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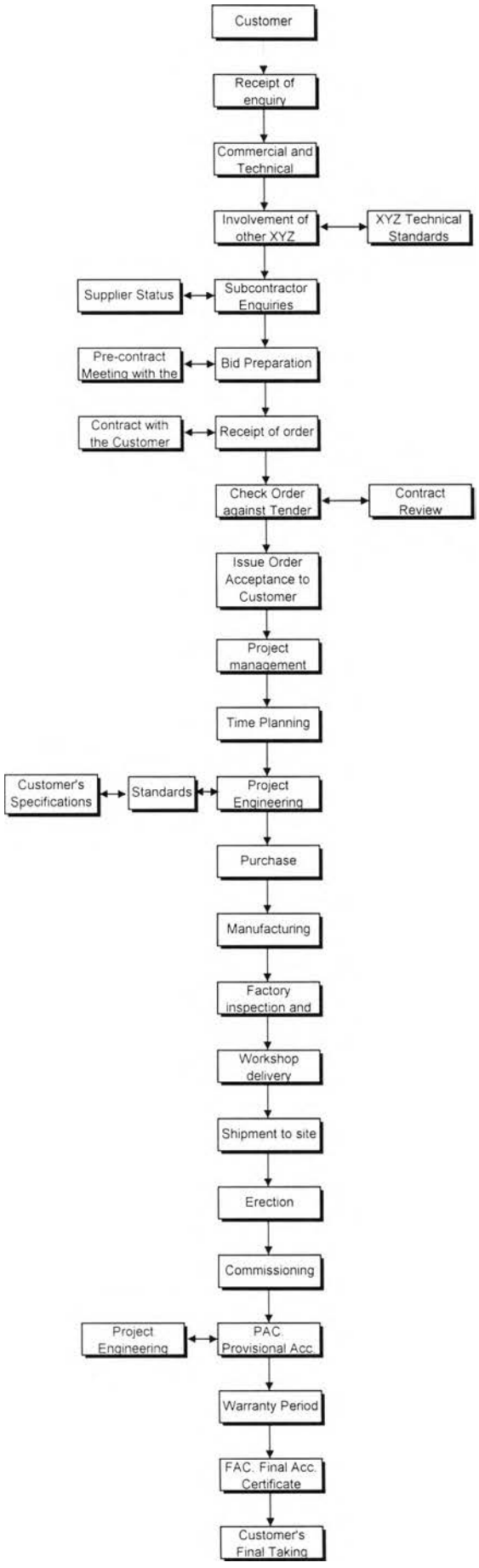
APPENDICES

APPENDIX I

XYZ SUBSTATION ACTIVITIES CHART

XYZ Substation
Activity Chart



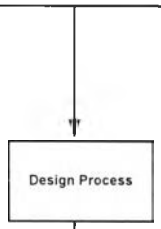
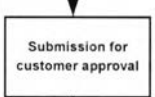
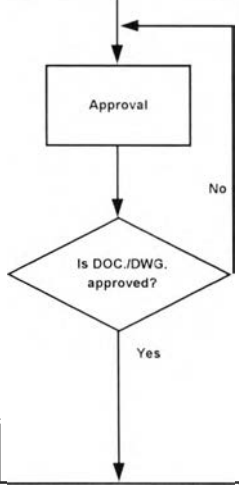
APPENDIX II

DESIGN FLOW CHART BEFORE / AFTER IMPLEMENTATION OF QUALITY ASSURANCE

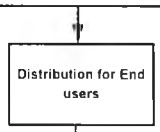
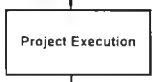
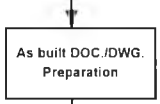
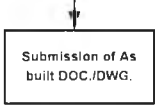
Design Flowchart before implementation of quality assurance

Item	S./NO.	Input	Work Process	Work Description	Work Instruction	Resp. Person	Output	Output Interface
1	1.1	-Job assignment -Award contract	start Job request from project manager	-To inform the contract's award.	-	DM.	-	-
	1.2	-Input of 1.1	Data Study	-To study the scope of work and customer specification of substation project.	-	DM.	-	-
	1.3	-Input of 1.1 and -The experience and availability of the design engineer.	Selection of design engineer	-To select the suitable design engineer for the project.	-	DM.	DE.	PM
	1.4	-Request form for meeting -Input of 1.1 -Tender document -Proposal data -Quotation -Price schedule -Master project schedule -Deviation document	Internal KOM	-To attend the meeting and review related technical matter, scope of work transferred from project manager to design staff.	-	DM/DE	MOM	
2	2.1	Input & Output of 1.4	Find out the scope of delivery and design requirement	-To study deeply as follow; *Scope of work* *Technical matter* *Customer specification and drawings* *Abbreviation* *Our offer,fax and letters* *Our quotation* *Basic Data* *General requirement* *Standard* *Design Schedule* *Drawing list* *Supplier Selection and etc.*		DM/DE		PM
	2.2	Input & Output of 2.1	Arrange Filing System	-To prepare a filing system for all document related in the project.		DE.	Design working file	-
	2.3	Input & Output of 2.1	List of DOC./DWG. for submission	-To prepare a list of doc-document and drawing submitted to customer. -To identify the document and drawing number.		DE.		Customer
3	3.1	Input & Output of 2.1	Design Input	-To get the design input to complete design work. *System study report.* *Basic block diagrams.* *Preliminary layout drawings.* *Basic system diagrams.*		DE.	Design input data	

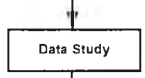
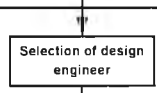
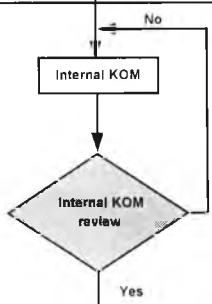
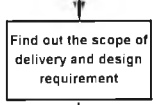
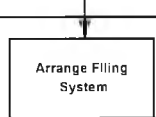
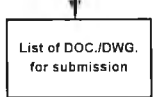
Design Flowchart before implementation of quality assurance

Item	S./NO.	Input	Work Process	Work Description	Work Instruction	Resp. Person	Output	Output Interface
4	4.1	Input & Output of 3.1		-To complete design work as detail belows; *Single line diagram.* *General layout plan.* *Conceptual design* *-System diagram* *-Block diagram* *-Function diagram* *-Panel front view* *-Panel location* *-List of lable* *-List of main equipment* *Detail design* *-Bus structure plan* *-Switchyard section* *-Steel structure* *-Foundation plan* *-Cable trench* *-Earthing plan* *-Plant circuit diagram* *-Equipment circuit diagram* *Calculation* *-Condutor sag& tension cal.* *-Steel structure cal.* *-Earthing cal.* *-CT&VT cal.* *Bill of material & list of apparatus* *-Switchyard equip-ment & material* *-Earthing material* *-Cable ladder & steel structure* *-Relay equipment* *-Cable & access-ories* *-List of apparatus*		DE.	Design output	-Customer -Project team -Supplier -Etc
5	5.1	Output of 3.1 & 4.1				DM.		
6	6.1	Output of 4.1		-To submit design document and drawing for customer approval.		DE		Customer
	6.2	Output of 6.1		-To return the approved document and drawing with comments (if any). -To check for customer comments and discrepan-cies. -To submit for re-approve (if necessary).		DE/DM	Approved Doc./Dwg.	Customer

Design Flowchart before implementation of quality assurance

Item	S /NO.	Input	Work Process	Work Description	Work Instruction	Resp. Person	Output	Output Interface
7	7.1	Output of 6.2		-To distribute the approved document and drawing for end users.		DE		Commiss-ioning Erection and etc
8	8.1	Input of 7.1		-Installation and commiss-ioning work.	-	Project team	Working progress	Customer
9	9.1	Output of 8.1		-To prepare the as built drawing in accordance with contract requirement.		DE.	As built dwg.	Customer
	9.2	Output of 9.1		-To submit the as built drawing to customer.	-	DE		Customer

Design Flowchart after implementation of quality assurance

Item	S./NO	Input	Work Process	Work Description	Work Instruction	Resp. Person	Output	Output Interface
1	1.1	-Job assignment -Award contract		-To inform the contract's award.	-	DM.	-	-
	1.2	-Input of 1.1		-To study the scope of work and customer specification of substation project.	-	DM.	-	-
	1.3	-Input of 1.1 and -The experience and availability of the design engineer.		-To select the suitable design engineer for the project.	-	DM.	DE.	PM
	1.4	-Request form for meeting -Input of 1.1 -Tender document -Proposal data -Quotation -Price schedule -Master project schedule -Deviation document		-To attend the meeting and review related technical matter, scope of work transferred from project manager to design staff.	Internal KOM check list (D1)	DM/DE	D1 doc. & MOM	
2	2.1	Input & Output of 1.4		-To study deeply as follow; *Scope of work* *Technical matter* *Customer specification and drawings* *Abbreviation* *Our offer.fax and letters* *Our quotation* *Basic Data* *General requirement* *Standard* *Design Schedule* *Drawing list* *Supplier Selection and etc.*	Design planning check list (D2)	DM/DE	D2 doc.	PM
	2.2	Input & Output of 2.1		-To prepare a filing system for all document related in the project.	Design Working Manual (WM01)	DE.	Design working file	-
	2.3	Input & Output of 2.1		-To prepare a list of doc-document and drawing submitted to customer. -To identify the document and drawing number.	Design Working Manual (WM02&03) Design schedule (D3) Design Document Status (D4)	DE.	D3&D4 doc.	Customer
	2.4	Input & Output of 2.1		-To prepare design quality plan to the project.	Design Quality Plan (D5)	DE.	D5 doc.	Customer (if required)

Design Flowchart after implementation of quality assurance

Item	S./NO.	Input	Work Process	Work Description	Work Instruction	Resp. Person	Output	Output Interface
3	3.1	Input & Output of 2.1	Design Input	-To get the design input to complete design work. *System study report.* *Basic block diagrams.* *Preliminary layout drawings.* *Basic system diagrams.*	Desing in Progress Check list (D6)	DE.	Design input data & D8	
4	4.1	Input & Output of 3.1	Design Process	-To complete design work as detail belows; *Single line diagram.* *General layout plan.* *Conceptual design* *-System diagram* *-Block diagram* *-Function diagram* *-Panel front view* *-Panel location* *-List of lable* *-List of main equipment* *Detail design* *-Bus structure plan* *-Switchyard section* *-Steel structure* *-Foundation plan* *-Cable trench* *-Earthing plan* *-Plant circuit diagram* *-Equipment circuit diagram* *Calculation* *-Condutor sag& tension cal.* *-Steel structure cal.* *-Earthing cal.* *-CT&VT cal.* *Bill of material & list of apparatus* *-Switchyard equipment & material* *-Earthing material* *-Cable ladder & steel structure* *-Relay equipment* *-Cable & accessories* *-List of apparatus*	Design Working Manual (WM01-20) Desing in Progress Check list (D6)	DE.	Design output & D8 doc.	-Customer -Project team -Supplier -Etc.
5	5.1	Output of 3.1 & 4.1	Design Review & Verification	-To ensure that the design output meet the design input.	Design Review and Verificaiton check list (D7) Design Review report (D8)	DM.	D7&D8 doc.	
6	6.1	Input & Output of 3.1 Output of 4.1 Design change request doc. from customer	Design Change	-To ensure that the procedures of review & verify this change are carried out & documemted	Design Modification Proposal (D9) The summary of additional hours and costs (D10) Design change request form (D11)	DE & DM	D9,D10& D11 doc.	PM Customer

Design Flowchart after implementation of quality assurance

Item	S./NO	Input	Work Process	Work Description	Work Instruction	Resp. Person	Output	Output Interface
7	7.1	Output of 4.1	Submission for customer approval	-To submit design document and drawing for customer approval.	Letter of Transmittal form(D12) Doc./Dwg. for approval check list (D13)	DE.	D12&D13 doc.	Customer
	7.2	Output of 7.1	Approval → Is DOC./DWG. approved? (No → Approval; Yes →)	-To return the approved document and drawing with comments (if any). -To check for customer comments and discrepancies. -To submit for re-approve (if necessary).		DE/DM	Approved Doc./Dwg.	Customer
8	8.1	Output of 7.2	Distribution for End users	-To distribute the approved document and drawing for end users.	Letter of Transmittal form (D12) Distribution Design Doc./ Dwg.check list (D14)	DE	D10	Commissioning Erection and etc.
9	9.1	Input of 8.1	Project Execution	-Installation and commissioning work.	-	Project team	Working progress	Customer
10	10.1	Input & Output of 9.1	Design Validation	-To ensure that the system conforms to customer requirement by testing or commissioning	-	Commissioning	Test report	Customer
11	11.1	Output of 9.1	As built DOC./DWG. Preparation	-To prepare the as built drawing in accordance with contract requirement.	As built drawing check list (D15)	DE.	As built dwg.	Customer
	11.2	Output of 11.1	Submission of As built DOC./DWG.	-To submit the as built drawing to customer.	-	DE		Customer
12	12.1	Input & Output of 8.1	Feedback Design Result	-To prepare the feed back design result.	Feedback design result form (D16)	DE	D16 doc.	-

