Appendix-8 GV Switching procedure

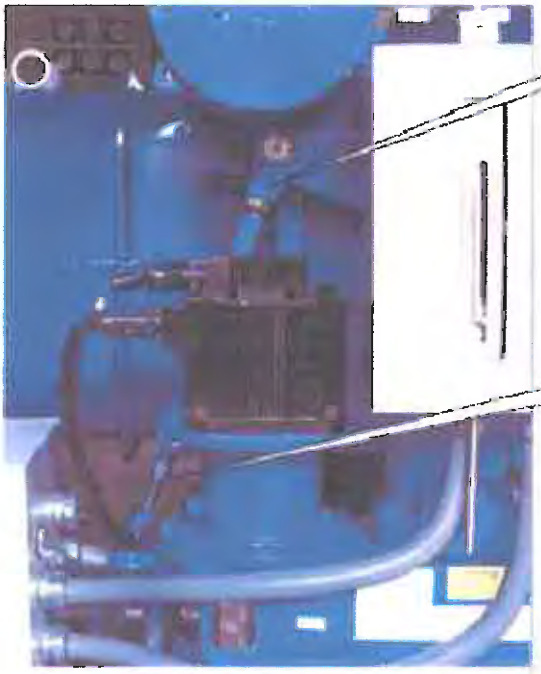
1/22/2009

Switching Procedure for Guide Vane at 1/3 Zone

The figure below shows 1/3 GV Operable and 2/3 GV Locking
In case of generator output is to be approx. less 60kW operation.

Take off the Pin

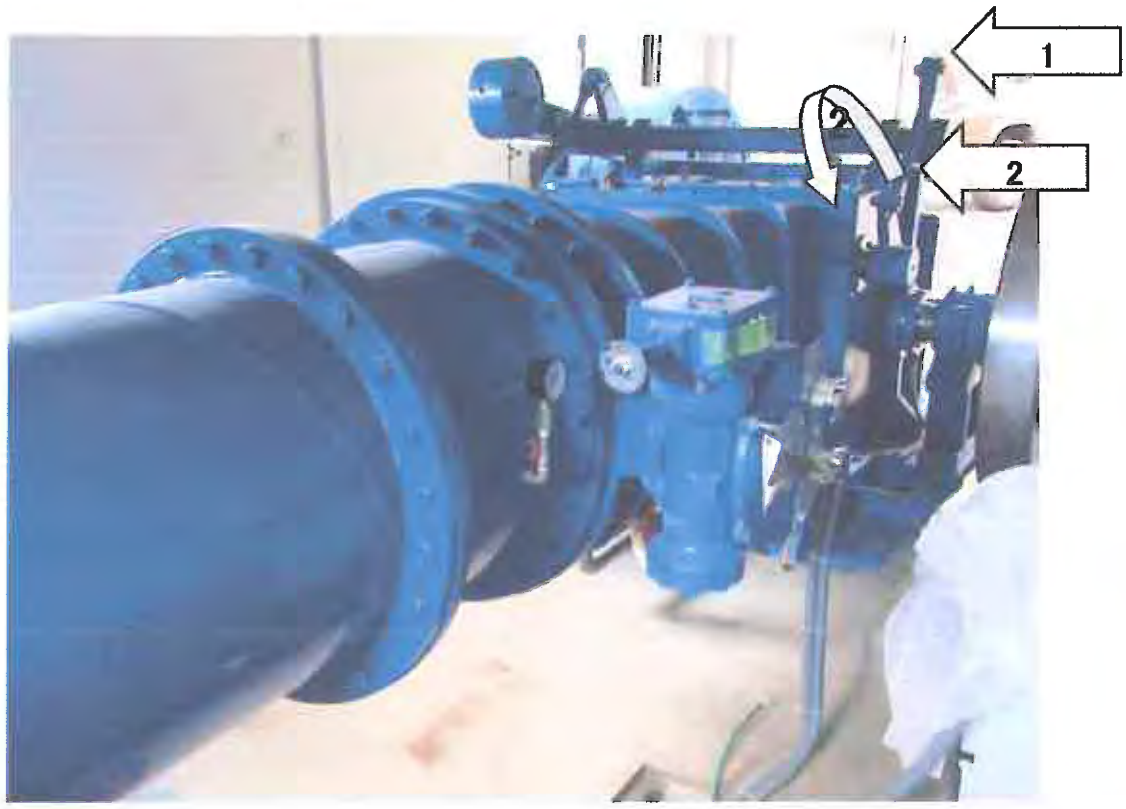
Turn the lever and to connect the Locking Arm



Locking Arm

Switching procedure for Guide Vane at 2/3 Zone

The figure below shows 2/3 GV Operable
1/3 GV is no locking device and always free position.



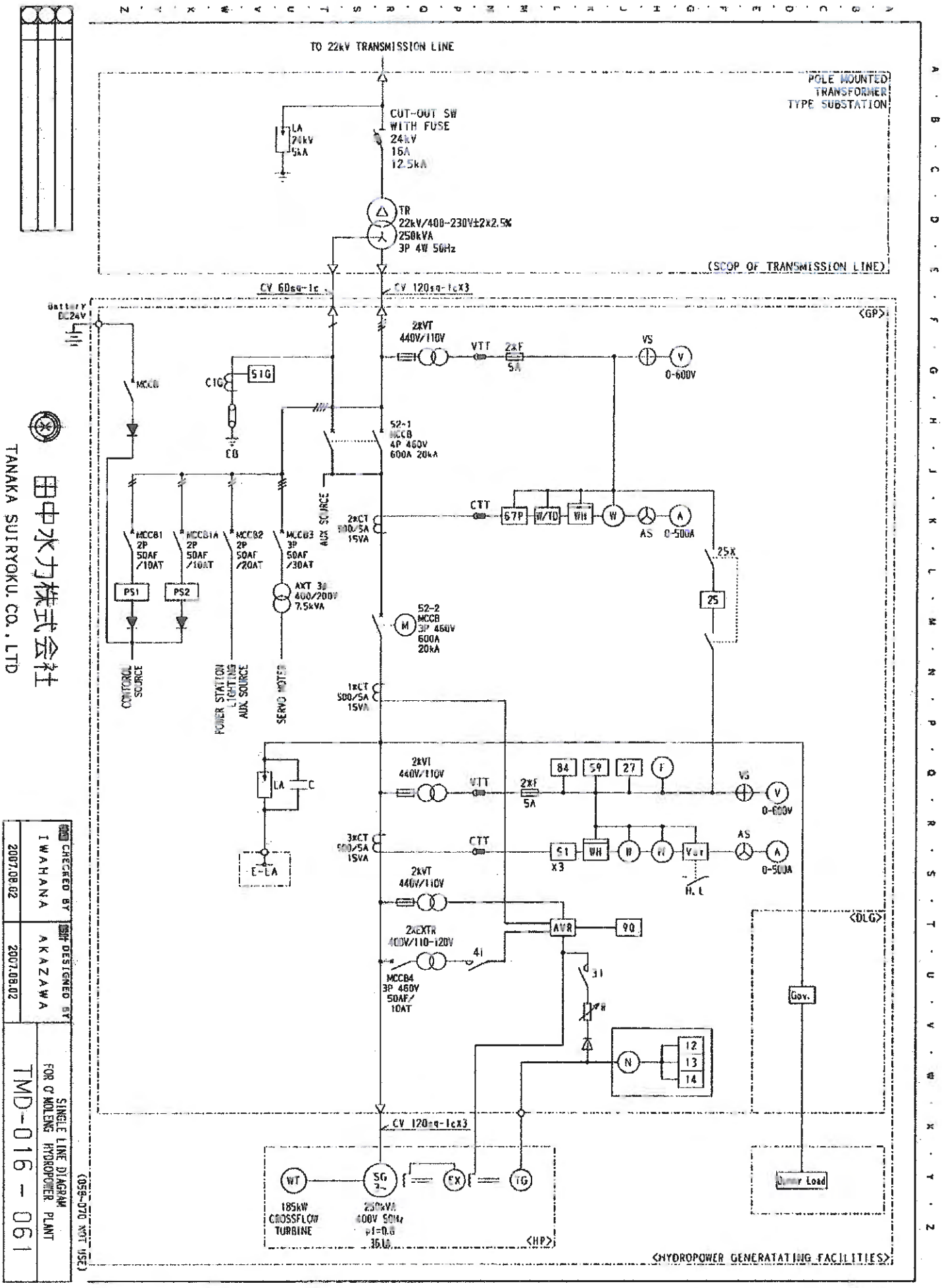
Step 1: Take off the Pin (1) of 2/3 GV same as procedure of 1/3 GV changing.

