CHAPTER 6

Results and Discussion of Implemented Project Management

Before the proposed quality assurance activities for project management of water treatment plant would be implemented into any project, the project team will be explained about the proposed quality assurance system and it must be ensured that they understood them.

6.1 Implementation of proposed quality assurance activities

The proposed quality activities were implemented into a TMC project that prepares treated water supply to the manufacturing process and the facility of factory. The project duration was four months, which started in July 1999 and completely tested in October 1999.

6.1.1 Design procedure for pre-awarded project

With the improved design procedure, Customer Requirement Questionnaire [F-PE-002-TMC-0] (See in Appendix A) was controlled to use in recording information from customer. Basically, this document has been designed in form of filling-form, thus it could be verified itself that which information has not been filled. In addition, it was modified to be checklist itself for the completion of customer requirement both all equipment supplied and treated water quality required. This document was passed to design engineer to review the collected data before the design concept was initiated. However, in verification Customer Requirement review checklist [F-PE-019-TMC-0] has guided the design engineer to review the critical information. Another important of review activity was to prevent the problem incurred from the insufficient of information received. As a result, it was found that critical information for the conceptual design was completely recorded, but only the equipment requirement was a bit unclear. Therefore, Design engineer has contacted the customer in order to confirm the scope of supplied equipment. Anyway, this could be ensured that the designed system and the number of supplied equipment meets the customer requirements.

Then, Designed Process work sheet [F-PE-004-TMC-0] (see in Appendix B) was prepared for designing the concept of required water treatment system by drawing all necessary equipment packages, complementary equipment, and capacity of the system. In design the basic specification, design engineer has delegated discipline engineer to design the others system: the electrical control system, instrument and function control, and piping system. During the others system were designed, design engineer has designed and prepared the equipment data sheet for all designed water treatment package including Multimedia Filter, Activated Carbon Filter, and Water Softener system (see in Appendix D to Appendix F). These data sheet would be reviewed the correction of criteria design by the design review checklist [F-PE-020-TMC-0], since incorrect or inappropriate design criteria would cause the system failure. In addition, the designed system was reviewed and confirmed the customer requirement by the checklist in Customer Requirement Questionnaire before proceeding the subsequent activity of the project execution. However, after reviewing by checklist, it was found that there was no any incorrect or improper design criteria for TMC project and the quantity of equipment to be supplied was completely.

The final operation for pre-awarded project was to proceed design document and drawing. Design document was provided in form of proposal whereas drawing was prepared as process flow diagram, which identify type and number of designed equipment.

6.1.2 Design procedure for awarded project

For design procedure of awarded project, to verify contract was the first activity that was responsible of assigned Project Engineer and Site management. This was to confirm that the contractual requirements were adequately documented and defined, were completely unambiguous, were mutually acceptable, and could be met (Lionel, 1993). The intention for project engineer was to review the discrepancies between the proposed system and the contractual requirement whereas site engineer to review the installation requirement in order for preparing installation plan. In verification, the contract verification review checklist [F-PE-021-TMC-0] helped the reviewer to beware the critical items described in the contract. Since TMC project's contract was once reviewing, there was less deviation of scope of work, and was no deviation of equipment

supplied. However, there was an additional requirement affect the capacity of the system. The contract identified that treated water will be designed for supply to Cooling Tower as dwell. As a result of this requirement, the Multimedia Filter was needed to design the capacity of system up to 30 m^3/hr.

After the proposed system and contractual requirement have been reviewed, detailed activities related to the project execution from design up to commissioning were planed and scheduled. In establishing the project planning, computerized planning system, Microsoft Project 98, was a specific tool to be used. In such plan, the detailed schedule was presented by the Gantt charts that cover the entire duration of a work package. They also identify milestone, interface date, and critical paths and float. This plan would be used for monitoring time progress and controlling budget cost. The actual start and stop dates of task are recorded.