APPENDIX III

FAILURE MODE AND EFFECT ANALYSIS (FMEA) FOR SUBSTATION PROJECT DESIGN

POTENTIAL FAILURE MODE
AND EFFECTS ANALYSIS (PROCESS FMEA)

Item PEA 5-11 Process Respons. Design process
Substation System 22kV MV SWG Key Date 5 January 2000
Core Team 1.Suchin 2.Rummiya 3.Chanwit

FMEA Document no. FMEA-ENG-001
Prepared By Suchin Samatiwat
FMEA Date (Orig.) 20 September 1999
FMEA Date (Rev.) 14 February 2000

S/ No.	Process Function and Requirements	Potential Failure Mode	Potential Effect (s) of Failure	Sev	Potential cause (s) / Mechanism (s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action (s)	Responsibility & Target Completion Date	Action Result: Actions Taken	Sev	Occ	Det	R.P.N.
1.1	Job request from Project Manager	Insufficient information transfered from Project Manager	Lack of data to study and clarify	2	Not enough information from customer	3	None	10	60	-	-	No action	-	-	-	-
1.2	Data Study	Insufficient information to study	Fail to select the Design Engineer effectively	3	Not enough information from customer -Do not know system well -Give information lately	3	None	10	90	-	-	No action	-	-	-	-
1.3	Selection of Design Engineer	The selected Design engineer is not suitable for the project	Take longer time to do the design work and cannot do the design effectively	5	There is no choich to select because other design engineers are not available.	4	Check from experience	4	80	-	-	No action	-	-	-	-
1.4	Internal Kick off meeting	Deviation between the invitation to Bid and the contract is not discussed	Lead to the customer dissatisfaction	8	Project staff forgets to discuss this information during the meeting	6	None	10	480	Establish the formal check list during attend the KOM	Suchin 20 Jan 2000	Control Doc. D1 was implemented in PEA5-11 Project	8	3	3	72
		Verbal Commitments are not fully discussed	Lead to the customer dissatisfaction	7	Project staff forgets to discuss this information during the meeting	6	None	10	420	Establish the formal check list during attend the KOM	Suchin 20 Jan 2000	Control Doc. D1 was implemented in PEA5-11 Project	7	4	3	84

POTENTIAL FAILURE MODE
AND EFFECTS ANALYSIS (PROCESS FMEA)

Item PEA 5-11 Process Respons. Design process
Substation System 22kV MV SWG Key Date 5 January 2000
Core Team 1.Suchin 2.Rummiya 3.Chanwit

FMEA Document no. FMEA-ENG-001
Prepared By Suchin Samatiwat
FMEA Date (Orig.) 20 September 1999
FMEA Date (Rev.) 14 February 2000

S/ No.	Process Function and Requirements	Potential Failure Mode	Potential Effect (s) of Failure	Sev	Potential cause (s) / Mechanism (s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action (s)	Responsibility & Target Completion Date	Action Result: Actions Taken	Sev	Occ	Det	R.P.N.
		Failure to check the customer data/document (any discre-pancies)	Lead to the customer dissatisfaction	8	Project staff forgets to discuss this information during the meeting	6	None	10	480	Establish the formal check list during attend the KOM	Suchin 20 Jan 2000	Control Doc. D1 was implemented in PEA5-11 Project	8	3	3	72
2.1	Find out the scope of delivery	Failure to understand some items in the scope of delivery	Design mistake	8	Do not study the requirement carefully and so many items are discussed in short time	5	None	10	400	Establish the formal check list	Suchin 20 Jan 2000	Control Doc. D2 was implemented in PEA5-11 Project	8	4	3	96
2.2	Arrange Filing system	Difficult to find out document	Take long time to use some information	5	There is no a good filing system to keep the project's document	6	None	10	300	Establish design working manual to keep document with the same standard	Suchin 20 Jan 2000	Control Doc. WM01 was implemented in PEA5-11 Project	5	2	3	30
		Loss of some document used in project	Design mistake	8	There is no a good filing system to keep the project's document	6	None	10	480	Establish design working manual to keep document with the same standard	Suchin 20 Jan 2000	Control Doc. WM01 was implemented in PEA5-11 Project	8	3	2	48
2.3	List of DOC./ DWG. for submission	List of doc./ Dwg. is not coverred all customer requirement	Lead to customer dissatisfaction	8	Lack of enough information or experience	6	Compare to customer requirement	5	240	Establish the formal document such as -form -check list	Suchin 20 Jan 2000	Control Doc. D3 & 4, WM2 &3 was implemented in PEA5-11 Project	8	2	2	32

POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS (PROCESS FMEA)

Item PEA 5-11 Process Respons. Design process
Substation System 22kV MV SWG Key Date 5 January 2000
Core Team 1.Suchin 2.Rummiya 3.Chanwit

FMEA Document no. FMEA-ENG-001
Prepared By Suchin Samatiwat
FMEA Date (Orig.) 20 September 1999
FMEA Date (Rev.) 14 February 2000

S/ No.	Process Function and Requirements	Potential Failure Mode	Potential Effect (s) of Failure	Sev	Potential cause (s) / Mechanism (s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action (s)	Responsibility & Target Completion Date	Action Result: Actions Taken	Sev	Occ	Det	R.P.N.
		Design schedule is not related to project schedule	Project Manager cannot keep the project schedule on time	7	Design schedule is much longer than PM. expectation.	5	To ask design staff directly	4	140	Establish the formal document such as -form -check list	Suchin 20 Jan 2000	Control Doc. D3 & 4, WM2 &3 was implemented in PEA5-11 Project	7	2	2	28
2.4	Prepare Design Quality Plan	Quality plan does not apply to the actual project	Poor design work	5	There is no design quality plan	6	None	10	300	Establish the formal procedure -Form -Document required	Suchin 20 Jan 2000	Control Doc. D5 was implemented in PEA5-11 Project	5	3	3	45
3	Design Input	Insufficient design information	Design mistake	6	Lack of process control	8	None	10	480	Establish the formal procedure and check list	Suchin 20 Jan 2000	Control Doc. D6 was implemented in PEA5-11 Project	6	2	3	36
4	Design Output	(See Design FMEA)														
5	Design review and verification	Failure to check the design output meet the design input	Lead to customer dissatisfaction	7	There is no process to control	8	Check with contract	6	336	Establish the formal procedure -Form -Document required	Suchin 20 Jan 2000	Control Doc. D7 & D8 was implemented in PEA5-11 Project	7	2	2	28
6	Design change	Design change from customer	Rework and delay of work	8	Customer environ-ment change such as network change, regulation change	8	Check with contract	8	512	Establish the formal change order procedure and form are required	Suchin 20 Jan 2000	Control Doc. D9,10,D11 was implemented in PEA5-11	8	4	3	96

POTENTIAL FAILURE MODE
AND EFFECTS ANALYSIS (PROCESS FMEA)

Item PEA 5-11 Process Respons. Design process
Substation System 22kV MV SWG Key Date 5 January 2000
Core Team 1.Suchin 2.Rummiya 3.Chanwit

FMEA Document no. FMEA-ENG-001
Prepared By Suchin Samatiwat
FMEA Date (Orig.) 20 September 1999
FMEA Date (Rev.) 14 February 2000

S/ No.	Process Function and Requirements	Potential Failure Mode	Potential Effect (s) of Failure	Sev	Potential cause (s) / Mechanism (s) of Failure	Occur	Current Process Controls	Det	R.P.N.	Recommended Action (s)	Responsibility & Target Completion Date	Action Result: Actions Taken	Sev	Occ	Det	R.P.N.
					and etc.							Project				
7.1	Submission for customer approval	Number of document submitted for approval is not equal as the agreement	Resend and may lead to customer dissatisfaction	5	Do not check with the contract	3	Check with the contract	4	60	-	-	None	-	-	-	
7.2	Approval	Failure to check the revised DOC./DWG.	Lead to customer dissatisfaction	6	There is no process to control	5	Visual check	5	150	Establish the formal form and check list	-	Control Doc. D12 & D13 was implemented in PEA5-11 Project	6	2	2	24
8.1	Distribution for end users	Number of document submitted to end users are not equal as the agreement	Resend and lead to waste the time	4	Do not check with the agreement	4	Check with the agreement	5	80							
		Wrong distri-bution to end users	Resend and lead to waste the time	3	Do not check with the agreement	3	Check with the agreement	5	45							
		Incorrect to stamp the purpose of Doc./Dwg.	Resend and lead to waste the time	5	Do not check with the agreement	6	Check with the agreement	4	120	Establish the formal form and check list	Suchin 20 Jan 2000	Control Doc. D12 & D14 was implemented in PEA5-11 Project	5	3	2	30

POTENTIAL FAILURE MODE
AND EFFECTS ANALYSIS (PROCESS FMEA)

Item PEA 5-11 Process Respons. Design process
Substation System 22kV MV SWG Key Date 5 January 2000
Core Team 1.Suchin 2.Rummiya 3.Chanwit

FMEA Document no. FMEA-ENG-001
Prepared By Suchin Samatiwat
FMEA Date (Orig.) 20 September 1999
FMEA Date (Rev.) 14 February 2000

S/ No.	Process Function and Requirements	Potential Failure Mode	Potential Effect (s) of Failure	Sev	Potential cause (s) / Mechanism (s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action (s)	Responsibility & Target Completion Date	Action Result: Actions Taken	Sev	Occ	Det	R.P.N.
9	Project Execution	None	-	-	-	-	-	-		- -	-	-	-	-	-	
10	Design validation	None	-	-	-	-	-	-		- -	-	-	-	-	-	
11.1	As built DOC./DWG. Preparation	Failure to revise as the red/green marks	Lead to rework and customer dissatisfaction	8	Human errors	6	Visual check	6	288	Establish the formal form and check list	Suchin 20 Jan 2000	Control Doc. D15 was implemented in PEA5-11 Project	8	3	3	72
		Failure to meet submittal schedule	Delay to close the project	4	No planning	2	None	10	80			No action	-	-	-	
11.2	Submission of As built DOC./DWG.	None	-	-	-	-	-	-		-	-	-	-	-	-	
12	Feedback Design Result	Cannot keep this information to use in the future project	Cannot get complete information	4	Commissioning and site staff do think this is the important records	5	None	10	200	Establish the formal procedure and form	Suchin 20 Jan 2000	Control Doc. D16 was implemented in PEA5-11 Project	4	2	2	16

POTENTIAL FAILURE MODE
AND EFFECTS ANALYSIS (DESIGN FMEA)

Item: PEA 5-11 Process Respons.: Design function process
Substation System: 22kV MV SWG Key Date: 5 January 2000
Core Team: 1.Suchin 2.Rummiya 3.Chanwit

FMEA Document no.: FMEA-ENG-002
Prepared By: Suchin Samatiwat
FMEA Date (Orig.): 20 September 1999
FMEA Date (Rev.): 14 February 2000

S/ No.	Design Function and Requirements	Potential Failure Mode	Potential Effect (s) of Failure	Sev	Potential cause (s) / Mechanism (s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action (s)	Responsibility & Target Completion Date	Action Result: Actions Taken	Sev	Occ	Det	R.P.N.
4	Perform the functions according to the customer's requirement	Poor design	Difficult to modify or additional work in the future	5	No experience	4	None	10	200	Standard or working manual are required for the same criteria	Suchin 20 Jan 2000	Working manual WM01-20 was implemented in PEA 5-11 Project	5	2	5	50
		Not fulfil the customer's requirement	Rework	7	There is no process to control	5	Check with contract	6	210	Review and Verification of design work is added in the procedure	Suchin 20 Jan 2000	Working manual WM01-20 was implemented	7	3	3	63
		Typing errors	Rework	5	Human errors	6	Visual check	3	90	-	-	No action	-	-	-	-
		Engineer design in hurry manner	Design mistake and rework	5	Human errors	5	Visual check	3	75	-	-	No action	-	-	-	-
		Design work is based on wrong standard	Rework	6	Do not study the customer's contract	5	Check with contract	5	150	Standard or working manual are required for the same criteria	Suchin 20 Jan 2000	Working manual WM01-20 was implemented in PEA 5-11 Project	6	4	4	96
		Design work is delay to submit	Customer dissatisfaction	7	No experience	4	To ask design staff directly	6	168	Standard or working manual are required for the same criteria	Suchin 20 Jan 2000	Working manual WM01-20 was implemented	7	2	2	28