Step 2: Turn the lever (2) and free position (but not connect to the Locking arm)

Caution: Inlet valve open when turbine starting, the turbine speed may be increased more than setting value (450rpm) due to water leakage from 1/3 GV.
Then starting condition is incompleted.

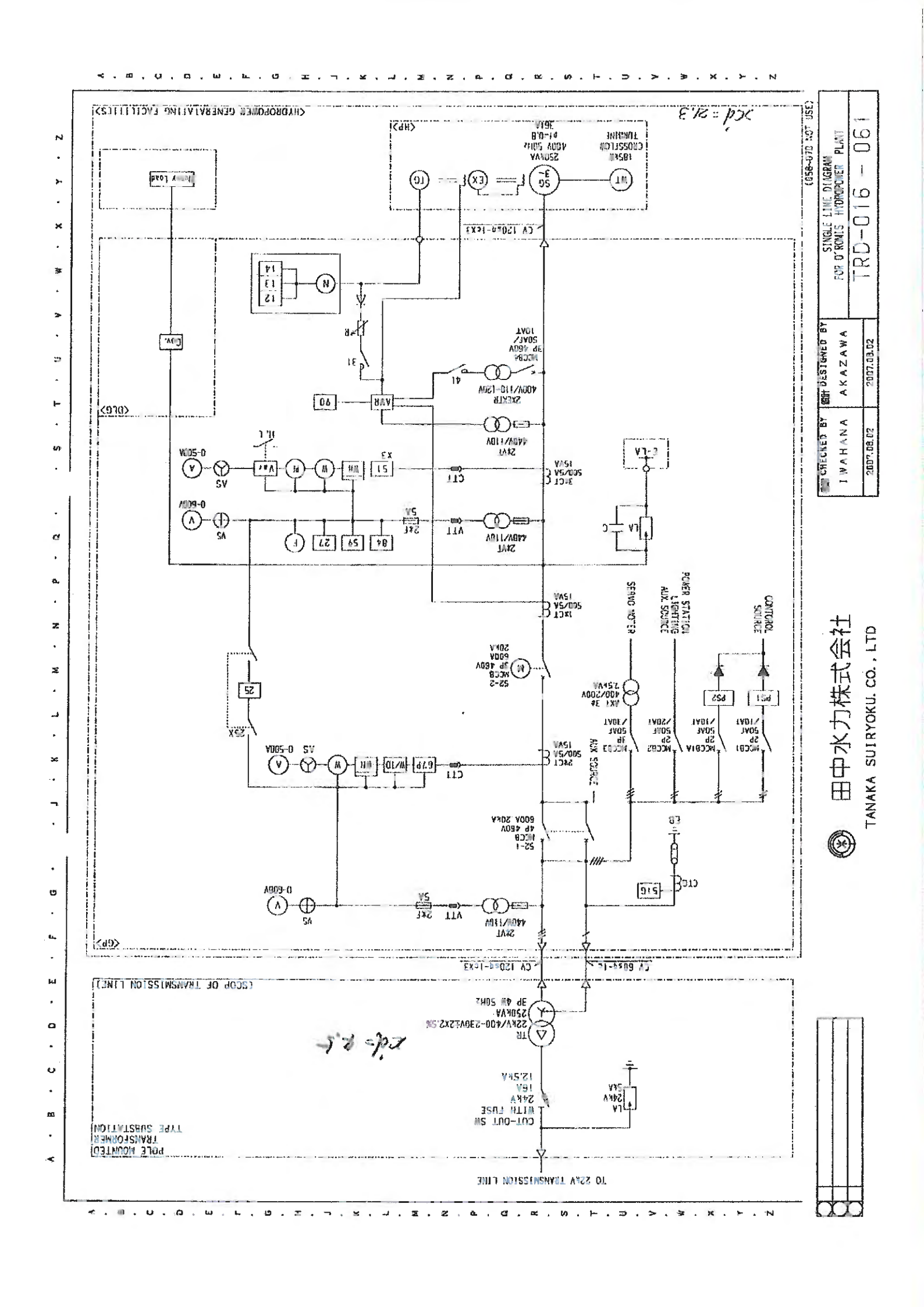
Measure: Speed relay (meter setting) LL must be changed more than 450rpm by manual.