Next, to design the specification of equipment was carried out and design documents were prepared accordingly. In designing, specific criteria and critical point of individual equipment was applied and controlled. The main designed document or equipment specifications of TMC project comprise the specification of raw water pump, Multimedia Filter, Activated Carbon Filter, Water Softener, and Instruments. Also, the calculation of piping system covering pipe size, pipe route, distance of suction pipe, and the material of pipe. After the all equipment was designed, the equipment checklist [F-PE-022-0] was applied to ensure that the design specifications conforming the customer requirement as describing in contract and tender and conforming the design criteria. The result of checking was found that all criteria designs and critical points of equipment specification were in the range of specific criteria and completely met the customer requirements.

The Process and Instrument Diagram [F-PE-008-0] was provided following the designed specification, and then the Bill of Material [F-PE-011-0] was created as the summation of equipment, parts, or items would be used for TMC project. The final execution of this procedure was the preparation of Procurement document as in form of Purchasing Requisition in order to pass to the procedure of equipment procurement.

6.1.3 Equipment Procurement

For the procurement procedure, to assess vendor or subcontractor was an activity to assure that the quality of material and fabricated equipment would not affect the process whether during installation or after commissioning or in common operation phase. As it was the first project implemented of this function, historically recorded information was less. However, to evaluate vendors and subcontractors would be executed by present information.

In inspection received items, all items classified into two groups as mentioned earlier that consist of bought-out and domestically fabricated items. Bought-out items comprise Pump, Tank, Metering pump, Valves, Pressure Gauge, Flow meter, and Level switch. Fabricated items comprise Steel pressure vessel of activated carbon, multimedia, and water softener. Inspection checklists for bought-out items [F-PE-023-0] and for fabricated items [F-PE-024-0] were applied to inspect of individual item. An importance of this operation was to verify that items conform to specified requirement and theirs quality were adequate for use.

6.1.4 Installation

Firstly, assigned site manager was responsible for reviewing installation agreement and preparing installation and material plan in order for controlling the schedule of the use of material during project installation. At this time, commissioning plan [F-PE-014-0] was also prepared. However, material plan document has described as well as Bill of Material, therefore, it was developed by defining the required date for every equipment and component.

Install procedure was initiated by site engineer visited the site to review the completion of site and prepared the final layout drawing. While site engineer was surveying, it was found that the cover of underground tank was incompletely constructed. However, the original layout has been compared with the detail of existing tank such as the position of inlet and outlet flange. The consequence was most details were similar. Thus the final layout drawing could be carried out and used for the subsequence activity. Anyway, site engineer has visited site again approximately three

weeks later in order to ensure that tank was complete and adequate for equipment installation.

Until the end of October, the operation at site was able to start, and equipment has been placed and installed. Plan layout drawing helped installation team to place equipment at the right position. The duration of equipment installation spent approximately one and half week. For the wiring work, since there were approved wiring diagram and routing drawing, it could start simultaneously with PE tank installation.

The subsequence done after equipment installation has been reviewed and corrected was to install interconnecting pipe among equipment. In order to prevent the failure from piping work, there were three installation drawings created. They include two section view drawings and a piping drawing. With the use of those drawings, the routed pipe, position of valves and instrument, and the proper position of pipe support was clearly indicated and understood. Installation team could carry out his work individually. In addition, it could control the period of piping work to finish earlier than schedule half a day. However, the verification of piping performance was carried out both during piping work and after completion. The result of pipe rechecking was there were two joints that did not cement, three positions that lack of pipe support, and a wrong direction of installed check valve.

For the electrical control panel, actually, the function of equipment control was checked on arrival. Therefore, the inspection after the completion of wiring work focused on the correction of wiring, cables, and the calibration of instrument. Electrical control panel review checklist [F-PE-027-TMC-0] was used as a guide to recheck the critical points that might incur during wiring work.

The final quality assurance activity was to verify the equipment installation in order to confirm that they completely and correctly installed, and the status of all installed equipment were in the condition of testing. The project has further tested both individual functional control and overall functional control before the commissioning was carried out. The project completed after five days commissioning and hand-over to the customer.

6.2 The result and Discussion of implemented project

After the project has completed and hand-over to the customer, the project performance was concluded by project engineer and the results has been submitted to Project manager. The following are the results of implemented project performance showing the reduction of poor quality of work, reduction of project completion delay, and improvement of customer satisfaction.