APPENDIX IV

THE STANDARDS CHECK LIST, FORM AND DOCUMENT CONTROL FOR SUBSTATION PROJECT DESIGN (DOCUMENT D1 TO D16)

XYZ COMPANY
Substation Business

INTERNAL KICK OFF MEETING CHECK LIST

(D1)

(D1)

Internal KOM Check list

Substation :.....	Date:		
Project Name :.....	Checked by		
	Approved by		

ITEM	DESCRIPTION	YES	NO	REMARKS
1	**Organization chart** - Customer/Consultant requirement. - Preliminary proposal chart. - Job assignment of staff's. - Resume of staff's			
2	**Document Review** - Customer contract & specification. - Customer or Consultant drawing. - Preliminary proposal drawing. - Scope of work. - Proposal equipment & type. - Propose deviation or condition. - Preliminary manufacturing drawing. - Tendering BOQ/Estimation sheet.			
3	**Master project schedule** - Contract master schedule - Propose equipment order and delivery schedule - Preliminary design period - Construction, testing and commissioning schedule. - Agreed final completion date.			
4	**Project Meeting** - Kick up minute of meeting. - Hand over minute of meeting. - Internal meeting schedule & detail. - Customer meeting requirement. - Supplier meeting schedules & detail. - Co-ordination meeting schedule & detail.			

(D1)

Internal KOM Check list

Substation :.....		Date:	
Project Name :.....		Checked by	
		Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
5	**ISO/Quality Plan** - Is Quality plan required? - Quality inspection schedule & detail. - Quality document from supplier & other department. - Quality procedure necessary or not? - Quality inspector in organization chart.			
6	**Safety & Security** - Safety inspector in organization chart. - Is security system provided? - Security measures.			
7	**Civil & Other information** - Preliminary civil design drawing. - Equipment drawing & load detail. - Layout plan detail of S/S. - Boundary for scope of area. - Preliminary civil design schedule. - Construction schedule. - Other services such as Air-conditioning, Lighting, exhaust drawing & schedule. - Manhole, hand hole detail, schedule, scope of work.			

XYZ COMPANY
Substation Business

DESIGN PLANNING CHECK LIST

(D2)

Document no.	Approved by	Verified by	Issue date	Page	Rev.
XYZ-D2			10/08/1999	1 of 3	0

(D2)

Design Planning Check list

Substation :.....	Date:		
Project Name :.....	Checked by		
	Approved by		

ITEM	DESCRIPTION	YES	NO	REMARKS
1	**Design Schedule** - Specification time frame for design mentions in contract document. - Contract design schedule. - Preliminary/Propose schedule. - Over all schedule of project. - Is design schedule comply with customer requirement.			
2	**Basic Data** - Customer specification. - Correspondence and minutes of meetings. - Applicable standard. - XYZ Tender drawing, offer and deviation - Pre-design calculation.			
3	**Drawing List** - Is Minimum drawing requirement specified in specification? - Switchyard, Electrical, Communication drawing list. - Manufacturing drawing list. - Equipment drawing list. - Conceptual & detail design drawing list.			
4	**Supplier Selection, Drawing/ Documents** - Is equipment supplier finalizing? - Is proposal data approved? - Is equipment documents available? - Equipment drawing. - Drawing requirements. 1. Drawing size. 2. No-of copy. 3. Title block and drawing no.			

(D2)

Design Planning Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	4. Station name 5. Customer name 6. Clients requirements on drawing, rules, symbol, sign etc. 7. Lettering, size of script, line thickness. 8. Scale. 9. ACAD reference, directory file. 10. Tools.			
5	**General requirement** - Correspondence and minutes of meeting. - XYZ tender with drawing. - XYZ offer and deviation. - Drawing and specification provided by customer. - General conditions. - Local conditions. - Scope of works. - Proposal data. - Standard drawings. - Typical drawings. - Design drawings. - Scope of work. - Specification 1. Design criteria. 2. Substation equipment. 3. Installation specification. 4. Civil & Architectural work. 5. Other.			
6	**Standard** - Is standard specified? - Any require detail provided? - Other.			

XYZ COMPANY
Substation Business

DESIGN SCHEDULE

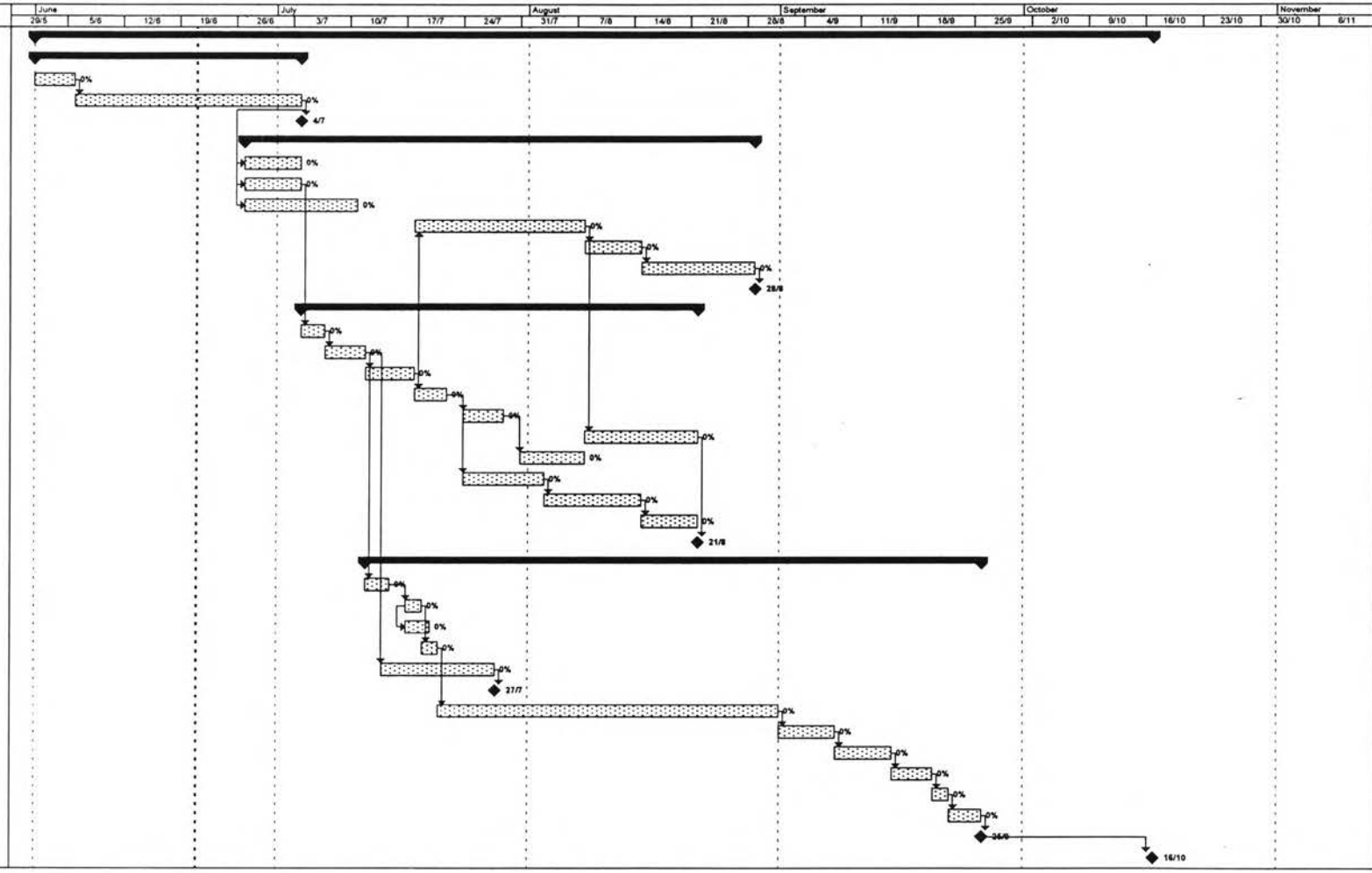
(D3)

Project :
Customer :

Design Plan

XYZ Limited
Prepared by : Suchin S.

ID	Task Name	Duration	Start	Finish	Predecessors
1	Design Phase	98 days	Thu 1/6/00	Mon 16/10/00	
2	Specification	23 days	Thu 1/6/00	Tue 4/7/00	
3	Review Scope of Work	3 days	Thu 1/6/00	Mon 5/6/00	
4	Technical Clarification	20 days	Tue 6/6/00	Mon 3/7/00	3
5	*Design Review*	0 days	Tue 4/7/00	Tue 4/7/00	4
6	Calculation Sheets	46 days	Tue 27/6/00	Mon 28/8/00	
7	Short Circuit Force Calculat	5 days	Tue 27/6/00	Mon 3/7/00	4FS-5 days
8	Insulation Co-ordination	5 days	Tue 27/6/00	Mon 3/7/00	4FS-5 days
9	Battery and Charger Calcula	10 days	Tue 27/6/00	Mon 10/7/00	4FS-5 days
10	Earthing Calculation	15 days	Tue 18/7/00	Mon 7/8/00	17
11	Short Circuit Calculation	5 days	Tue 8/8/00	Mon 14/8/00	10
12	Relay Setting and Co-ordina	10 days	Tue 15/8/00	Mon 28/8/00	11
13	*Engineering Calculations*	0 days	Mon 28/8/00	Mon 28/8/00	12
14	Switchyard Engineering	35 days	Tue 4/7/00	Mon 21/8/00	
15	Switchyard Data	3 days	Tue 4/7/00	Thu 6/7/00	8
16	Single Line Diagram	3 days	Fri 7/7/00	Tue 11/7/00	15
17	General Plan	4 days	Wed 12/7/00	Mon 17/7/00	16
18	Bus Steructure Layout	4 days	Tue 18/7/00	Fri 21/7/00	17
19	Bus Section Layout	5 days	Mon 24/7/00	Fri 28/7/00	18
20	Earthing Plan	10 days	Tue 8/8/00	Mon 21/8/00	10
21	Indoor Equipment Layout	6 days	Mon 31/7/00	Mon 7/8/00	19
22	Steel Structure Layout	8 days	Mon 24/7/00	Wed 2/8/00	18
23	Cable Trench and Conduit F	8 days	Thu 3/8/00	Mon 14/8/00	22
24	ID Plates Installation	5 days	Tue 15/8/00	Mon 21/8/00	23
25	*Drawing for Erection and Ci*	0 days	Mon 21/8/00	Mon 21/8/00	20
26	Electrical Engineering	64 days	Wed 12/7/00	Mon 25/9/00	
27	Block Diagram	3 days	Wed 12/7/00	Fri 14/7/00	16
28	Control and Relay Panel Lay	2 days	Mon 17/7/00	Tue 18/7/00	27
29	Panel Assembly	3 days	Mon 17/7/00	Wed 19/7/00	28SS
30	Interlocking Function Diagra	2 days	Wed 19/7/00	Thu 20/7/00	28
31	Single Line Diagram for Aux	10 days	Fri 14/7/00	Thu 27/7/00	16FS+2 days
32	*Conceptual Design*	0 days	Thu 27/7/00	Thu 27/7/00	31
33	Plant Circuit Diagram	30 days	Fri 21/7/00	Thu 31/8/00	30
34	Cable Table	5 days	Fri 1/9/00	Thu 7/9/00	33
35	Wiring Table	5 days	Fri 8/9/00	Thu 14/9/00	34
36	BOM / List of Apparatus	3 days	Fri 15/9/00	Tue 19/9/00	35
37	List of Labels	2 days	Wed 20/9/00	Thu 21/9/00	36
38	Used Terminals	2 days	Fri 22/9/00	Mon 25/9/00	37
39	*Drawing for Production*	0 days	Mon 25/9/00	Mon 25/9/00	38
40	*Final Document (Design Phase)*	0 days	Mon 16/10/00	Mon 16/10/00	39FS+15 days