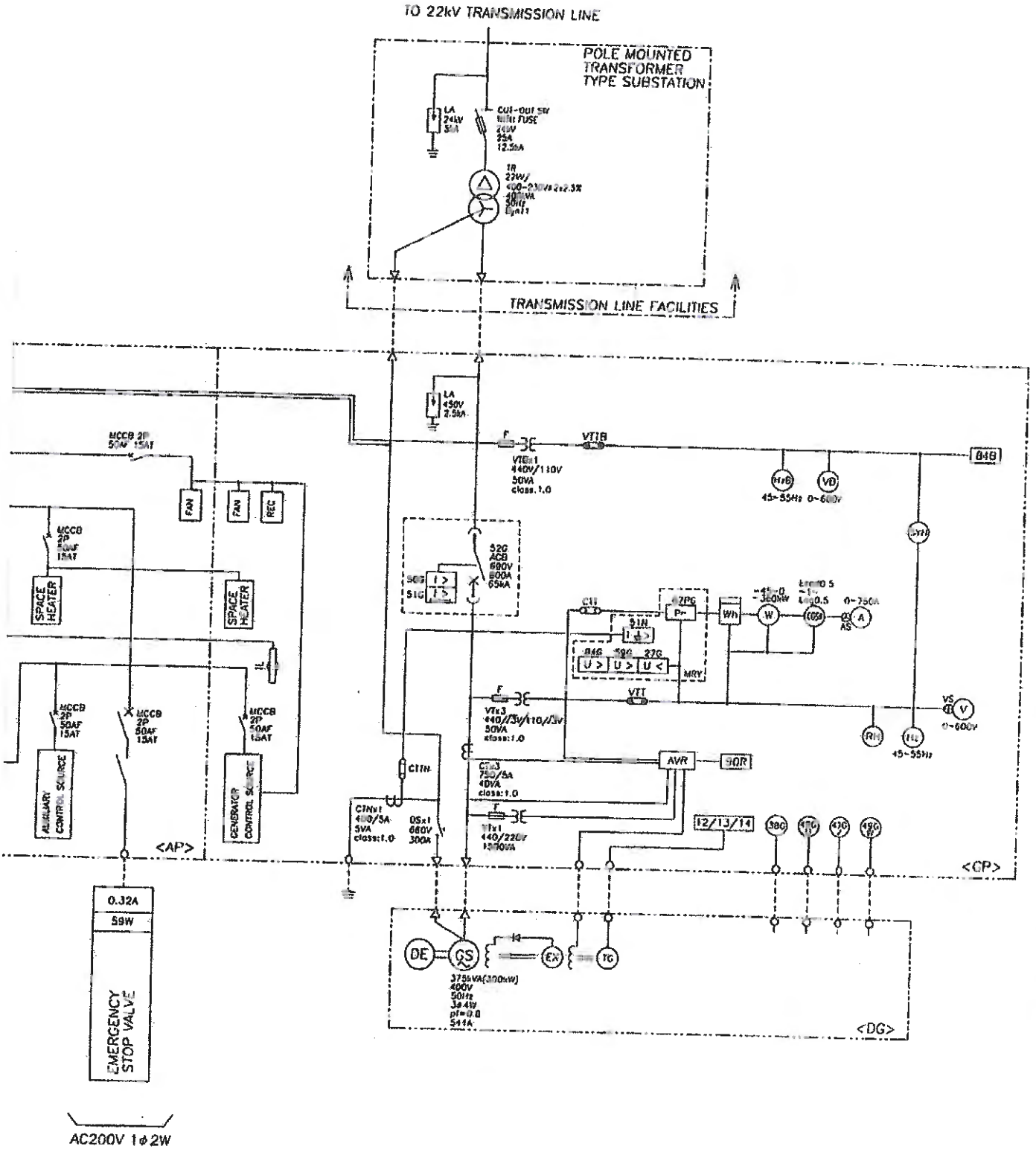
Appendix-9 Single diagrams



田中水力株式会社
TANAKA SUIRYOKU. CO., LTD

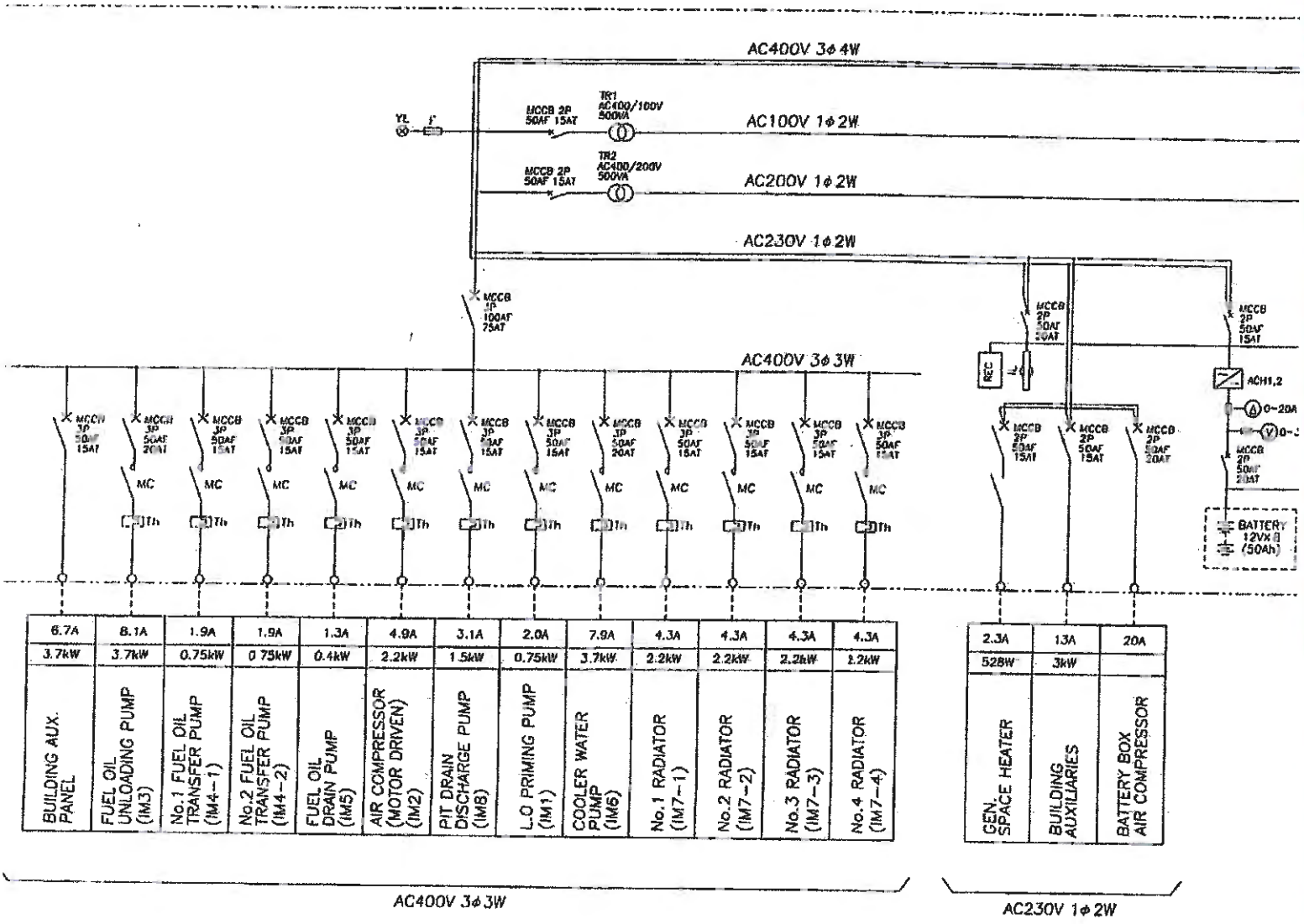
CHECKED BY	DESIGNED BY	SINGLE LINE DIAGRAM FOR O' MOLENG HYDROPOWER PLANT
IWAHANA	AKAZAWA	TMD-016 - 061
2007.08.02	2007.08.02	(059-070 NOT USE)


SINGLE LINE DIAGRAM
FOR O'ROMIS HYDROPOWER PLANT
TRD-016 - 061
DESIGNED BY
AKAZAWA
2007.03.02
CHECKED BY
IWAHANA
2007.08.02
田中水力株式会社
TANAKA SUIRYOKU. CO., LTD
TO 22kV TRANSMISSION LINE
POLE MOUNTED
TRANSFORMER
TYPE SUBSTATION
LOOP OF TRANSMISSION LINE
HYDROPOWER GENERATING FACILITIES
SERVO MOTOR
POWER STATION
AUX. SOURCE
CONTROL
SOURCE



(1/2)

TAIYO ELECTRIC CO., LTD.	TITLE	DRAW.No.		SHEET No.
1 2 3 4 5	SINGLE LINE DIAGRAM	L3-16653-SL		5


AC400V 3φ 4W
AC100V 1φ 2W
AC200V 1φ 2W
AC230V 1φ 2W
AC400V 3φ 3W
MCCB 2P 50AF 15AT
TR1 AC400/100V 500VA
TR2 AC400/200V 500VA
MCCB 3P 100AF 75AT
MCCB 2P 50AF 20AT
MCCB 3P 50AF 15AT
MCCB 3P 50AF 20AT
MC
Th
REC
ACH1,2
BATTERY 12VX8 (50Ah)
6.7A 3.7kW BUILDING AUX. PANEL
8.1A 3.7kW FUEL OIL UNLOADING PUMP (IM3)
1.9A 0.75kW No.1 FUEL OIL TRANSFER PUMP (IM4-1)
1.9A 0.75kW No.2 FUEL OIL TRANSFER PUMP (IM4-2)
1.3A 0.4kW FUEL OIL DRAIN PUMP (IM5)
4.9A 2.2kW AIR COMPRESSOR (MOTOR DRIVEN) (IM2)
3.1A 1.5kW PIT DRAIN DISCHARGE PUMP (IM8)
2.0A 0.75kW L.O PRIMING PUMP (IM1)
7.9A 3.7kW COOLER WATER PUMP (IM6)
4.3A 2.2kW No.1 RADIATOR (IM7-1)
4.3A 2.2kW No.2 RADIATOR (IM7-2)
4.3A 2.2kW No.3 RADIATOR (IM7-3)
4.3A 2.2kW No.4 RADIATOR (IM7-4)
2.3A 528W GEN. SPACE HEATER
13A 3kW BUILDING AUXILIARIES
20A BATTERY BOX AIR COMPRESSOR
AC400V 3φ 3W
AC230V 1φ 2W

(2/2)

Appendix-10 Form-1, 3, 4 and 5

Yearly Work Plan in 2009

Director	Deputy Director	Chief	Prepared

Form-1

Name: EUMP **Date:** 10/1/2009

No.	Station Name	Budget (US$)	Work Priority	Work Order	Work Category	Number of Worker	Work Leader	Super Visor	Work Schedule												Note
									1	2	3	4	5	6	7	8	9	10	11	12	
1	O'Moleng	500	1	O'M	P.I	4	Mr. Heng Sokhorn	Tanaka Suiryoku													
2	O'Romis	500	1	O'R	P.I	4	Mr. Pen Pidu	Tanaka Suiryoku													
3	Diesel	700	1	DG	P.I	4	Mr. Yeb Thav	Daihatsu													
4	T/L	300	2	TL	P.I	3	Mr. Savuth Sothea	EM													
5	D/L	200	1	TL	P.I	3	Mr. Savuth Sothea	EM													

Regend:
1) P.I: Periodic Inspection
2) Work schedule

Instruction:

1)
2)
3)
4)
5)
6)

(Form 10-1)

Check List of Work Safety

Periodic Inspection at O'Moleng P.S Confirmed by Mr. Khin

(Note) Head of the operation shall check the items marked with *.