6.2.1 Poor quality of work reduction

There was less failure of work incurred by the design procedure because the use of review checklist helped design engineer to prevent and to detect the failure. For the design procedure of TMC project before awarding, the use of Customer Requirement Review checklist [F-PE-019-0] caused design engineer understand the customer requirement and beware the critical design condition. In addition, the Design Basic Specification checklist [F-PE-020-0] has been used to review the designed equipment and system whether the criteria design or specification of component or supported document. With both review actions, the failure from design has been detected and corrected before proceeding the designed document and cost estimation. For example, the enhancement of physical property of resin used in water softener was detected whilst the design basic specification review was carried out. This was because design engineer updated information with purchasing department and was informed that supplier advise to design the system with the new resin. This new resin will be launched soon and will replace the previous model. As a result, design engineer has changed the design following the new model. This could reduce the rework period for redesign the steel vessel dimensions, the cycle time of system, and chemical tank because, actually, such information will be found when the items are arrival.

In the design phase after TMC project has awarded, Contract Verification checklist [F-PE-021-0] has guided the project engineer to verify the contractual requirement and the deviation between the proposed system and the contract. This has prevented the rework required for redesign Multimedia filter capacity and the financial

loss for the additional component of Multimedia filter due to the contract required additional filtrated water to supply Cooling Tower.

However, there were some reworks happened in the project execution both design and installation phases. They include the redesigned the concept of control panel that was found during the inspection at the subcontractor site and reinstalled the pipe route for chemical injection to the tank found whilst the individual equipment was tested. Rework also included repairing work such as pipe leakage, wrong position of floated level switch, and the damage of material coated on steel vessel surface due to delivery and during the placing on site. Moreover, there were a large number of reworks incurred by the external impact. They included redesign function of control panel since the customer required to monitor the total treated water and usage volume, reinstall the pipe route according to the customer advice at site and to avoid the intersection with the pipe for fire pump. The figure below shows the number of reworking hours comparing with the project planning hours.

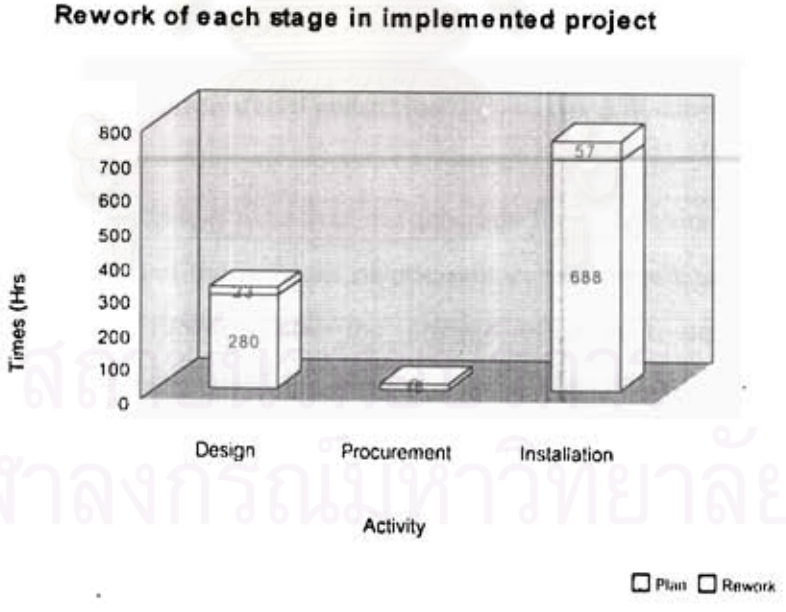

Figure 6.1: The comparison of reworks between before and after implementation

Source : Data of XYZ company

For the failure of work explained in term of financial loss, it was less because of less overtime spent for rework and a little number of additional components required for replacing. The following figure showing the quantity of financial loss incurred in each stage of TMC project.