Project:
Date

Task | Milestone | Rolled Up Task | Rolled Up Progress | External Tasks
Progress | Summary | Rolled Up Milestone | Split | Project Summary

XYZ COMPANY
Substation Business

DESIGN DOCUMENT STATUS

(D4)

Document no.	Approved by	Verified by	Issue date	Page	Rev.
XYZ-D4			10/08/1999	1 of 2	0

DOCUMENT SUBMISSION STATUS

Issue by | Date | Language | Register No. | Revision : 0 | Page :

Project : | Date :
Order no. : | Issued by :

Remarks : **AFC** = Asking for construction, **DFA** = Document for approval, **DFR** = Document for re-approval, **FFA** = Final document for approval, **RFA** = Reproducible document for approval
AP = Approved, **AN** = Approved except as noted, **FC** = For construction, **NR** = Not reviewed, **RA** = Received and acceptable, **RC** = Returned for correction

								Documents for Approval								Final Documents					
								1st		2nd		3rd		4th		Blue Print		Reproducible		MicroFilm	
	Document No.	Description	Sh.	Rev.		Issued		Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return
1					Plan		Ref.														
					Actual		Date														
							Status														
2					Plan		Ref.														
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XYZ COMPANY
Substation Business

DESIGN QUALITY PLAN

(D5)

Document no.	Approved by	Verified by	Issue date	Page	Rev.
XYZ-D5			10/08/1999	1 of 3	0

Quality Plan

Contract no:	**Customer:**	**Prepare by:**	**Date :**
	Consultant:	**Review by:**	**Date :**
Subject: Design Quality Plan	**Job no.:**	**Approve by:**	**Date :**

No.	Description	Specifying document	Record form	Procedure required	Responsibility			Remarks
					ABB	Consultant	Customer	
1	Design Schedule	Contract / Proposal Schedule	D3 & D4	As per XYZ procedure	X/RP			
2	Drawing List	Drawing / Specification	D4	As per XYZ procedure	X/RP			
3	Supplier's Drawing & Specification	Proposal data / Specification	D2	As request	R			
4	Standard	Specification / XYZ Standard	D2	As per agreement	X			
5	Civil Drawing & Information	Drawing / Specification	D1	As request	R/X			
6	Design Output	Drawing / Calculation	D6	As per XYZ procedure & WM01-20	X/RP			
7	BOM and List of Apparatus	Specification / XYZ proposal / Drawing	D6	As per XYZ procedure & WM01-20	X/RP			

Customer R = Review W = Witness X = Implement I = Inspection A = Approval RP = Report

Quality Plan

Contract no:	Customer:	Prepare by:	Date :
	Consultant:	Review by:	Date :
Subject: Design Quality Plan	Job no.:	Approve by:	Date :

No.	Description	Specifying document	Record form	Procedure required	Responsibility			Remarks
					ABB	Consultant	Customer	
1	Design Schedule	Contract / Proposal Schedule	D3 & D4	As per XYZ procedure	X/RP			
2	Drawing List	Drawing / Specification	D4	As per XYZ procedure	X/RP			
3	Supplier's Drawing & Specification	Proposal data / Specification	D2	As request	R			
4	Standard	Specification / XYZ Standard	D2	As per agreement	X			
5	Civil Drawing & Information	Drawing / Specification	D1	As request	R/X			
6	Design Output	Drawing / Calculation	D6	As per XYZ procedure & WM01-20	X/RP			
7	BOM and List of Apparatus	Specification / XYZ proposal / Drawing	D6	As per XYZ procedure & WM01-20	X/RP			

Customer R = Review W = Witness X = Implement I = Inspection A = Approval RP = Report

XYZ COMPANY
Substation Business

DESIGN IN PROCESS CHECK LIST

(D6)

(D6)

Design in Process Check list

Substation :.....	Date:		
Project Name :.....	Checked by		
	Approved by		

ITEM	DESCRIPTION	YES	NO	REMARKS
1	**Single line Diagram,** **Relay and Metering Diagram** **Input check** - Customer specifications. - General conditions. - Special conditions. - Local conditions. - Scope of work. - Proposal. 1. Price schedule. 2. Proposal data. - Ratings and features. - Standard drawings. - Design drawings. - Standard applicable. - XYZ tender with drawing, offer and deviation. - Correspondence and meeting. - Switchyard data basic. **Output Check** - Physical arrangement. - Technical data apparatus and bus bars. - BOQ, Item no., Contract no. - CT Polarity. - Maintenance earthing points. - Scope of works. - Future extension. - Reference drawing. - Purchase order for H.V. equipment. - Dimension prints for H.V. equipment. - Item no. - Customer serial no.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
2	**General Arrangement plan,** **Layout plan of substation** **Input Check** - Single line diagram. - Switchyard data. - Customer specification with drawing. - XYZ tender with drawing, offer and deviation. - Correspondence and minutes of meeting. - Site area data. - Dimension prints. **Output Check** - Over all site area and total dimensions. - Phase conductors with string insulators - Transmissions line routing with designations. - Take off structure, most, girders and deadened structures. - Building fences service roads. - Bay width and distances to fences, building and total Switchyard dimensions. - Phase marking for busbars and feeders. - Scale and if possible North direction arrow. - Coordinate system x/y, Switchyard references axis system. - Bay and busbar designation. - Lightning protection wire and steel structures. - Reference drawings. - Legend. - Section views reference. - Main technical data if necessary.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
3	**Conceptual Design** **1. System Diagram** **Input Data** - Client specifications and contract. - Technical part of the tender. - Legend of symbols. **Output Data** - Symbols with item designation for all HV-apparatus. - Item designation/ name for all swg-bays and busbars. - General electrical data of all HV-apparatus and busbars. - Information of differences between phases, e.g. phase of line trap etc. - Main transformer data as ratio, vector group, type of cooling, tap changer data, etc. - CT and VT-data such as ratio, location of P1/P2, class, burden and number of cores. - Border of delivery. - Shows the principles for protection and supervision of the HV-equipment in order to have it fixed for further engineering. - Show the connections of VT's and CT's. - Shows general electrical data of above mentioned equipment. - Guide for further design work (circuit diagram etc.)			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	2. Block Diagram **Input Data** System diagram, client specification and technical part of the tender General data of : HV apparatus incl. CT's and VT's Protective relays Measuring and metering equipment Power flow in the switchgear **Output Data** Single line representation of typical feeders with data of protective relay and metering equipment, including; - Single line representation of HV-apparatus. - Single line representation of measuring circuits incl. protective relays. - Single line represents. Or schedule of trip circuits and protective signals. - General data of metering and protective relay equipment (Survey) - Data of CT – and VT-cores. - Mode of operation for HV-Switches e.g. motor/hand, one phase/three phase. **3. Function Diagram** **Input Data** - System diagram - Clients specification. - Description of standard function or praxis. **Output Data** Block diagram of functions common for the substation e.g.:			

(D6)

Design in Process Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Synchronizing system. - Interlocking system. - Station alarm and registration system. - Tap change control system. - AC/DC- distribution. - Circuit breaker control. System data related to the project should be given (e.g. setting of synchro check relay, size of fuses used in AC – and DC – distributions, etc.) General data of the system will be shown in pamphlets etc. **4. <u>Panel Front View</u>** **<u>Input Data</u>** - Customer specification with drawings. - Tender and contract with drawings. - System diagram. - Dimensions of cubicles and apparatus. **<u>Output Data</u>** - Position of apparatus in fronts (with legend if necessary) - Item designation of cubicles and bays. - Feeder names (if used) - Panel board size. - Front view and top view of the complete panel board. - Mimic diagram (control panels). - Color and protection class (IP) of cubicles. - Cut out dimension in floor (on request). - Direction of door opening. - Transportation units.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	5. Panel Location **Input Data** - All panel front views (also other suppliers) - Building lay-outs - Building installation plans (electrical, plumbing, etc.) **Output Data** Room lay-out drawings with: - Position of panels. - Item designation or names of panels. - Top view of all panel boards and boxes. - Door opening and front of panels should be shown. - Door, windows and other equipment which influence the location of panels. - Cable ducts and floor cut-outs may also be shown. **6. List of Typical Labels/ List of Labels and Engraving** **Input Data** - System diagram. - Panel assembly drawings. - Data of standardized labels. - Client specification or instruction of praxis. **Output Data** - Type of labels (material). - Size of labels. - Type and size of text. - Text (deviled in rows). - Position for mounting of label. - Manufacturing (engraving) instruction. - Number of labels with similar text.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	7. List of Main Equipment **Input Data** - Client specification. - List of offered equipment. - Block- and Function diagrams. **Output Data** - List of equipment intended to be used in the project. - References to basic requirements and standards. - References to descriptions of the equipment, with clear identification of type, manufacturer, etc.			
4	**Detail Design** **1. Bus Structure Plan** **Input Data** - Single line diagram. - Switchyard data basis. - Switchyard layout. - Customer specification with drawing. - XYZ tender with drawing, offer and deviation. - Correspondence and minutes of meeting. **Output Data** - Apparatus including TX. Explanatory letters CB, CT, VT etc. - Phase conductors with string insulators. - Position of drives and marshalling boxes. - Min. Clearance. - Mast, girders and bus bars supports. - Building, free walls, fences roads, cable trenches, rails and lighting.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Bay width and depth, distances to fences, buildings and total dimensions. - Phase distances busbars and feeders. - Phase marking for busbas and feeders. - Scale and if possible North direction arrow. - Coordinate system X/Y, switchyard references axis system. - Bay and busbar designation. - Lightning protection wire and steel structures. - Item no. for apparatus, conductors, insulators, connection clamps etc. - Reference drawings. - Legend. - Section views reference. - Main technical data if necessary. **2. <u>Switchyard Section Drawing</u>** **<u>Input Data</u>** - Single line diagram. - Switchyard data basis. - Customer specification with drawing. - XYZ tender with drawing, offer and deviation. - Correspondence and minutes of meetings. - Site area data. - Dimension prints. **<u>Output Data</u>** - Switchyard H.V. equipment and material. - Dimensions for location of apparatus, transformers, mast etc. - Height of foundation (to steel structure base plate)			

(D6)

Design in Process Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Height of TOS, masts, busbars, equipment connection etc. - Distance between phases minimum clearance on critical points. - Locations of operating mechanisms for breakers and disconnecting switches. - CT. polarity. - Possible step-bolts, ladders, fences and spacers. - Points for temporary earthing. - Opening direction of disconnecting switches. - Phase marking for busbars and feeders. - Scale. - Marking of spans with span identification. - Working zone clearance. - Reference drawings. - Legend. **3. <u>Steel Structure Design</u>** **<u>Input Data</u>** - Customer specification with drawing. - Switchyard layout and section drawing. - Switchyard data. **<u>Output Data</u>** - Steel structure design drawing. - Top and base plate detail. - Anchor bolt sizing - Assembly detail. **4. <u>Foundation Plan</u>** **<u>Input Data</u>** - Customer specification with drawing. - Correspondence and minutes of meeting.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Layout. - Section drawings. - Dimension prints. - Switchyard data. - Calculations of rigid and flexible conductors. - Necessary size of cable trenches. - Quantity size and location of marshalling boxes. - Location and connection of power cables. **Output Data** - Location of foundations. - Quantity and location of foundation bolts. - Marshalling boxes. - Location and size of cable trenches. - Location and fastening of marshalling boxes. - Special arrangements e.g. cables under roads etc. - To be sent to customer/consultance for approval. - Form basis for civil design. - Basis for calculation of cable lengths. **5. Cable Trench** **Input Data** - Foundation plan. - Necessary size of cable trenches. - Customer specification with drawing. - Correspondence and minutes of meetings. - Quantity size and location of marshalling boxes. - Location and connection of power cables.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	Output Data - Location and size of cable trenches. - Location and fastening of marshalling boxes. - Special arrangements e.g. cables under roads etc.			
	6. Earthing plan and Earthing drawing **Input Data** - Customer specification with drawing. - XYZ tender with drawing, offer and devitation. - Correspondence and minutes of meetings. - Dimension prints for H.V. equipment. - Switchyard data. - Layout and section drawings. - Steel assembly drawings. - Foundation plan. - Result of calculation of earthing grid. **Output Data** - Drawing of earthing grid. - Detailed drawings showing earthing of each type of apparatus and other equipment. - Item no. referring to list of material. - Information for civil works.			
	7. Plant circuit Diagram **Input Data** - Client specification. - Tender drawings. - System diagram. - Block and function diagrams. - Equipment circuit diagram of all used equipment.			