Step	Date of confirmation	Check	Item to be confirmed	Note
Preparations for the work			General Safety and Health management organization	
			Appointment of the contractor in charge of General management	
			Preparation and approval of Work plan	
			Date, time and procedure of Shutdown	
			Scope and specifications of Shutdown	
			Organizations of the work and test	
			Proper number and allocation of workers	
			Preparation of materials, tools, protective devices	
			Satisfactory plan and procedures	
			Scope of the work and the premise	
			Communication and adjustment with persons in concern	
			Measures in the case of bad weather	
			Appointment and approval of each position	
			Preparatory meeting before the start of the work	
			Assembling of persons in concern	
			Confirmation of Work plan and specification details	
			Confirmation of the organization for the work and communication	
			Having persons in concern be well informed of the relating or concurrent work	
			Confirmation of necessary equipment, materials and protective devices	
Start of the work			Execution of the shutdown operation	
			Execution of the locking/grounding	
			Cross reference with the confirmation table	
			Electric check on the grounding connection	
			Execution of the grounding (22kV Lines and others, if necessary)	
			Report and confirmation on completion of Locking/Grounding	
			Setting of the work premise	
			Confirmation of before the work start	
			Setting of the scope of work premise and "do not enter" places	
			Attaching the safety markings	
			Appropriate watching place for the safety supervisor	*
			Meeting on the start of the work	

Step	Date of confirmation	Check	Item to be confirmed	Note
Completion of the work			Confirmation of the condition of the finished equipment	
			Patrol and inspection of the work scope	
			No mistake in the work	
			Valves shall be closed or opened in accordance with the specified work procedure	
			Firm re-tightening of the terminal bolts & Nuts	
			No materials nor tools left in the work spots	
			Judgement of the results of the work and test	
			Report and approval of the completion of the work	
			Receipt of the work slips	
			Restoration of the work premise	
			Unlocking of the locking and disconnecting the grounding	
			Taking over the shutdown scope to the operation manager	
			Returning the work slips	
Restoring operation			Confirmation on the main control panel	*
			Disconnecting all the groundings	*
			Unlocking all the lockings	*
			Normal conditions in the control power source	*
			Normal conditions of the relays	*
			Normal conditions of the indicator lamps and the indicators	*
			Restoring operation	*
			Confirmation after the restoring operation	*
			Normal condition of the indicator lamps and the indicators	*
			No abnormality in the site equipment	*
			Completion of the work	*
			Reporting to Station Master and persons in concern	*
			Returning the keys used for the work	*
				*
				*
				*
				*
Termination			Finalizing the work records	
			Checking quantity of materials used in the work	
			Procedures taken for re-filling of spare parts and stock materials	
			Filing the maintenance records including the work sheets	
			Filing other work records	
			Filing the records of the operation procedure table	*

(Form 10-2)

Work Planning Check List

Periodic Inspection at O'Moleng P.S Confirmed by Mr. Khin

Work Schedule		2009/11/28 at 8:00 - 2009/12/05 by 16:00 (Hrs)	
Month Day	**Check**	**Item**	**Instruction**
		Appointment of Head of the work, etc.	
		Scope responsibility of Head of the work, etc.	
		Is appropriate in view of the contents of the work ?	
		Is appropriate in view of the quantity of the work ?	
		Organization of the General Management of Safety and Health	
		Were assigned General Manager of Safety and Health and Manager of Safety and Health of the contractor ?	
		Is the person in charge of Safety and Health appointed.	
		Preparation of the organization of the work management	
		Is the organization suitable for the work ?	
		Is organized the team for the locking and the grounding ?	
		Are the necessary workers secured ?	
		Is the work not oversized ?	
		Is appointment of each position completed ?	
		Is the work planning appropriate ?	
		Are the work contents, procedures, progress time schedule appropriate ?	
		Are the shutdown scope and the work premise made properly ?	
		Are adequate safety precautions made ?	
		No negligence of the locking and grounding.	
		Fixing procedures for abnormalities and pending problems	
		Are detailed inspection items studied ?	
		Study of the previous work records and installation test records	
		Are attached documents prepared properly ?	
		Is the Work Safety Check List prepared ?	
		Is the pre-work adjustment adequate ?	
		Communication with organizations in concern	
		No negligence of necessary documents	
		Procurement and preparation of equipment, materials, tools, protective devices, etc.	
		Are the documents from manufacturers and contractors prepared	
		Is any special caution to be made ?	
		Is determined the shutdown officially ?	

Work Plan

Form-3

O'Moleng P.S	Work No. OM-001	Approval			
		Director	Deputy Director	Chief	Work Manager
Preparation:	10/1/2009				

Work Name	Periodic inspection for turbine	Slip No.	
Equipment	Hydropower generating equipment	Shutdown	No.
Purpose	Periodic inspection for htdropower station	Work	No.
Schedule	2009/11/28 at 8:00 - 2009/12/05 by 16:00 (Hrs)	Grounding	No.
Shutdown	2009/11/28 at 8:00 - 2009/12/05 by 16:00 (Hrs)	Daily: at 8:30 by 15:30	

Work Items	Relative Work
1)Disassembly inspection of turbine and bearing 2)Runner inside inspection 3)Generator inspection 4)Dummy load inspection 5)Contorol panel inspection	1)Waterway and intake inspection 2)Transmision line inspection and others

Safety Measure			
Prohavited operation	#1 Control SW, #52-1,2 CB, Inlet valve	Grounding	Non
Locking	Inlet valve	Protection	Pad lock key for Control panel

Work Organization			
Work order	1) Own work 2) Contract 3) Consignment	Safcty manager	Mr. Chin Sokhun
Work manager	Mr. Thai Khin	Site manager	Mr. Heng Sokhorn
Work manager	Mr. Thai Khin	Assitant	Mr. Eng Rithy
Assistant	Mr. Heng Sokhorn	Operator	Mr. Heang Vandy
Work leader	Mr. Heng Sokhorn	Workers	Mr. Um Monichetra
Safety	Mr. Eng Rithy	Workers	Mr. Chheoum Kosal
Maker' SV	Tnaka Hydro	Total	(9)
Praparatory meeting	Date 2009/11/28 at 8:00	Attendants	1)K. Pisith 2)Se 3)Khin
	Place Technical Devision		4)Sokhom 5)Other staff

Work Standards (Print numbers of (1, 2, 3 ----) are attached.)	
( ) Work contents	Instruction
( ) Work manage sheet	1)
( ) Shutdown, Locking & Grounding area	2)
( ) Work organization	3)
( ) Work schedule	4)
( ) Work safety procedure	5)
( ) Tools and Material list	
( ) Safety indicators	
( ) Safety check list	

General Work Plan

Form-4

O'Moleng P.S	Work No. OM-G001	Approval			
		Director	Deputy Director	Chief	Work Manager
Preparation:	10/1/2009				
Work Name	Periodic inspection for turbine				
Equipment	Hydropower generating equipment				
Total Work	2009/11/28 at 8:00 - 2009/12/05 by 16:00 (Daily 8 Hrs X 6 dys · continous)				

	Work Item	Work Content	Method	Schedule	Actual	Name of Leader	Confirmed
1	Periodic inspection for turbine	1)Inspection of turbine & generator, inletvalve, control panel 2)Dummy load, etc.	Contrct	Frm: 10/28 To: 11/05		Mr. Thai Khin	
2	Inspection of civil facilities	Inspection of waterway and intake	EUMP	Frm: 10/28 To: 11/05		Mr. Chin Sokhun	
3	Inspection of transmission line	1)Inspection of 22kV T/L 2)Inspection of 400V D/L, etc.	EUMP	Frm: 10/28 To: 11/05		Mr. Thai Khin	
4				Frm: To:			
5				Frm: To:			