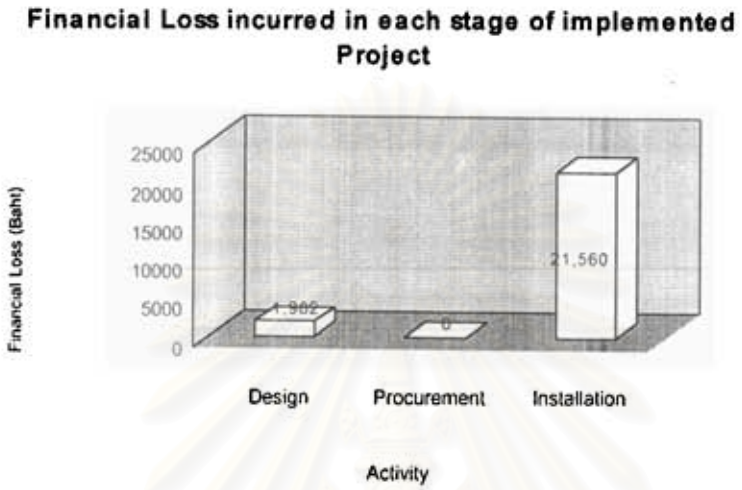

Figure 6.2 : Financial Loss incurred in the implemented project

Source : Data of XYZ company

6.2.2 Project completion delay reduction

The project completion was over than the schedule three days due to the redesign the electrical control panel and the reinstall of interconnecting pipe. Customer required adding the control panel function and the change of pipe route from another subcontractor in TMC project caused installation schedule could not be controlled to finish on time. Actually, project manager could control the schedule of design and installation activities by reviewing diary report [F-PE-017-0] submitted twice a week, on Monday and Wednesday morning. The progress of work has shown, together with the next plan for the day after, thus project manager could know the status of project and request overtime to do the work that in the over scheduled.

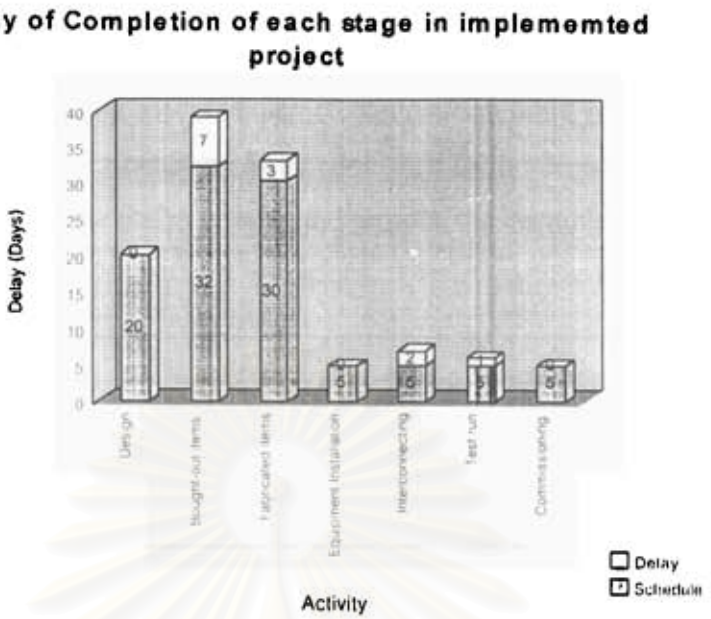

Figure 6.3 : Delay completion of each step in implemented project

Source : Data of XYZ company

6.2.3 Improvement of customer satisfaction

In the TMC project, there was less customer dissatisfaction whether in terms of scope of work and scope of supplied equipment or the project completion period or defect of work, or technical specification.

In order for clearly understanding of contractual requirements and preventing the discrepancies, Project engineer and Site management has verified the contract before proceeding the subsequent process. They found that most of the requirements both scope of work and scope of equipment supplied were similar to the proposed system and tender document. Only the requirement of treated water for supplying to Cooling Tower was added. Even though it caused the capacity of Multimedia filter has to be increased, there was less impact if it has been found before detailed design activity. However, this requirement was prepared at the design phase. It could prevent the customer dissatisfaction.