(D6)

Design in Process Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Descriptions and instructions of all used equipment. **Output Data** - All functions of the delivered equipment and its relation to other equipment, shown with: - Symbols according to standards. - Item designations indicating function and/ or location. - Interconnections between equipment. - Clear identification of circuits. - References of circuits between sheets. - References to other circuit diagrams. - Explanation of circuits/ functions (if necessary). **8. equipment circuit Diagram** **Input Data** - Descriptions and instructions of all internal apparatus. - Function specification (standard or customer requirement) **Output Data** - All circuits and sparatus in the unit, shown with: - Symbols according to standards. - Item designation. - Connections between spparatus. - Clear identification/ description of interface points. - Explanation of circuits/ functions. - Designation of location (if used)			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
5	**Calculation** **1. Conductor pulls, sag and tension calculation** **Input data** - Customer specification with drawing. - XYZ tender with drawing. - Switchyard layout and section drawing. - Dimension prints for string insulator. - Max. conductor pulls. **Output data** - Mast and girders. - Conductors. - Bay width & total dimensions. - Height of mast and girders. - Identification of conductors. - Phase distance busbars and feeder. - Scale and if possible North direction show. - Loads pulls and direction of pulls. - Detail connections and typical ladder and screens. - Reference drawings. - Legend. - Show sag and pulls of spans as function of temp. - Show max. design forces due to static or dynamic loading on span. **2. Steel structure calculation** **Input data** - Customer specification with drawing. - Switchyard layout and section drawing. - Switchyard data.			

(D6)

Design in Process Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Calculation of rigid and flexible conductors. - Dimension prints of equipment. **Output data** - Complete assembly drawings and calculation. - Base plate & top plate details. - Quantity and location of foundation bolts. - Working load on foundations. **3. Earthing calculation** **Input data** - Customer specification with drawing. - XYZ tender with drawing, offer and deviation. - Correspondence minutes of meetings. - Soil resistively result. - Foundation plan. **Output data** - Grid dimension. - Conductor sizing. - Step and touch voltages. - Ground resistivity. - Riser conductor size. - Reference drawing. **4. CT, CVT Sizing and Relay setting calculation** **Input data** - Customer specification with drawing. - Relay and metering diagram. - Equipment specification and details.			

(D6)

Design in Process Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- XYZ tender with drawing, offer and deviation. - Polarity - Manufacturers catalogue and criteria of relay setting. - Short circuit calculation. - Power consumption requirement of relay & accessories equipment. **Output data** - Dimensioning of CT & CVT. - Burden & Ratio. - Setting value of protective relay. - Reference drawing. - Protective coordination curve.			
6	**Bill of Material, List of apparatus.** **1. Dimension prints, Switchyard equipment & material** **Input data** - Customer specification with drawing. - Switchyard data. - Layout. - Section drawing. - Summary of equipment. - Results of calculations. **Output data** - Drawing dimension prints of connection, clamps, fittings, insulators, conductors, lighting, and cable ladder. - Quality type of the equipment & accessories. - Reference drawings.			

(D6)

Design in Process Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	2. List of Earthing material **Input data** - Earthing plan and Earthing drawing. - Dimension prints H.V. equipment. - Switchyard data. - Detail of steel structure. **Output data** - List of all earthing material. - Item no. for identification from earthing drawings. **3. List of switchyard material, ladder & steel structure** **Input data** - Layout and section drawings. - Switchyard data. - Detail of steel structure & cable ladder. - Dimension prints for H.V. equipments, Switchyard hardware, cables etc. **Output data** - List of material. - Item for identification of drawing. **4. List of relay & protection material** **Input data** - Layout and section drawing. - Equipment data & its detail. - Customer specification with drawing. - Section drawing. - Function diagram - Panel view drawing.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	Output data - List of material. - Item for identification of drawing. **5. List of cable & it's accessories** **Input data** - Layout and section drawing. - Equipment data & its detail. - Customer specification with drawing. - Foundation & structure plan & section. - Functional diagram. - Interfacing drawing. **Output data** - Breakdown of cable & accessories. - Type and identification no. of the material. **6. List of Apparatus** **Input data** - Client specification and contract. - Technical part of the tender. - Circuit diagrams. - Description and technical data of all used equipment. **Output data** - Item designation of apparatus. - Location and reference to circuit diagram. - Type of apparatus. - Technical data. - Manufacture and type detail. - Identification/ drawing number. - Graphical symbols. - Quantity of items.			

(D6)

Design in Process Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
7	**Review, coordinate with Civil / Material Drawing** **Input data** - Customer specification. - Correspondence and minutes of meetings. - Applicable standard. - XYZ's tender - Switchyard layout. - Complete list of material indoor/outdoor. - Buildings drawing and site plan. - Foundation plan. - Definite dimension drawing of switchyard and indoor building. - Requirement from manufacturer. **Output data** - Location of cable trench. - Main cable route. - Layout of control, relay and battery room. - Openings in floors, wall, and sizes of doors. - Static and dynamic loads on building lifting and crane capacity. - Switchyard layout & foundation plan detail. - Cable basement, or trenches. - Manhole, stairs, transport opening to basement. - Fire sealing. - Floor tolerances. - Dynamic & static loads. - Holes for power and control cables. - Ventilation. - Sound proofing.			

(D6)

Design in Process Check list

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
8	**Review, Drafting of Drawing** **Input data** - Customer specification & drawing. - Drawing list. - Standard drawing. - Design criteria, and general requirements for substation equipment - Civil and architectural works. - Drawing block title & drawing no. - Station & customer name. - Scale, lettering. - Schedule of design drawing. - Tools ACAD file & directory. **Output data** - Final design schedule. - Design drawing. a) *Circuit diagram.* b) *Single line diagram.* c) *Apparatus, equipment diagram & detail section.* d) *Block diagrams functional diagram.* e) *External wiring diagram.* - Reference drawing. - Quality requirement.			

XYZ COMPANY
Substation Business

DESIGN REVIEW AND VERIFICATION CHECK LIST

(D7)

(D7)

Design Review and Verification Check list

Substation :.....	Date:		
Project Name :.....	Checked by		
	Approved by		

ITEM	DESCRIPTION	YES	NO	REMARKS
1.	**Review, Verification, Modification, Design in final stage.** **Design review** - Customer specification & drawing. - XYZ's proposal & document. - Equipment detail & type. - Design criteria. - Functional & logical diagram. - Calculation (if used). - Co-ordination with other services. - Record of all the person included in the review process. - Standard. - Review all the design step. (planning, input, output design stage etc.) *Note :* *Above recheck shall be carried out by other person than the designer.*			
2.	**Design verification** - Through design review. - Repeat calculation in different way (if require). - Evaluation to verify the performance requirement. - Through review of drawing and design outputs. - Laboratory test (if require/possible). - Product or Equipment verification from supplier. - Comparing the similar design or reference if necessary. - Review of design stage document as per the Flow-Chart (if necessary).			

(D7)

Design Review and Verification Check list

Substation :.....	Date:		
Project Name :.....	Checked by		
	Approved by		

ITEM	DESCRIPTION	YES	NO	REMARKS
3.	**Design validation** - Check design validation of product or material such as test specification. - Test plan, test procedure, measuring equipment, test activities, configuration of the product. - Evaluate the design process. - Check & verify software, tool use for design. - Standard. - Compatibility with the customer specification & drawing requirement. - Process of installation & testing to verify the design.			
4.	**Design changes or modification** - Identify the document or new requirement. - Collect data & instruction for changes. - Review and approval document for changes. - Procedure verification for changes. - Identify the principal requirements, specification drawings or other design documents that are affected by change. - State the reason for change. - Result of the evaluation, review and decision.			
5.	**Material review, evaluation of supplier specification** - Customer specification & drawing. - XYZ tender & correspondence detail. - List of material for the project. - Technical detail of the material. - Standard. - Material drawing and requirement.			

(D7)

Design Review and Verification Check list

Substation :.....	Date:		
Project Name :.....	Checked by		
	Approved by		

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Data and document of material. - ISO certificate of material production. - Evaluation of supplier form - Price/bid proposal. - Delivery time - Deviation/ non-compliance report of material (if any). - Production process of material.			
6.	**Co-ordination with material supplier** - Customer specification & drawing. - Technical detail & requirement. - Detail drawing & installation detail. - Civil requirement. - Layout & detail section drawing. - Scope of supply and parts. - Quantity. - Dimension drawing & detail. - Erection & testing requirement. - List of materials drawing/ documents.			
7.	**Prepare cable list, external wiring diagram.** **Input** - Applicable standards. - Customer specification/ drawing. - List of drawing/ document. - Scope of supply. - Design drawing. - List of material. - Manufacturer drawing/ document. - Single line, block diagram, and functional diagram.			

(D7)

Design Review and Verification Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	Output - Design drawing with correction detail. - Cable size & quantity. - Type of cable. - Interfacing cable diagram.			
8.	**Quality check** - Specification & Drawing. - XYZ proposal/ correspondence during tendering. - Quality plan. - Standard applicable for project. - Process & procedure of design to meet the specification & customer requirement. XYZ standard.			

XYZ COMPANY
Substation Business

DESIGN REVIEW REPORT

(D8)

Document no	Approved by	Verified by	Issue date	Page	Rev.
XYZ-D8			10/08/1999	1 of 2	0

MINUTES OF MEETING					XYZ Limited Engineering Division
Issued by :	Date :	Language : ENG	Register No. :	Revision :	Page : 1

Project / Order No. :	Date :
	Approved by:

Participants:

Absentees :

ITEMS	ACTIVITIES	ACTION BY	DATE REQUIRED	DATE COMPLETED
1.	Approval of last minutes of meeting			
2.	Details			
3.	Problems and remedy			
4.	Miscellenous			
5.	Next meeting			

XYZ COMPANY
Substation Business

DESIGN MODIFICATION PROPOSAL

(D9)

XYZ COMPANY	DESIGN MODIFICATION PROPOSAL	Project name:

PART 1

Source of modification proposal

( ) Client
( ) XYZ Company
( ) Others

PART 2

This modification proposal is rejected / accepted for further processing reason / affected discipline

.....
Project Manager

PART 3

Please estimate the effect of the above proposed modification

Document affected

Primary Design		*Secondary Design*	
-Single Line Diagram	-Indoor Layout	-System Diagram	-List of main equipment
-Switchyard layout	-Cable laying power cable	-Block diagram	-Plant circuit diagram
-Steel Structure design	-Cable Ladder Design	-Function diagram	-Panel circuit diagram
-Foundation Plan	-Indoor Earthing Desing	-Panel Front view	-Cabling concept
-Earthing Plan & Design		-Panel Layout	-List of cable

PART 4

Summary of modification impact

.....
Design Manager

PART 5

This modification proposal is accepted / rejected

.....
Project Manager

XYZ COMPANY
Substation Business

THE SUMMARY OF ADDITIONAL HOURS AND COSTS

(D10)

XYZ COMPANY	SUMMARY OF ADDITIONAL HOURS AND COSTS	Project name: Date:

Man hours Costs
for Engineering

1.Design manager _____
2.Desing supervisor _____
3.Senior design engineer _____
4.Design engineeer _____
5.Draft man / Adminstrator _____

Traveling Cost

1.Air ticket _____
2.Train ticket _____
3.Own car _____
4.Rental car _____
-Rental _____
-Fuel _____

Document Cost

1.Letter (size A4) _____
2.Drawing (size A0, A1, A3) _____
3.Operation and maintenance manual _____
4. Others _____

Additional Material and Tools Cost

List of material

Others

SUMMARY OF MODIFICATION COSTS

MAN HOURS COST
TRAVELING COST
DOCUMENT COST
ADDITIONAL MATERIAL AND TOOLS COST
OTHERS

TOTAL COSTS ----------

XYZ COMPANY
Substation Business

DESIGN CHANGE REQUEST FORM

(D11)

XYZ COMPANY	DESIGN MODIFICATION REQUEST	Project name:
TO	DATE	INITIATOR ___ CLIENT ___ CONTRACTOR
TITLE		PAYMENT ___ LUMP SUM ___ REIMBURSABLE ___ UNIT RATE
CONTRACTOR IS HEREBY INSTRUCTED TO PROCEED WITH THE WORK DESCRIBED HERE UNDER :		
APPLICABLE CORRESPONDENCE		
ADJUSTMENT TO CONTRACT : TOTAL ESTIMATED HOURS		TOTAL ESTIMATED COST
DOCUMENTS AFFECTED		
ESTIMATED IMPACT ON PROGRAMME WORK TO COMMENCE BY : PLANNED COMPLETION DATE :		EFFECT ON CONTRACT SCHEDULE : EFFECT ON MANNING
ACCEPTED BY CONTRACTOR NAME : SIGNATURE : DATE :		APPROVED BY CLIENT NAME : SIGNATURE : DATE :

XYZ COMPANY
Substation Business

LETTER OF TRANSMITTAL FORM

(D12)

Document no.	Approved by	Verified by	Issue date	Page	Rev
XYZ-D12			10/08/1999	1 of 2	0

LETTER OF TRANSMITTAL

Our ref. :	-	Date :	
From :		To :	
Subject :		Attn :	

We are sending you the following items :-

☐ Letter	☐ Drawing	☐ Variation Request
☐ Memorandum	☐ Sample	☐ Variation Order
☐ Specification	☐ Photographs	☐ Certificate of Payment
☐ Inspection Report/Records	☐ Progress Report/Record	
☐ Other ...Calculation.....		

