied and meets the desired target. With this line only one air compressor is used when the bitumen blowing units are running at low through put. Because the cost

¹ Some of the cost from human error can not be calculated.

of electricity is reduced around 170,000 Baht/month because the design of piping is changed, then, the energy loss from this failure mode is completely solved. So, the severity number of this failure mode is reduced from level 6 to 1. For the occurrence of the failure mode, because the possibility of the occurrence of the failure mode is eliminated, then, occurrence number is reduced from level 10 to 1. However, nothing is changed in detection ability of the failure mode, so, the detection number is still level 2. The recalculation of the RPN of this potential failure mode is shown in table 5.1.

Table 5.1: Recalculated RPN after the action plans are implemented

Potential failure mode No.	Before implementation				After implementation			
	sev	occ	det	RPN	sev	occ	det	RPN
No.5	4	10	7	280	2	2	7	28
No. 6	6	10	2	120	1	1	2	2

However, although the some action plans desired to correct the remaining three potential failure modes have not been implemented due to the plant was shut down; but, because the results of the two implemented action plans are satisfied. So, it can be implied that if the remaining action plans are done, they should be success.

1. Potential failure mode No. 4: Set up steam trap inspection and repairing program

The purpose of this action plan is to reduce the loss of steam via steam traps and monitor the working of steam trap. If this plan is implemented, the possibility of the occurrence of the failure mode can be reduced from level 5 to level 2 approximately. But because no design of the system is changed, the severity and detection level will be the same because if the failure mode occur, the effect is still the same with the same level of detection ability.

2. Potential failure mode No. 2: Reduce excess O₂ from hot oil furnace by modifying O₂ controller

This action plan is intended to reduce the occurrence of the potential failure mode by modify the controller to control the excess O₂ in flue gas. For expectation, the occurrence level can be reduced from level 10 to 2.

3. Potential failure mode No. 10: Modification of new steam turbine

This action plan is also intended to reduce the occurrence of the potential failure mode by modify new steam turbine to support the amount of let down steam. From expectation, the occurrence level can be reduced from level 10 to 2.

Table 5.2 shows the expected results of the remaining action plan.

Table 5.2: Recalculated RPN after the remaining action plans are implemented (expected)

Potential failure mode No.	Before implementation				After implementation			
	sev	occ	det	RPN	sev	occ	det	RPN
No.4	7	5	6	210	7	2	6	84
No. 2	9	10	2	180	9	2	2	36
No. 10	6	10	2	120	6	2	2	24

From the table 5.1 and 5.2, the energy cost reduced from the modified failure mode analysis activity is shown in table 5.3. (see detail of the calculation in Appendixκ)

Table 5.3: Estimated energy cost saving from modified FMEA activity

Failure mode Number	Estimated Energy cost saving (Baht/month)
No. 5 (dewaxing filter lighting)	~17,000
No. 6 (bitumen units air line)	~ 170,000
No. 4 (failure of steam trap)	~ 792,000 (expected)
No. 2 (hot oil heater low efficiency)	~ 1,940,000 (expected)
No. 10 (MP steam let down to LP steam)	~ 161,000 (expected)
<i>Total</i>	<i>~ 3,080,000 (expected)</i>

5.2 Energy Intensity Index (EII) calculation

Energy Intensity Index (EII) is another indicator that can measure the utilization of energy consumed in the process, so, it is the good indicator to monitor the loss of energy in the process. The EII can be calculated as following equation.

$$EII = \frac{\text{Re ported Re finery Energy Consumption}}{\sum (\text{Unit Utilized Capacity} * \text{Unit Re ference Energy Coefficient} + \text{Sensible Heat})}$$

The EII of the process units before and after implementation of modified FMEA activity is shown in table 5.4 (see the detail calculation in Appendix M)

Table 5.4: Energy Intensity Index (EII) of each process unit

Process unit	Before implement modified FMEA	After implement modified FMEA
SDU	65	53
BBU	21	18

5.3 Implementation result discussion

Although some of action plans are not implemented, but from the result of the plans that are implemented and the expected result of the plan that are not implemented can imply that the modified FMEA can be in refinery in the energy conservation purpose. With these results, the priority of the potential failure modes can be rearranged as shown in table 5.5.

Table 5.5: The result of the action plans implementation

Failure mode No.	Description	RPN
8	The temperature of cooling water supply is lower than designed value.	100
3	Excess stripping steam	90
7	The compressed air from the compressor is excess and always blown to atmosphere.	90
1	VDU Heater's efficiency is low	84
4	Failure of steam traps	84*
11	Too low product run down temperature	80
9	The temperature outlet of AFC is controlled by using by-pass valve.	80
2	HOU Heater's efficiency is low	36*
5	One side of the dewaxing filters does not need lighting all the time.	28
10	MP steam is letdown to LP steam with the rate of 4 - 5 TPH constantly.	24*
6	The compressed air from the compressor is excess and always blown to atmosphere.	2

Note The RPN of failure mode No.2,4 and 10 are the expected result.

5.4 Problems of the implementation

The problems of the modified FMEA activity can be concluded as following

1. The plant is shut down and started up many times due to the financial and marketing problems during the step of the action plans' implementation that cause the difficulty in action plan implementation and in action plans' efficiency monitoring.
2. The members of the cross-functional team come from many working shifts that cause the different idea of working and difficult to make an appointment.

3. Some of the technicians who join the suggestion activity do not have the understanding to suggest the idea in energy conservation cause some of suggestions are useless.