Although the project completion has delayed, it brought about from the additional requirement of customer and another subcontractor operation. The customer, therefore, did not fell dissatisfy in the delay of completion. This was because during project execution, the others schedule could be controlled to finish earlier for some tasks and later for some tasks. In the entire view of the project, the customer satisfies the time spent in this project.

The failures of installation work caused a bit dissatisfaction in the customer mind. Anyway, it has been rectified before the completion of project installation. The final aspect of customer satisfaction was the technical specification. With the preparation of the designed document during the contract preparation, technical specification of all equipment and complementary equipment has more clarified in the design document submitted to the customer. The customer has understood and has no requested to change any equipment.

6.3 Evaluation the Failure Mode and Effect Analysis

Item	Potential Failure Mode	RPN 1 (Before)	RPN 2 (After)	% Change
1	Insufficient information	448	56	88
2	Failure of installed equipment	280	72	74
3	Designed specification has error in calculation	224	64	71
4	Incorrect control panel Function	224	32	86
5	Inappropriate instrument installed and calibration	192	32	83
6	Lacking of parts during installation	160	48	70
7	Specific component inappropriate standard	144	16	89
8	Inappropriate equipment specification is designed	128	64	50
9	Loss information of project execution	128	72	44
10	Inappropriate route pipe	128	24	81
11	Select inappropriate subcontractor	126	90	29
12	Incorrect position of installed Equipment	120	24	80
13	Lack of installation tools	120	32	73
14	Select poor performance vendor	108	90	17
15	Poor quality of product to be received	105	28	73
16	Misunderstand customer Requirement And condition of design	105	42	60
17	Loss information of customer requirement	105	28	73

Table 6.1: The comparison of RPN after implementation

The FMEA team has been requested to attend in the meeting for evaluating the results of project implementation, after the project has completed. Each of Seventeen activities that have RPN greater than 100 is reevaluated the Severity, Occurrence, and Detection value. Table 6.4 is indicating the results of RPN after implementation (RPN2) comparing with the RPN before implementation (RPN1), and the percentage of changing as well. From the table, it is shown that the RPN after implementation (RPN2) has reduced in the range from 17% to 89% comparing with the RPN before implementation (RPN1). The potential failure mode of selecting poor performance vendor has less reduction, 17 %, since the improved vendor survey procedure has just begun, and there are few improved vendors in the list. The consequence is the same value of Occurrence score. However, the Detection value has reduced from 6 to 5 according to the results of having improved vendor list. As a result, RPN value of this process has less changed. On the other hand, the potential failure mode of specific component inappropriate standard has more reduction, 89%. This is because the use of checklist has assisted design engineer to review the designed specification, thus the occurrence of this failure reduced from score 6 to 2. In addition, the designed detail checklist can detect this potential problem. As a result, the Detection value has reduced from 6 to 2 as well as Occurrence. The consequence is RPN value reduction from 144 to 16 or 89 percent.

The project management of implemented project, furthermore, has been enhanced by proposed quality assurance activities. The improved document and created document such as equipment data sheet and interconnecting pipe drawing could reduce the probability that potential causes of the failures will occur (Occurrence). This is because such documents have guided the project team to perform their work. This meant that the potential failure is less chance to occur, if the condition of operation still in the range and detail describing in those documents. The verification activity and the use of checklist have improved the ability of the proposed system to detect the potential causes of failures. This is because the project team has been reminded by the review checklist to perform the vital and important tasks in the project execution.

6.4 Improvement of project management after implementation the quality assurance activity

With the proposed quality assurance activities, the project management for water treatment plant has improved in more several areas. The explanations below are the improved areas of the implemented project.

6.4.1 Improve the design output

Having controlled the use of modified Customer Requirement Questionnaire, necessary and critical information for project execution is collected completely by project sale engineer. Basically, that document is provided to check out the customer requirement in term of what type of system is required or how much treated water quality is needed, or how many capacity of system is used. Sometimes, the customer has specified equipment or system needed. Besides the customer requirements have been recorded, the supplied information or equipment or the others facilities are collected as well. They usually include the raw water quality, existing system, available area or location, and the electricity. The proposed system has modified this single checklist, normally being blank form, to be double checklist in order to ensure that scope of work and equipment supplied in proposal are met the customer requirement. The client needs, therefore, are evident listed and then before proposal submission, each item of these needs is searched in the proposal. If any requirement item is not met, the rectification that maybe adds that equipment or increase the scope of work is immediately carried out. Furthermore, the completion of collected data not only reduces the time for system designed but also improves design output and proposes the system with the competitive price.