Detailed as follows :

Item No.	Description	No. of Copies	Remarks

Transmitted to you :

☐ As Checked	☐ For Approval	☐ For Review & Comments
☐ As Approved	☐ For Using	☐ For Information & Records
☐ As Requested	☐ For Action	☐ Others

Transmitted by : Date :	Recieved by : Date :

XYZ COMPANY
Substation Business

DESIGN DOCUMENT AND DRAWING FOR APPROVAL CHECK LIST (D13)

(D13)

Design Document and Drawing For Approval Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
1.	**Drawing/Document Approval And Distribution Review of Material** Issue drawing and document for approval - General customer requirement such as specification, drawing, and any deviation. - General technical requirement such as test protocols, inspection requirement, standard, data and schematic of material components. - General drawing requirements such as drawing sizes station name, customer name, title block, drawing number, symbols etc. - Project schedule. - Drawing and document list. - General criteria for design such as standard, assumption block diagram, functional requirement etc. - General check for design review, design verification, etc. - Distribution list & requirement according to contract & specification.			
2.	Re-design or modification, data change for Re-Approval - Customer comment & requirement. - Non compliance report (if any) - Revise specification or drawing (if any) - Any deviation data/document from XYZ proposal. - Re-design criteria. - Standard and scope of requirement. - Recheck other requirement as mention in item 1.			

(D13)

Design Document and Drawing For Approval Check list

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
3.	Verification of purchased product - Customer specification and drawing. - XYZ proposal, deviation sheet (if any) - Price proposal, deviation sheet (if any) - Equipment out times/ drawing. - Catalogues. - Delivery schedule. - BOQ. - Technical specification of each equipment. - Quality & ITP plan. - Test report, witness report. - Civil requirement, coordination requirement.			
4.	Erection, Testing and Commissioning Drawing/ Document Control. - Customer specification, drawing. - XYZ proposal - List of drawing and documents. - Project schedule, BOQ. - Approval drawing and documents. - Material standards detail & catalogues. - Installation details drawing. - Civil requirement & coordination plan. - Erection & testing equipment & details. - Customer inspection requirement. - Data & schematic of purchased equipment.			
5.	Review of quality plan and safety measure - Customer specification and requirement. - XYZ quality plan & proposal. - Quality and ITP plan of purchased equipment. - Quality plan for material purchase.			

(D13)

Design Document and Drawing For Approval Check list

Substation :.....	Date:		
Project Name :.....	Checked by		
	Approved by		

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Quality requirement (if any) - Safety requirement (if any) - Safety practice & consideration in design. - General practice for safety requirement, code & standard. - Organization chart.			

XYZ COMPANY
Substation Business

DISTRIBUTION DESIGN DOCUMENT / DRAWING FORM

(D14)

Document no.	Approved by	Verified by	Issue date	Page	Rev.
XYZ-D14			10/08/1999	1 of 2	0

Distribution Design Document / Drawing
For Substation Control

Title of Drawing	Ref. Apx	Distribution					
		Ext	Int	Wks	Ere	Com	App
List of Drawings / Index		X	X	X	X	X	R
Drawings for system design							
System Diagram (Overview Diagram)	2-1	X	X		X	X	X
List of Special Symbols		X	X			X	
System of Designation, Expl.		X				X	
Block Diagram	2-2	X	X			X	X
Function Diagram	2-3	X	X			X	X
Panel Front View	2-4	X	X	X	X	X	X
Panel Location	2-5	X	X		X	X	R
List of Typical Labels	2-6	X					X
Example of Circuit Diagram		X	X				R
List of Main Equipment (for appr)	2-7	X	X		X	X	X
List of Gen. Proj. Requirement	2-8	R	X	X	X	X	
Inspection and Test Plan		X				X	X
Calculations		R				X	R
Circuit diagrams and apparatus lists							
Plant Circuit Diagram	2-9	X	X	X	R	X	R
Panel Circuit Diagram	2-10	X	X	X	R	X	R
Equipment Circuit Diagram	2-11	X	X	X	R	X	R
List of Apparatus	2-12	X	X	X	R	X	
Cable drawings							
Cabling Concept	2-13		X		X	X	
List of Cables	2-14	X	X		X	X	
Cable Connection Schedule	2-15	X	X		X	X	
Workshop documents							
Arrangement of terminals	2-16		X	X	R	R	
Connection Table	2-16		X	X	R	R	
Assembly Drawing	2-16		X	X		R	
Panel Cut Out Plan	2-16		X	X		R	
List of Labels and Engraving	2-6		X	X		R	
Test Specification	2-16		X	X		R	
Signal lists							
List of Signals (Signal point list)	2-17	X	X			X	R
List of Alarms, Events	2-17	X	X			X	R
List of Interface Points (SCADA)	2-17	X	X			X	R
Erection, commissioning and maintenance							
Erection Instructions	2-18		R		R	R	
Operat. & Maintenance Manual	2-19	X				X	
List of Erection Spare Parts	2-20		R		X	R	
List of Spare Parts, Recomm.	2-20	R	R				R
Training Documentation		R				R	
Software documents							
List of Pictures	2-21	X	X				R
Logic Function Diagram	2-22	X	X			R	R
Software Output Documents	2-23		X			R	

EXT = External use
ERE = for Erection
R = on request

INT = Internal use
COM = for Commisionin
REF = Reference

WKS = for workshop
APP = for approval
APX = Appendix

XYZ COMPANY
Substation Business

AS BUILT DRAWING CHECK LIST

(D15)

(D15)

As Built Drawing Check List

Substation :.....	Date:	
Project Name :.....	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	AS-built drawing, operation and maintenance manual, training.			
1.	**Review of as-built drawing** - General customer and technical requirement such as drawing, standard, specification, material, test protocol etc. - Drawing and document list. - Any revise and modification document requested by customer? - Marked up drawing for modification made during testing and commissioning. - Installation, testing and commissioning document and record form. - Distribution list and requirement for final drawing/ document. - Review contract requirement.			
2.	**Correction of drawing** - Collect markup as-built drawing. - Verify the collected documents and as-built drawing. - Drafting drawing for correction. - Review and verify the as-built drawing/documents. - Issue and distribute as-built drawing/ document.			
3.	**Collection of final material detail** - Collect markup drawing and document from erection & testing team. - Collect final material and accessories details verify from the erection team. - Collect actual BOQ from erection team. - Verify the catalogue and material use according to erection team.			

(D15)

As Built Drawing Check List

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
	- Modify as-built BOQ and material catalogue.			
4.	**Preparation of operation and Maintenance Manual** - Review customer specification, drawing and requirement. - Review XYZ proposal and commitment. - Scope of supply. - List of as-built of drawing. - List of material and it's catalogue. - Manufacturer's instruction and manual for each main equipment. - List of equipment supplier and it's contact address. - Project schedule.			
5.	**Customer training as per project** - Review of customer specification. - Scope of supply. - XYZ proposal & tender document. - Project schedule. - Identify or prepare the training course detail. - Prepare the documents for training.			
6.	**Analysis and close the project** - Review of customer specification & drawing. - Review of contract. - Project schedule. - XYZ proposal & price schedule. - Status of the project. - Quality plan. - Customer satisfaction & survey of customer comment. - List of problem & modification occurred during project execution.			

(D15)

As Built Drawing Check List

Substation :	Date:	
Project Name :	Checked by	
	Approved by	

ITEM	DESCRIPTION	YES	NO	REMARKS
7.	**Report to the Management** - Review of contract & XYZ proposal. - Review status of project. - Check quality plan/ customer satisfaction. - Prepare closing report identify problem & solution. - Suggestion for future project.			

XYZ COMPANY
Substation Business

FEEDBACK DESIGN RESULT FORM

(D16)

XYZ COMPANY

To	From	Date	Reg	Page
			DEV-001	1 OF
	Dealt with by, Telephone			
Project:	**FEEDBACK DESIGN RESULT FORM**			

Subject: Electrical and Switchyard Design Deviation

Deviation or problem	Action/Solution	Remark Equipment/Subject

APPENDIX V

THE STANDARDS WORKING MANUAL FOR SUBSTATION PROJECT DESIGN (DOCUMENT WM1 TO WM20)

Verified by	Approved by	Revision: Issued Date: 99/08/20 Page: 1 of 3

Subject: Design Filing System

1.0 Purpose

This instruction help engineer to easier keep a standardized format of all ***Design files*** within design / engineering department.

2.0 Scope

-

3.0 References

-

4.0 Definition

-

5.0 Associated documents

-

6.0 Detailed instructions

7.0 Records

Verified by	Approved by	Revision: Issued Date: 99/08/20 Page: 1 of 2

Subject: Identification Drawing Numbers

1.0 Purpose
This instruction is made for determining a format of identity number for drawings and calculation sheets used in a tender/project.

2.0 Scope
This instruction applies for all projects that there is no any specific requirement.

3.0 References
-

4.0 Definition
-

5.0 Associated documents
1.List of Technical Documents, WM03

6.0 Detailed instructions

6.1 General

6.2 Format – Industrial Projects

6.3 Format – Utility Project

7.0 Records

Verified by	Approved by	Revision: Issued Date: 99/08/20 Page: 1 of 3

Subject: List of Technical Documents

1.0 Purpose

This instruction guides to some of Technical documents that should be produced, where appropriate, for a project. Other Documents not shown herein may also be made, depending on customer's requirement.

2.0 Scope

This instruction applies for all projects that there is no any specific requirement.

3.0 References

-

4.0 Definition

-

5.0 Associated documents

1. Identification Drawing Numbers, WM02

6.0 Detailed instructions

Documents
Switchyard (Outdoor) :
Switchyard (Indoor) :
Electrical :
Communication :
Calculation :
BOM :

7.0 Records

-

Verified by	Approved by	Revision: Issued Date: 99/08/20 Page: 1 of 4

Subject: Drawing Dimensioning

1.0 Purpose

This instruction specifies sizes and layout of forms for technical drawings used in a project produced by CAD application.

2.0 Scope

This instruction applies for all projects that there is no customer's specific requirement.

3.0 References

-

4.0 Definition

-

5.0 Associated documents

-

6.0 Detailed instructions

6.1 Selection and designation of sizes

6.2 Forms

6.3 Title Block

6.4 Entry fields, description

6.5 Additional document identity

7.0 Records

-

Verified by	Approved by	Revision: Issued Date: 99/08/20 Page: 1 of 2

Subject: Material lists for Purchasing

1.0 Purpose

This instruction is made to give guideline for preparing Part Lists for Purchasing.

2.0 Scope

3.0 References

-

4.0 Definition

-

5.0 Associated documents

-

6.0 Detailed instructions

1.0 Purpose
This instruction is made to give guideline for Short-Circuit Calculation.

2.0 Scope

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

This document is prepared to give an idea about short circuit calculation.

6.1 General

This section will deals with elements of fault calculations. The circuit breakers, disconnectors should be capable of breaking and making the currents as per their ratings and should have rated short-time capacity. The design of equipment is based on considerations of normal and short circuit currents.

The protective relaying schemes can be selected only after ascertaining the fault levels and normal currents at various locations.

Fault studies are also necessary for system design, stability considerations, selection of Layout, etc.

The faults are classified as
- Three phase faults
- Single line to earth fault
- Line to line fault
- Minimum faults
- Maximum faults
- Double line to ground faults.

