CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

The study of the quality assurance for design control of transmission and distribution substation started from overview the design of substation project which described the technical document and the general design process of substation project as described in chapter 3. The technical document for substation comprised of the general project document, the primary circuit design and the secondary circuit drawings.

The general design process of substation project which can be mainly divided into two type of design function as the primary circuit design and secondary circuit design. The primary circuit design means the design activities for Switchyard & Substation Layout. The secondary circuit design means the design activities for Control and Relay protection.

Then the analysis of current substation design process was described in chapter 4. The main design process are as below;

1. Project Transfer
2. Design Planning
3. Design Input
4. Design Process
5. Design Review
6. Approval
7. Distribution for end users
8. Project Execution
9. As Built Drawing

The main problems in the design substation comprised of 1) lack of document and data control , 2) lack of procedures to control and 3) technical problems.

The feedback information from the past projects execution was collected during last three years starting from 1998 to 2000 in by classified into 3 categories as time schedule aspect, technical aspect and financial aspect including the result by using the FMEA analysis.

For time schedule aspect, the planning time schedule and the actual time schedule are used to compare. These are shown in table and figure 4.1.

For technical aspect, the number of design change will be recorded. The table and figure 4.2 are shown the design changes record for five projects before implement the quality assurance of design work.

For financial aspect, the percentage of the additional man hours charge and material and other cost for five projects are shown in table and figure 4.3 .

After apply the quality assurance system to the existing design process, the new flowchart of design work will be launched as shown and described in charter 5. This includes the document control such as design check lists and forms (D01-D20) and working manuals (WM01-WM20) also be created as shown in appendix IV and V.

The proposed quality assurance system for design substation has been implemented in PEA 5-11 project during March 1999 to May 2000. Before implementation of the quality assurance system, the design staffs were explained about the detail of design procedures, design instruction manuals and control document. The design work of this project was implemented according to the quality assurance system. The procedure of design work are followed as the flowchart diagram in appendix II. This included that the standards check list, form, document control and design working manuals were applied to this project .

The result of implementation were the improvement in time schedule, technical , financial and customer aspect as detail below;

1. The percentage of delay time of this project comparing with the last five projects was decrease as shown in table and figure 6.1.
2. The number of design changes in this project was less than the past project. This includes the effect of design changes was also reduced (project time schedule and additional cost) as shown in table and figure 6.2
3. The man-hours spent in this project was less than the budget by using the past project to be criteria including no overtime cost spent in this project also. The number of reworks and design changes was reduced including the unexpected cost as shown in table and figure 6.3.

The result of FMEA implementation in PEA 5-11 Project was analyzed by design team. The value of RPN exceed than 100, is evaluated by design staff as in appendix III. The difference of RPN1 and RPN2 is compared in percentage of change ranging form 36% to 93% as shown in table 6.4

7.2 Recommendation

The recommendation after study the quality assurance for design substation are as follows;

7.2.1 Apply the Quality Assurance System to other segments.

Refer to the activities chart in appendix I , there are other segments which can be applied the quality assurance such as Project management, Contract preparing and etc.

7.2.2 Continuous improvement the Quality Assurance System.

Although the quality assurance has already established in the engineering division, the continuous improvement in each procedure need to be applied. This includes the internal training should be settled in order to ensure that all staffs still understand and follow the quality assurance system.

7.2.3 Further improvement in the engineering division.

The design check list and working manual are not covered all design functions. So the design team should prepare the additional check list and working manual in order to cover all design function.

7.2.4 Concurrent Engineering

Concurrent engineering is a contemporary expression for a working method suitable for design of substations. The policy of Concurrent engineering is built on agreed work procedures, mutual confidence and partnership so hat parallel activities can take place by all partners involved. Effective data interchange is an obvious necessity.

This policy is particularly important for substation design where the final result very much depends on specific functional requirements for the project and the co-ordination of equipment included. It is important that the requirements are clearly defined before start of manufacturing with regard to the delivery time, but the requirements must not be requested with large time margin. The "just in time" strategy has to be used also for information.

Information and requirements can be transferred in many different ways; in meetings, specification and drawings etc. However, this type of data transferring, connected to contractual agreements must be verified and approved for release. For this reason defined and registered documents always have to be used.