6.4.2 Improve System validation

With the proposed system, engineering design worksheet and equipment data sheet has been prepared to record the results of design calculation: for example, what the criteria design are and how any equipment or component specification is designed. Importantly designed data is traceable. Consequently, whenever the designed system is

required the maintenance or required to increase of capacity, it spends less time to find out such designed input data. Otherwise, the problem incurred during normal operation can be found the solution and solved immediately by checking the results of design calculation and criteria design.

6.4.3 Improve reliability on customer aspect

In bidding phase, Customers usually dissatisfy and unreliable when they have found more errors, design failures of proposed specification, and incomplete scope of work. With the improved design procedure, the design output that basically specified in the form of proposal is verified by review checklists. Thus, the errors or failures found will be rectified before submission to the customers.

For awarded project, the failure of system operation owing to the design or installation can be detected at the earlier phases: detailed design failure is detected at the design procedure and installation failure is detected both during installation and before commissioning procedure. There is no repair or rework requirement that has to be done on the customer face, hence it can prevent the customer dissatisfaction and improve the reliability on customer aspect as well.

6.4.4 Improve the comprehension and clarification scope of work and customer requirements

The procedure of contract verification requests the project engineer and site management to study and to comprehend the scope of work and customer requirement at the beginning of awarded project. This is to ensure that the contractual requirement can be met by the proposed system. Moreover, understanding scopes of work and requirement clearly cause Project engineer has planned and assigned the resources effectively. For Site management aspect, the effective installation activities can be planned and executed from the understanding scope of work. These also include to prevent the failure incurred from installation procedure and to facilitate activities of installation. In case of having deviations or discrepancies specified in the contract, they will be found and discussed with the customers immediately in order to prevent the problem of doing out of scope and customer dissatisfaction.

6.4.5 Improve the project monitoring

Project manager can monitor the progress of project execution easier than previous project because the proposed quality assurance system has required project team report their works weekly during the design phase and twice a week during installation phase. In diary report, the recorded information includes task to be done, percent of task completed, task due date, next planned task, and responsible person. This information can imply the status of project in term of task completed, slippage tasks, and resource usage. Project Manager has mainly reviewed the task being done and its possibility to finish on the due date in order to plan the resource expended for the task over schedule.

6.4.6 The project operation cost and material cost reduction

The costs of project execution that evident reduction comprises the overtime cost and material cost. Since Project manger can closely monitor the certain status of project execution, the overtime requirement is carried out only the task that has time constrain. For the material cost reduction, the less of design failure and installation failure bring about the wastable material has reduced accordingly. Design assurance activity such as design review minimizes the occurrence of failure since any failure will be found and corrected at the design phase. This means the ordering of any wrong or inappropriate raw material is prevented. As well as the performance of design assurance activity, installation assurance activity, meaning to prepare installation and fabricated drawing, cause the use of material such as pipe more precisely. Therefore, there are fewer scraps from the project installation.

6.4.7 Improve equipment consistency

The proposed quality assurance activity has requested to assess the quality of subcontractor and vendor performance, thus any vendor and subcontract who has less or poor quality of performance will not be selected to involve in the project. This quality assurance activity also includes rechecking the incoming materials, and accepting only the materials that theirs quality are in the acceptance quality range. Sometimes, a few damage of component from deliver process can be accepted if that damage does not

significant impact on the quality of system. This means that the damage or the out of operation of equipment or system is prevented. The consistency of equipment is improved.

6.4.8 Improve the current project activity

The actual time spending for some tasks of the project execution has less than the scheduling especially the task in installation phase. With using of installation control document, installation team has understood each work clearly. As results, such task is carried out complete earlier. However, the schedule of each task is planned base on the past project performance that without the installation document.