6.2 Procedure of short circuit fault calculations

6.3 Input parameters for Fault Calculations

6.4 Calculations

6.5 EDSA, EDSA Micro corporation USA

1.0 Purpose

This manual is a technical and selection guide for Control cables and Terminal blocks. Concerning in Phase markings and Signs are also investigated.

2.0 Scope

This instruction applies for all projects that there is no customer's specific requirement.

3.0 References

-

4.0 Definition

-

5.0 Associated documents

-

6.0 Detailed instructions

6.1 Signal and Control Cable

6.1.1 Wiring cables
6.1.2 Pair and multi-core cables

- Power control cables
- Electronics cables
- Computer cables / Telecommunication cables

6.1.3 Coaxial cables
6.1.4 Optical fibers cables

6.2 Terminal blocks

6.3 Markings and Signs

6.3.1 Phase markings
6.3.2 Signs

7.0 Records

-

1.0 Purpose

This instruction guides to general knowledge in substation's Protection system and Protection redundancy.

2.0 Scope

This instruction applies for all projects that there is no customer's specific requirement.

3.0 References

-

4.0 Definition

-

5.0 Associated documents

-

6.0 Detailed instructions

6.1 General

Protection system will be presented in a drawing called "Block diagram" and/or "Relay and metering diagram" to show how the protection system will look like. Designing of the system will base on customer's requirement, as well as utility's demand if it relates to. The customer's approval is always required for the system and equipment.

6.2 The task of the protection system

6.3 Choice of protection equipment

6.4 Sub-divided systems

6.5 Guide for Protection – General

6.6 Design of Control and Relay panel

7.0 Records

-

1.0 Purpose

This manual is a guideline for considering of Synchronizing, Tap changer control, Supervision equipment, as well as energy meter used in substation.

2.0 Scope

This instruction applies for all projects that there is no customer's specific requirement.

3.0 References

-

4.0 Definition

-

5.0 Associated documents

-

6.0 **Detailed instructions**

6.1 Synchronizing
- 6.1.1 Synchronizing instruments
- 6.1.2 Synchro-check relay

6.2 Tap changer control
- 6.2.1 Manual Control
- 6.2.2 Automatic control of a Transformer
  - Compensation
  - Blocking
- 6.2.3 Parallel Control
  - Simultaneous method
  - Master / follower method
  - Negative reactance method
  - Circulating current method

6.3 Supervision Equipment
- 6.3.1 Instrument
- 6.3.2 Recorder
- 6.3.3 Event / Disturbance recorder
- 6.3.4 Remote signaling

6.4 Energy meter

7.0 Records

-

1.0 Purpose
This instruction is made to give guide line for Digital SCS and Micro SCADA Design.

2.0 Scope

3.0 References

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions
This document is based on general practice use to design Digital SCS and MicroSCADA for substation.

6.1Computerized control equipment and system structure

6.2 Functional Design

6.3 Station Picture

6.4 Event Lists

6.5 5Alarm Lists

6.6 Communication

7.0 Record.

1.0 Purpose
This instruction is made to give guideline for AC auxiliary supply calculation.

2.0 Scope

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

6.1 GENERAL

The auxiliary power required by the substation for, among other things, lighting, motors, battery chargers etc, is provided by an AC-system supplied from local power transformers.

6.2 SYSTEM DESIGN

- Non-favourized system
- Favourized system
- Breakers and protection
- Distribution and sub-distribution

6.3 AUTOMATIC FEATURES AND INTERLOCKING

6.4 UNITERRUPTABLE AUXILIARY POWER

7.0 Records.

Subject: Battery and Battery Charger Calculation

1.0 Purpose
This instruction is made to give guide line for Battery and Battery Charger calculation for substation equipment.

2.0 Scope

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

This paper is intended to be used to calculate the require sizing of battery and battery charger.

6.1D.C. SYSTEMS FOR AUXILIARY POWER SUPPLY

6.2LOAD FEATURES
-Calculation factors
-Checklist
-Long time load current
-Load peaks
-Load diagram

6.3 BATTERY CALCULATION

6.4 Charger Calculation

- Single battery system
- Dual battery system
- Ambient temperature

7.0 Records.

1.0 Purpose
This instruction is made to give guideline for preparing Switchyard Data.

2.0 Scope
This instruction shall be applied for all projects

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

6.1 General
Switchyard data is an applicable electrical and mechanical data and standards for switchyard.

6.2 Basic Data
- Customer's specification
- Correspondence and minutes of meetings
- Applicable standards
- XYZ's tender
- Pre-design calculation
- Civil information

6.3 Purpose
The purpose of switchyard data are as follow;
- Send to customer and/or consultant for approval
- Basis for switchyard design
- Basis for design calculations
- Basis for ordering of switchyard material
- Send to project and erection departments

7.0 Records

Verified by	Approved by		Revision:
			Issued Date: 99/08/20
			Page: 1 of 9

Subject: Principle of Switchyard Design

1.0 Purpose
This instruction is made to give guideline for Principle of Switchyard Design.

2.0 Scope

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

This document is prepared to review the engineering practices for the design of switchyard.

6.1 General
6.2 The single line diagram
6.3 Switchyard documentation
6.4 Design
6.5 Insulation and safety clearances
6.6 Pollution
6.7 Station Earthing
6.8 Power Transformers &Circuit - Breakers
6.9 Disconnectors
6.10 Instrument Transformers
6.11 Lightning Protection
6.12 Conclusion

7.0 Records

Verified by	Approved by		Revision:	
			Issued Date:	99/08/20
			Page:	1 of 4

Subject: Insulation Co-ordination Calculations

1.0 Purpose

This instruction is made to give guideline for insulation co-ordination calculations for switchyard equipment.

2.0 Scope

3.0 References

LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

This documents is based upon the IEC C4-650 and ANSI Standard C92.1.

6.1 General

The insulation co-ordination as the process of bringing the insulation strengths of electrical equipment into the proper relationship with expected over voltages and with the characteristics of surge protective devices.

6.2 Input Parameter

6.2.1 Customer specifications value.
6.2.2 Parameters to decide during design.

6.3 Procedure of insulation co-ordination calculation.

6.3.1 Selection of surge arrester.
6.3.2 Calculation

7.0 Records

XYZ Limited
Substation Business

Working Manual
Manual No. WM16

Verified by	Approved by		Revision:	
			Issued Date:	99/08/20
			Page:	1 of 4

Subject: Earthing Grid Calculation

1.0 Purpose
This instruction is made to give guideline for Earthing Grid Calculation

2.0 Scope

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

This document is based upon the calculation principles stated in ANSI/IEEE Std 80-1986. Several other national standards deal with this matter to, but IEEE 80 are most commonly used. In IEEE the word Earthing is often replaced with Grounding. This is common in the United States and in countries influenced by USA.

6.1 General

6.2 Input parameter for Earthing grid calculations.
6.2.1 Customer Specification Values.
6.2.2 Parameters to decide during design.

6.3 Procedure of Earthing Grid Calculation.
6.3.1 Preliminary design
6.3.2 Final design
6.3.3 Special consideration during design.

6.4 Method for Earthing Grid Calculations
6.4.1 Normal Calculation.
6.4.2 EDSA, EDSA Micro Corporation USA

7.0 Records.

1.0 Purpose
This instruction is made to give guideline for Power Cable Dimensioning

2.0 Scope

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

6.1GENERAL
6.1.1 Cable Types
6.1.2 Accessories

6.2 CALCULATION OF CABLES
6.2.1 Design Standard
6.2.2 Installation Requirements
- Methods of installation
- Selecting cable types
  A. Maximum rated current
  B. Short-circuit current
  C. Short-circuit forces
- Co-ordination cable equipment

6.2.3 Dimensioning of XLPE Cables
-Short-circuit currents
-Continuous current ratings
-Voltage drops
-Short-circuit forces
-Other considerations

7.0 Records.

Subject: INDOOR EQUIPMENT AND INFORMATION FOR CIVIL DESIGN

1.0 Purpose
This instruction is made to give guideline for indoor equipment and information for civil design

2.0 Scope

3.0 References
LEC Handbook

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

CONTENTS

7.0 Records.

1.0 Purpose

This instruction is made to give guideline for Steel Structures Design for Substation.

2.0 Scope

- ξ Apparatus steel structure design.
- ξ Take off steel structure design.

3.0 References

LEC Handbook, Technical Instruction, HV Switchgear, Electrical Substation Engineering and practice.

4.0 Definition

-

5.0 Associated documents

-

6.0 Detailed instructions

This document is based on the general principle stated in ANSI and the other standard, which are normally used.

6.1 General

6.2 Simple single based structures

6.3 Structures with Span of 3-phases

6.4 Mechanical design principles for Outdoor Switchyards.

6.5 Definitions and Seismic or Earthquake load

6.6 Design Analysis

7.0 Records.

1.0 Purpose

This instruction is made to give guide line for Utility Mechanical and Electrical Facilities design.

2.0 Scope

3.0 References

4.0 Definition

5.0 Associated documents

6.0 Detailed instructions

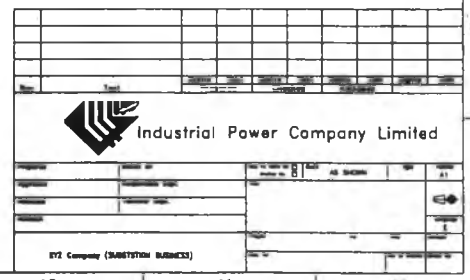
Contents

7.0 Records.

APPENDIX VI

STANDARD DRAWING AND ADAPTING DRAWING TO CUSTOMER

ADAPTING DRAWING TO CUSTOMER



STANDARD DRAWING

Drawn by	Form No.	Sheet
Design checked by	Rev In	Cont
	Dept Year Week	

Rev In	Revision	Appd	Year Week

Design checked by			Rev In Sheet
Drawing checked by			Rev In Sheet
Drawn by	XYZ Company (Substation)	Dept Year Week	Cont

APPENDIX VII

EXAMPLES OF THE CONTROL DOCUMENT IMPLEMENTED IN PROJECT

LETTER OF TRANSMITTAL

OUR REF :		DATE :	**99/8/30**
FROM :	**PRASAN R.**	TO :	**TAWEESAK T.**
SUBJECT :	**PEA 5-11(SOA)**	ATTN :	**GUMPON J.**

We are sending you the following items :-

- ☐ Letter
- ☑ Drawing
- ☐ Variation Request
- ☐ Memorandum
- ☐ Sample
- ☐ Variation Order
- ☐ Specification
- ☐ Photographs
- ☐ Certificate of Payment
- ☐ Inspection Report/Records
- ☐ Progress Report/Record
- ☐ Others.....

Detailed as follows :

Item No.	Description	No. of Copies	Remarks
1.	22kV. SWGR I/O Schematic diagram=J04	1.	992Z002-AHAD
2.	22kV. SWGR I/O Schematic diagram=J05	1.	992Z002-AHAE
3.	22kV. SWGR I/O Schematic diagram=J06	1.	992Z002-AHAF
4.	22kV. SWGR I/O Schematic diagram=J07	1.	992Z002-AHAG
5.	22kV. SWGR I/O Schematic diagram=J12	1.	992Z002-AHAN
6.	22kV. SWGR I/O Schematic diagram=J13	1.	992Z002-AHAP
7.	22kV. SWGR I/O Schematic diagram=J14	1.	992Z002-AHAR
8.	22kV. SWGR I/O Schematic diagram=J15	1.	992Z002-AHAS
9.	22kV. SWGR I/O Schematic diagram=J16	1.	992Z002-AHAT
10.	22kV. SWGR I/O Schematic diagram=J17	1.	992Z002-AHAU

Transmitted to you :

- ☐ As Checked
- ☑ For Approval
- ☐ For Review & Comments
- ☐ As Approved
- ☐ For Using
- ☐ For Information & Records
- ☐ As Requested
- ☐ For Action
- ☐ Others

Kindly acknowledge receipt of the above by signing the attached copy of this transmittal letter and returning one copy of the document to us for our reference.

Transmitted by : PRASAN R.	Recieved by :
Date : 30/8/99	Date : 30/08/44

ABB

LETTER OF TRANSMITTAL

OUR REF :		DATE :	99/8/20
FROM :	PRASAN R.	TO :	TAWEESAK T.
SUBJECT :	PEA 5-11(SOA)	ATTN :	GUMPON J.