Head of wok	Work manager	Safcty managcr	Lock & Grounding	Leadcr	Workcr	Confirmcd

Meeting	Schedule	2009/10/28 at 8:00	Place	EUPM room	Atendant	1)K. Pisith 2)Se
	Actual					3)Khin 4)Other staff

Remarks	**Scope of work**	**Instruction**
	1) Refer to Single diagram 2) Refer to Block diagram	1) 2) 3) 4) 5)

Confirmation Table of Locking and Grounding

Form-5

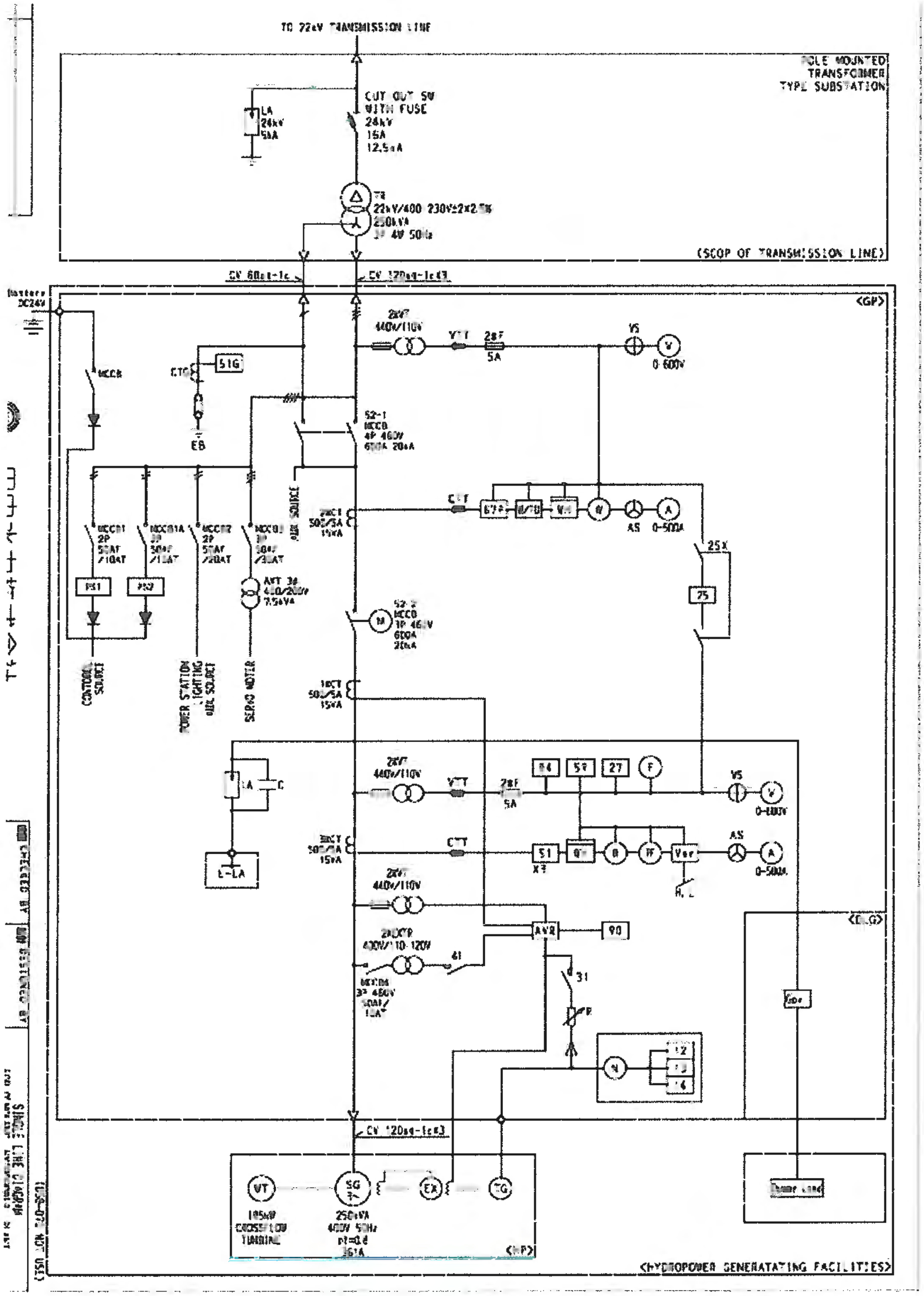
Work Name:	Periodic Inspection for Turbine	Name of P.S: O'Moleng	
Work Period	2009/11/28 at 8:00 - 2009/12/05 by 16:00 (	Date: 2009/10/28	Approved
Shutdown Date:	2009/11/28 at 8:00 - 2009/12/05 by 16:00 (	Mr. Thai Khin	

No.	Lock operation for Parts	Condition before lock	Lock date	Unlock date	Lock lavel No. and Place				Remark
					Panel	Local	Common	Lavel No.	
1	Turbine Stop #1	Stop	10/28	11/05	O			1	
2	InletValve CLOSED	Closed	10/28	11/05		O		2	
3	52-1 OFF	Off	10/28	11/05	O			3	
4	52-2 OFF	Off	10/28	11/05	O			4	
5	NFB-1 & 1A OFF	On	10/28	11/05	O			5	
6	NFB-2 OFF	On	10/28	11/05	O			5	
7	NFB-3 OFF	On	10/28	11/05	O			5	
8	Servo Moter MCCB OFF	On	10/28	11/05	O			5	
9									
10									
11									
12									
13									
14									
15									

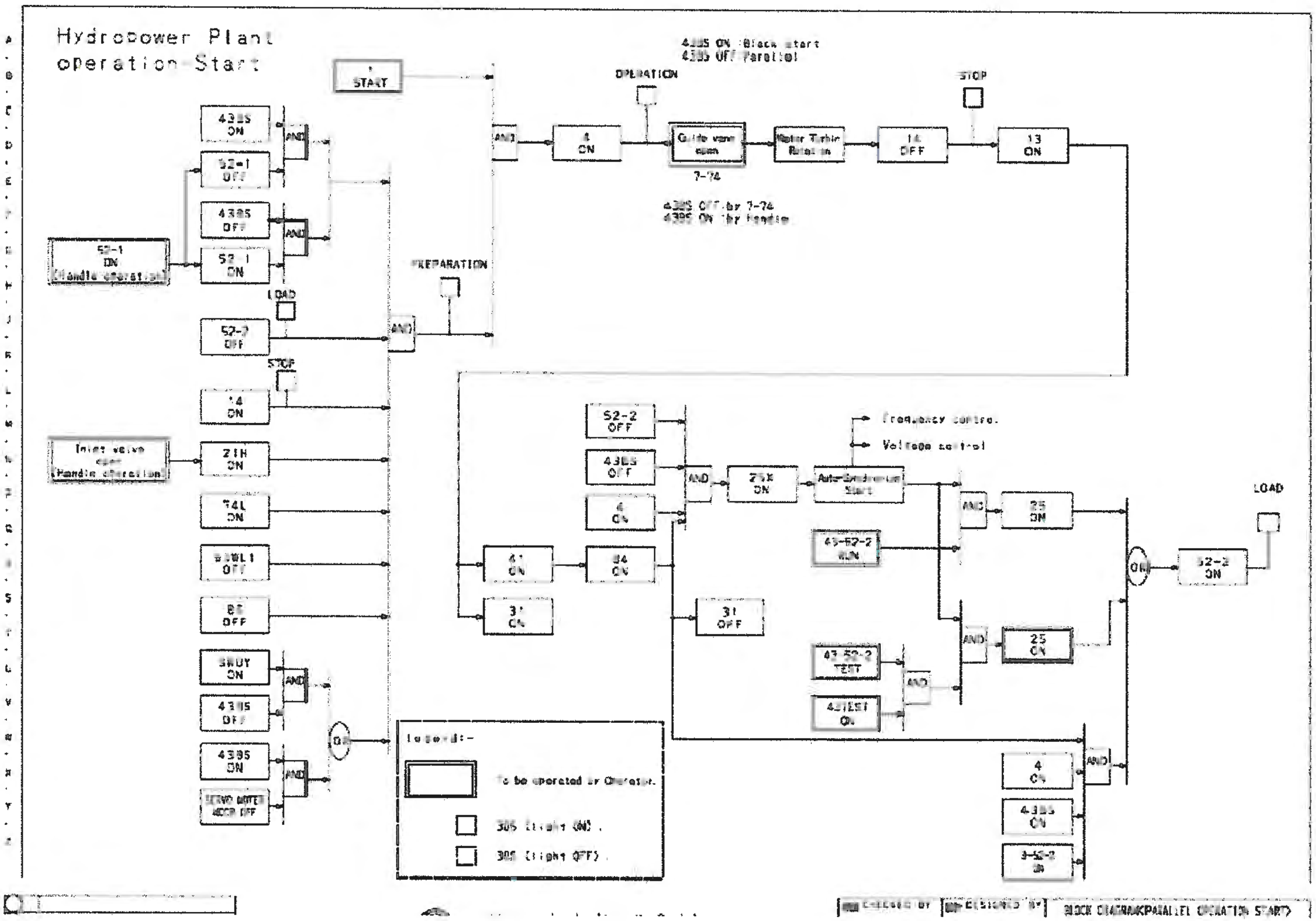
Scope of Shutdown and Work ares

1) Refer to Single diagram

2) Refer to Block diagram



TO 22kV TRANSMISSION LINE
POLE MOUNTED TRANSFORMER TYPE SUBSTATION
LA 24kV 5kA
CUT OUT SW WITH FUSE 24kV 15A 12.5kA
TR 22kV/400 230V±2x2.5% 250kVA 3P 4W 50Hz
(SCOP OF TRANSMISSION LINE)
CV 60sq-1c
CV 120sq-1cx3
Battery DC24V
<GP>
2VT 440V/110V
VTT
2aF 5A
VS
V 0-600V
MCCB
CTG
51G
EB
52-1 MCCB 4P 460V 600A 20kA
2KCT 500/5A 15VA
CTT
67F
AS
A 0-500A
AUX SOURCE
MCCB1 2P 50AF /10AT
MCCB1A 2P 50AF /10AT
MCCB2 2P 50AF /20AT
MCCB3 3P 50AF /30AT
AVT 3φ 400/200V 7.5kVA
PS1
PS2
25X
25
52-2 MCCB 3P 460V 600A 20kA
M
CONTROL SOURCE
POWER STATION LIGHTING AUX SOURCE
SERVO MOTER
1KCT 500/5A 15VA
LA
C
E-LA
2KVT 440V/110V
VTT
2aF 5A
84
59
27
F
VS
V 0-600V
3KCT 500/5A 15VA
CTT
51 X3
W
PF
Var
AS
A 0-500A
2KVT 440V/110V
AVR
90
2EXTR 400V/110-120V
41
MCCB4 3P 460V 50AF/ 10AT
31
R
N
<DLG>
Gov
CV 120sq-1cx3
WT
185kW CROSSFLOW TURBINE
SG 3~
250kVA 400V 50Hz pf=0.8 361A
EX
TG
<HP>
Dummy Load
<HYDROPOWER GENERATATING FACILITIES>
SINGLE LINE DIAGRAM



Hydropower Plant
operation Start
START
OPERATION
Guide vane open
7-74
Water Turbine Rotation
14 OFF
STOP
13 ON
4 ON
AND
PREPARATION
LOAD
STOP
52-1 ON (Handle operation)
Inlet valve open (Handle operation)
52-2 OFF
43BS OFF
4 ON
25X ON
Auto-Synchronism Start
Frequency control
Voltage control
25 ON
52-2 ON
OR
41 ON
84 ON
31 ON
31 OFF
4 ON
Legend:-
To be operated by Operator.
30S (light ON).
30S (light OFF).
CHECKED BY
DESIGNED BY
BLOCK DIAGRAM(PARALLEL OPERATION START)

Explanation of Yearly Work Plan

Work Plan No.	:	A series number in the Mondul Kiri Power Station
Shutdown sheet No.	:	Same No. With that of the supply interruption sheet No.
Work sheet No.	:	Same No. With that of the subject work sheet No. No. shall be given on issuing
Title of the work	:	Title of the work identified by the contract
Equipment subject to the work	:	Name or description for identification of facilities, equipment or lines which are to be worked
Cause of the work	:	Why and for what purpose the work shall be made. Shall be briefly described
Contents of the work	:	Contents of the work shall be described in concrete. Reference to Attachment "Contents of the work" shall be added when applicable
Associated work	:	The work to be done for power supply system, other organizations, take-chance items, other concurrent subjects, associated with the subject work. Their identifications and work timing.
Location of grounding	:	Description on all the grounding "A", "B" and "C". When a same grounding is repeated for different work purposes, each grounding shall be described in each work this grounding is used for. Describe the reference to Confirmation table of Locking/Grounding when applicable.
Prohibited operation	:	Describe the equipment that are prohibited to operate during the work
Locking	:	Describe all equipment to be locked. Describe the reference to Confirmation table of Locking/Grounding when applicable
Protective measures for equipment	:	Describe protective and safety measures for equipment, preventive measures for erratic operations, that shall be called for attention
Preventive, measures for dangerous accidents	:	Describe preventive measures for dangerous accidents that shall be called for attention. For example, assignment of safety supervisors or protection net, etc.
Work procedures	:	Describe categories, the own work, the contract, or the consignment work
Manager of Safety and Health	:	Describe the name of NEA's Manager of Safety and Health in the case of NEA's own work. In the case of contract work or consigned work, describe the name of its Manager of Safety and Health.

Head of the work Safety supervisor Work commander	:	Describe the name and the category of work. Describe the reference to Attachment "List of qualified personnel" when applicable.
Workers	:	Describe name of each worker to be directly at work, including that of NEA's and contractors.
Number of workers	:	Describe quantity of workers at the subject work including Head of the work. In case a worker is in charge of concurrent job titles, describe only major title. Work supervisor and Local direct operator are not included. Person in charge of setting the work premise and Person in charge of the confirmation of the work premise are not included in case they are not assigned to other work.
Preparatory meeting	:	Proposed date and time, place, proposed attendants
Helpers for setting the work premise (Contractor's)	:	Describe the names of workers(Contractor's) who will help NEA setting and restoring the work premise.

Use attachments when a box space of the sheet is not enough, which shall be noted in the corresponding box.

Do not leave boxes empty. Express explicitly the "null" such as "———" or "nothing" when applicable to prevent failures to fill.