We are sending you the following items :-

- ☐ Letter
- ☑ Drawing
- ☐ Variation Request
- ☐ Memorandum
- ☐ Sample
- ☐ Variation Order
- ☐ Specification
- ☐ Photographs
- ☐ Certificate of Payment
- ☐ Inspection Report/Records
- ☐ Progress Report/Record
- ☐ Others.....

Detailed as follows :

Item No.	Description	No. of Copies	Remarks
1.	22kV. SWGR I/O Schematic diagram=J01	1	992Z002-AHAA
2.	22kV. SWGR I/O Schematic diagram=J02	1	992Z002-AHAB
3.	22kV. SWGR I/O Schematic diagram=J03	1	992Z002-AHAC
4.	22kV. SWGR I/O Schematic diagram=J09	1	992Z002-AHAK
5.	22kV. SWGR I/O Schematic diagram=J11	1.	992Z002-AHAM

Transmitted to you :

- ☐ As Checked
- ☑ For Approval
- ☐ For Review & Comments
- ☐ As Approved
- ☐ For Using
- ☐ For Information & Records
- ☐ As Requested
- ☐ For Action
- ☐ Others

Kindly acknowledge receipt of the above by signing the attached copy of this transmittal letter and returning one copy of the document to us for our reference.

Transmitted by : PRASAN R.	Recieved by : Taweesak
Date : 20/8/99	Date : 20/08/99

ABB

LETTER OF TRANSMITTAL

Our ref. :	SOA/MEMO_32	Date :	November 12, 1999
From :	Chanwit S.	To :	Project Engineer
Subject :	Drawimg for Approval	Attn :	Mr. Gumpol J.

We are sending you the following items :-

☐	Letter	X	Drawing	☐	Variation Request
☐	Memorandum	☐	Sample	☐	Variation Order
☐	Specification	☐	Photographs	☐	Certificate of Payment
☐	Inspection Report/Records	☐	Progress Report/Record		
☐	Other				

Detailed as follows :

Item No.	Description	No. of Copies	Remarks
1.	Equipment Installation : 22 Kv Switchgear	2	ABB/SOA-S-06 Sh.01 Rev.01
2.	Equipment Installation : Capacitor Bank	2	ABB/SOA-S-06 Sh.02 Rev.02
3.	Equipment Installation : Power Cable Support	2	ABB/SOA-S-06 Sh.03 Rev.02
	-All copies are in transparent sheet.		

Transmitted to you

☐	As Checked	X	For Approval	☐	For Review & Comments
☐	As Approved	☐	For Using	☐	For Information & Records
☐	As Requested	☐	For Action	☐	Others

Kindly acknowledge receipt of the above by signing the attached copy of this transmittal letter and returning one copy of the document to us for our reference.

Transmitted by : Chanwit S.	Recieved by :
Date : 25 Nov 1999	Date : 25/11/99.

MINUTES OF MEETING

ABB Limited
Engineering Division

Issued by :	Date	Language :	Register No	Revision :	Page :
Chanwit S.	99-10-08	ENG			1

Project / Order No. :	TSS990TR001	Date :	99-10-05
		Issued by:	Chanwit S

Participants: Sanphet A. / Suchin S.

Prasan R. / Chanwit S.

Absentees :

ITEMS	ACTIVITIES		ACTION BY	DATE REQUIRED	DATE COMPLETED
1.	**Approval of last minutes of meeting**				
	First " Engineering Meeting " of project PEA 5-11				
2.	**Work progress**				
	Switchyard Design				
	- Single line Diagram	: 100 % Completed	CS		
	- General Plan	: 100 % Progressed	CS		
	- Equipment Layuot and Block out	: 100 % Completed	CS		
	- Cable Routing and Ladder	: 100 % Completed	CS		
	- Earthing System	: 100 % Completed	CS		
	- Equipment Installation	: 100 % Completed	CS		
	- BOM : Power Cable	: 100 % Completed	SS		
	- BOM : Cable Ladder and accessories	: 100 % Completed	SS		
	- BOM : Earthing Equipment	: 100 % Completed	SS		
	Electrical Design				
	- 22 kv SWG. CSCS I/O Scheme	: 100 % Completed	PR		
	- Cap. Bank Control C-Bank Scheme	: 100 % Completed	PR		
	- AC & DC Aux.Supply Scheme	: 100 % Progressed	PR		
	- External Wiring Diagram	: 25 % Progressed	PR		
	- Relay Setting	: 0 % Progressed	PR		
	- BOM : LV and Control Cable	: 0 % Progressed	PR		
	Calculation				
	- Earthing Grid Calculation	: 100 % Completed	CS		
	- Battery & Charger Calculation	: 100 % Completed	SS		
	- Voltage Drop Calculation	: 90 % Progressed	SS		

MINUTES OF MEETING

ABB Limited
Engineering Division

Issued by :	Date :	Language :	Register No. :	Revision :	Page :
Chanwit S.	99-10-08	ENG			2

Project / Order No. : TSS990TR001

Date : 99-10-05

Issued by: Chanwit S

ITEMS	ACTIVITIES	ACTION BY	DATE REQUIRED	DATE COMPLETED
3.	**Problems and remedy**			
	- Voltage drop calculation must be submitted together with			
	Max. Fault Current of AC & DC board which is just request			
	by PEA. So the extended time is needed.			
4.	**Miscellenous**			
	-			
5.	**Next meeting**			

DOCUMENT SUBMISSION STATUS

Issue by: Date : Language: Register No. Revision : 0 Page :

Project : PEA-PMD-ISD-PSR-5-12 (PRA) ELECTRICAL DESIGN DRAWING Date : MARCH 28/2000

Order no. : DDS990SMI03 Issued by : CHANWIT S.

Remarks : **AFC** = Asking for construction, **DFA** = Document for approval, **DFR** = Document for re-approval, **FFA** = Final document for approval, **RFA** = Reproducible document for approval
AP = Approved, **AN** = Approved except as noted, **FC** = For construction, **NR** = Not reviewed, **RA** = Received and acceptable, **RC** = Returned for correction

								Documents for Approval								Final Documents					
								1st		2nd		3rd		4th		Blue Print		Reproducible		MicroFilm	
	Document No	Description	Sh	Rev.		Issued		Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return
1	ABB/PRA-S-01	Legend And Symbol	1	1	Plan		Ref.	L-022	1126	L-034											
					Actual		Date	7/6/99	8/2/99	8/11/99											
							Status	DFA	AN	FFA											
2	ABB/PRA-S-01	Single Line Diagram	2	1	Plan		Ref.	L-022	1126	L-034											
					Actual		Date	7/6/99	8/2/99	8/11/99											
							Status	DFA	AN	FFA											
3	ABB/PRA-CL-002	General Plan	1	0	Plan		Ref.														
					Actual		Date														
							Status	DFA													
4	ABB/PRA-S-03	Equipment Layout And Block-out Plan	1	1	Plan		Ref.	L-030	0161	L-142	0565										
					Actual		Date	19/7/99	12/11/99	24/1/00	28/2/00										
							Status	DFA	AN	FFA	AP	AFC									
5	ABB/PRA-S-03	Equipment Layout And Block-out Plan	2	1	Plan		Ref.	L-030	0161	L-142	0565										
					Actual		Date	19/7/99	12/11/99	24/1/00	28/2/00										
							Status	DFA	AN	FFA	AP	AFC									
6	ABB/PRA-S-03	Equipment Layout And Block-out Plan	3	2	Plan		Ref.	L-030	0161	L-142	0565										
					Actual		Date	19/7/99	12/11/99	24/1/00	28/2/00										
							Status	DFA	AN	FFA	AN	AFC									
7	ABB/PRA-S-03	Equipment Layout And Block-out Plan	4	1	Plan		Ref.	L-030	0161	L-142	0565										
					Actual		Date	19/7/99	12/11/99	24/1/00	28/2/00										
							Status	DFA	AN	FFA	AP	AFC									
8	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	1	1	Plan		Ref.	L-058	0362												
					Actual		Date	14/10/99	5/1/00												
							Status	DFA	AN	FFA											
9	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	2	1	Plan		Ref.	L-058	0362												
					Actual		Date	14/10/99	5/1/00												
							Status	DFA	AN	FFA											
10	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	3	1	Plan		Ref.	L-058	0362												
					Actual		Date	14/10/99	5/1/00												
							Status	DFA	AN	FFA											
11	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	4	1	Plan		Ref.	L-058	0362												
					Actual		Date	14/10/99	5/1/00												
							Status	DFA	AN	FFA											
12	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	5	1	Plan		Ref.	L-058	0362												
					Actual		Date	14/10/99	5/1/00												
							Status	DFA	AN	FFA											
13	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	6	1	Plan		Ref.	L-058	0362												
					Actual		Date	14/10/99	5/1/00												
							Status	DFA	AN	FFA											
14	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	7	1	Plan		Ref.	L-058	0362												
					Actual		Date	14/10/99	5/1/00												
							Status	DFA	AN	FFA											
15	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	8	0	Plan		Ref.														
					Actual		Date														
							Status	DFA													

DOCUMENT SUBMISSION STATUS

Issue by:	Date :	Language:	Register No.	Revision : 0	Page :

Project :	PEA-PMD-ISD-PSR-5-12 (PRA)	ELECTRICAL DESIGN DRAWING	Date :	MARCH 28/2000
Order no. :	DDS990SMI03		Issued by :	CHANWIT S.

Remarks : **AFC** = Asking for construction, **DFA** = Document for approval, **DFR** = Document for re-approval, **FFA** = Final document for approval, **RFA** = Reproducible document for approval
AP = Approved, **AN** = Approved except as noted, **FC** = For construction, **NR** = Not reviewed, **RA** = Received and acceptable, **RC** = Returned for correction

									Documents for Approval								Final Documents					
									1st		2nd		3rd		4th		Blue Print		Reproducible		MicroFilm	
	Document No.	Description	Sh.	Rev.		Issued		Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return	Submit	Return
16	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	9	0	Plan		Ref.														
					Actual		Date														
							Status	DFA													
17	ABB/PRA-S-04	Cable Routing And Cable Ladder Installation	10	0	Plan		Ref.														
					Actual		Date														
							Status	DFA													
18	ABB/PRA-S-05	Substation Earthing System	1	1	Plan		Ref.	L-038	1572												
					Actual		Date	26/8/99	28/9/99												
							Status	DFA	AN	FFA											
19	ABB/PRA-S-05	Substation Earthing System	2	1	Plan		Ref.	L-038	1572												
					Actual		Date	26/8/99	28/9/99												
							Status	DFA	AN	FFA											
20	ABB/PRA-S-05	Substation Earthing System	3	1	Plan		Ref.	L-038	1572												
					Actual		Date	26/8/99	28/9/99												
							Status	DFA	AN	FFA											
21	ABB/PRA-S-05	Substation Earthing System	4	1	Plan		Ref.	L-038	1572												
					Actual		Date	26/8/99	28/9/99												
							Status	DFA	AN	FFA											
22	ABB/PRA-S-05	Substation Earthing System	5	1	Plan		Ref.	L-038	1572												
					Actual		Date	26/8/99	28/9/99												
							Status	DFA	AN	FFA											
23	ABB/PRA-S-05	Substation Earthing System	6	0	Plan		Ref.														
					Actual		Date														
							Status	DFA													
24	ABB/PRA-S-05	Substation Earthing System	7	0	Plan		Ref.														
					Actual		Date														
							Status	DFA													
25	ABB/PRA-S-06	Equipment Installation : 22 kV Switchgear	1	1	Plan		Ref.	L-063	0410												
					Actual		Date	2/11/99	20/1/00												
							Status	DFA	AN	FFA											
26	ABB/PRA-S-06	Equipment Installation : Automatic Capacitor Bank	2	1	Plan		Ref.	L-063	0410												
					Actual		Date	2/11/99	20/1/00												
							Status	DFA	AN	FFA											
27	ABB/PRA-S-06	Equipment Installation : Cable Riser	3	1	Plan		Ref.	L-063	0410												
					Actual		Date	2/11/99	20/1/00												
							Status	DFA	AN	FFA											
28	ABB/PRA-S-06	Equipment Installation : Cable Riser	4	1	Plan		Ref.	L-063	0410												
					Actual		Date	2/11/99	20/1/00												
							Status	DFA	AN	FFA											
					Plan		Ref.														
					Actual		Date														
							Status														
					Plan		Ref.														
					Actual		Date														
							Status														

ต้นฉบับ หน้าขาดหาย