Explanation of General Work Plan

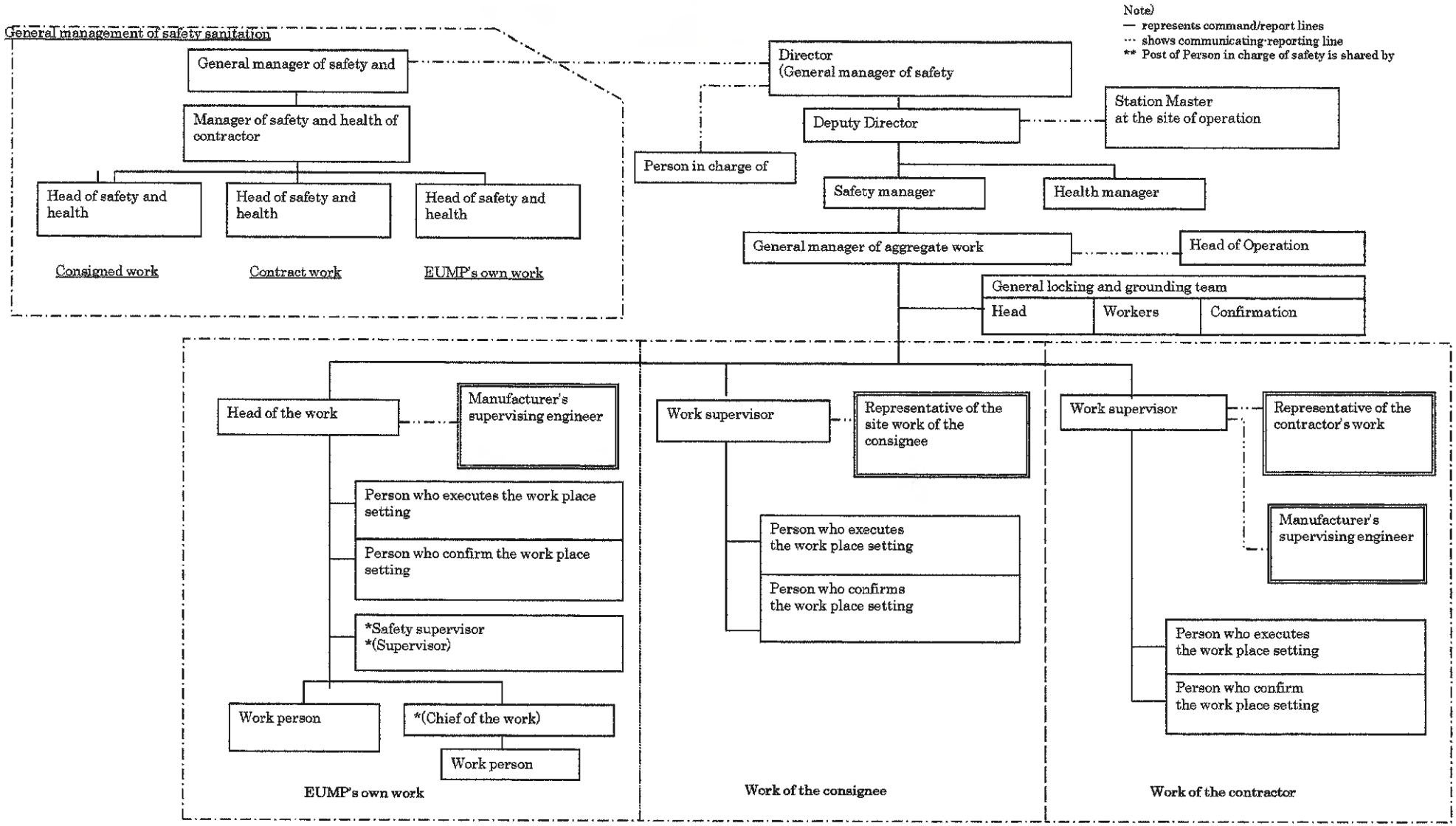
General Title of the work	:	Title of the shutdown work, or the general or representative title of the work
Equipment subject to the work	:	Describe names of equipment. Describe selected representative names when the work is of manifold
Total general working hours	:	Total general period of the aggregate work
General Safety and Health Manager Safety and Health Manager of the individual organization		Describe the name of persons and organizations of both the General Safety and Health Manager and the Safety and Health Manager of the individual organization, when he General Management Organization is employed for Safety and Health

Title of Work	:	Title of work in each Work Plan, and the titles of other organizations' work given by Work sheets. Describe also the civil work subject to the general management of safety and health, or closely related items in processing the work
Method		Describe whether the work shall be made by Own work, Contract, Consignment, or Other organization
Head of the work	:	Describe the names of Head of the work, Work supervisor, Witness person of the work
Designed work period	:	Describe the designed period of completing the work
Actual work period	:	Describe the actual period of completed the work
Confirmation	:	Describe the names of contact persons who are in charge of the operation in relation to the subject work
Number of workers. Place of grounding. Prohibited operation. Locking	:	These descriptions were erased from the Form

Note: Other items shall be filled up in the same manner as those of Work Plan Sheet

Appendix-11: Figure-1 Work management and safety organization

Fig. 1 Work Management and Safety Management Organization (Example)



Appendix-12: Operate Manual for Diesel Generator

OPERATE MANUAL FOR DIESEL GENERATOR

1. Confirm DC100V

2. All Breaker To be "ON"

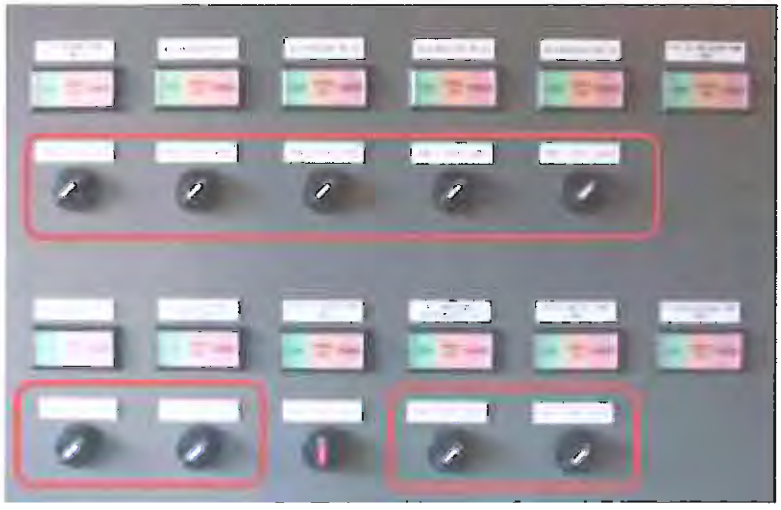
GENERATOR PANEL

AUXILIARY PANEL

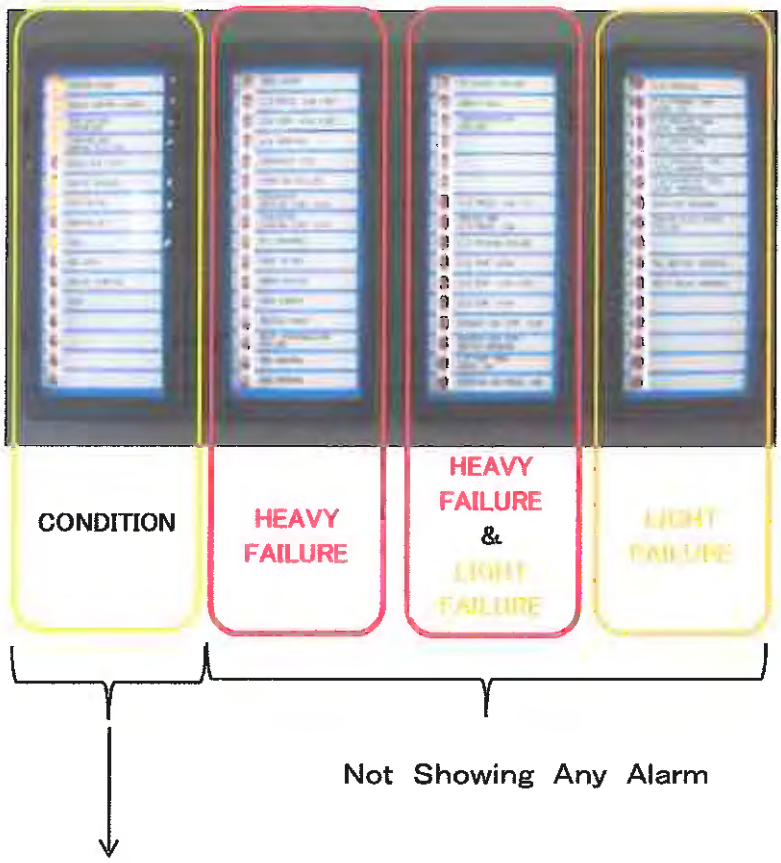
AUXILIARY PANEL

3. Confirm Each Switch Position

AUTO



4. Confirm The Indicator



DC100V POWER	Turn ON The Light
DC24V CONTROL SOURCE	Turn ON The Light
BUS VOLTAGE ESTABLISH	Turn ON The Light : At The Time of HYD-POWER Supplied Turn OFF The Light : At The Time of BLACKOUT
TURNING BAR NORMAL POSITION	Turn ON The Light
READY FOR START	Turn OFF The Light
ENGINE RUNNING	Turn OFF The Light
EXCITATION	Turn OFF The Light
WARMING UP	Turn OFF The Light
LOAD	Turn OFF The Light
52G OPEN	Turn ON The Light
ENGINE STOPPING	Turn OFF The Light
STOP	Turn ON The Light

5. Confirm of "READY FOR START"

①At The Time of BLACKOUT

- Turn on BLACKOUT SELECT SWITCH To "ON"

②At The Time of HYD-POWER Supplied

a) Push START PREPARATION PUSH BUTTON

b) Auto Start Aux Pumps

c) About 60sec. After Lighting "READY FOR START"

6. Start Operation for ENGINE (Confirm Lighting of "READY FOR START")

①At The Time of BLACKOUT

a) Turn on ENGINE CONTROL SWITCH To "START"

b) Start Up ENGINE

c) Check Voltage & Frequency

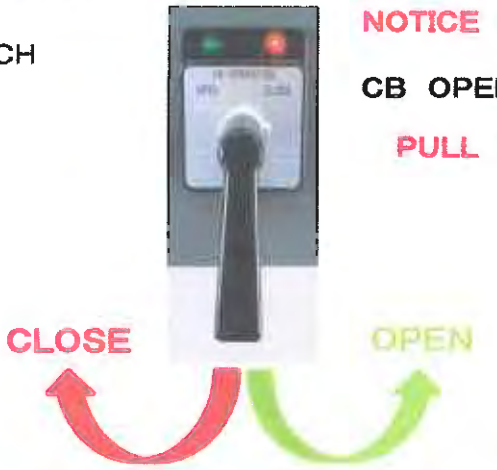
Voltage About 400V

Frequency About 50Hz

d) Pull Operate "CLOSE" by CB OPERATION SWITCH

e) Close ACB

f) Start Power Supply



NOTICE

CB OPERATION SWITCH

PULL OPERATION

* At The Condition on "AUTO"Position of MODE SELECT SWITCH

a) Turn on ENGINE CONTROL SWITCH To "START"

b) Start Up ENGINE

e) Close ACB by Automatically

f) Start Power Supply

②At The Time of HYD－POWER Supplied

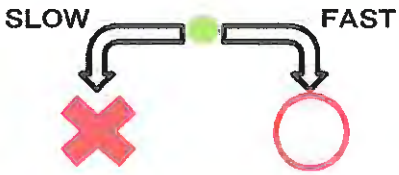
a) Turn on ENGINE CONTROL SWITCH
To "START"

b) Start Up ENGINE

c) Check Voltage & Frequency
Voltage About 400V
Frequency About 50Hz

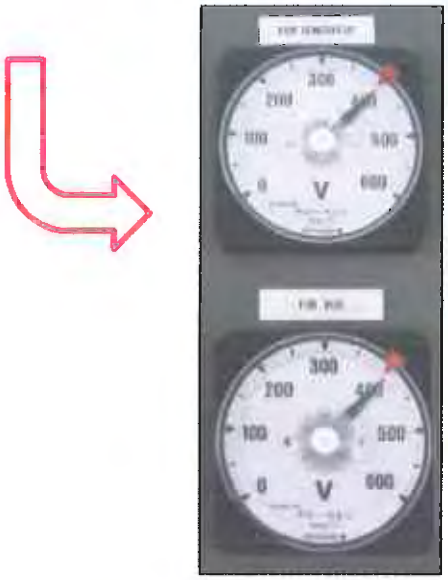
d) Turn on Synchro Select SWITCH
To "ON"

e) Make Action of
SYNCHRO SCOPE

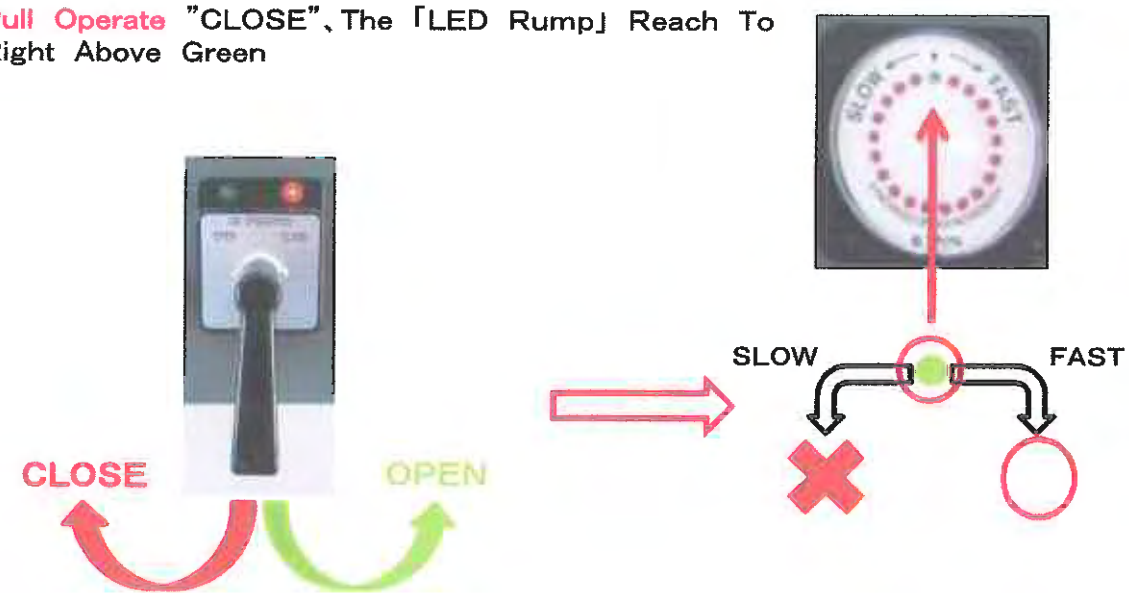


f) Operate Speed Control Switch
in Order To Slowly Rotate 「LED Rump」
To FAST Direction

e) Keep Voltage Difference With in 「5V」
Between 「FOR GENERATOR VOLTAGE」
& 「FOR BUS VOLTAGE」 USING by
Voltage Control Switch



h) Pull Operate "CLOSE", The 「LED Rump」 Reach To Right Above Green



i) Starting Parallel Running Closed by ACB

* At The Condition on 「AUTO」 of MODE SELECT SWITCH

a) Turn on ENGINE CONTROL SWITCH To "START"

b) Start Up ENGINE

c) Continue The Running of ENGINE About 2min30sec for 「WARMING UP」

d) Starting Synchro Automatically After 「WARMING UP」

e) Generator Frequency & Voltage are Adjusted Automatically

f) Close ACB by Automatically

g) Starting Parallel Running Closed by ACB

7. Governor Control

①D／G Independent Running

a) Furequency Control

Operate by Speed Control Switch

「INC」:Incrase Frequency
「DEC」:Decrase Frequency

b) Voltage Control

Operate by Voltage Control Switch

「INC」:Incrase Voltage
「DEC」:Decrase Voltaeg

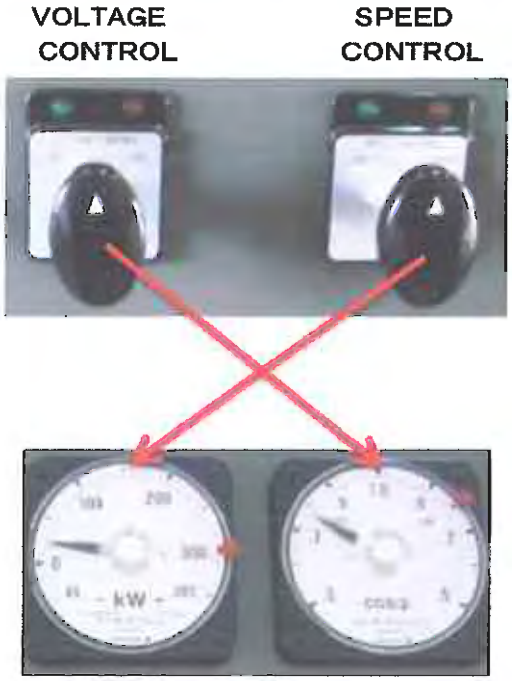
②D／G Parallel Running

a) Active Power Control (kW)

Operate by Speed Control Switch

「INC」:Incrase Power
「DEC」:Decrase Power

NOTICE
1) Prohibited Under 0kW
2) Heavy Failure 「REVERSE POWER」
by 「−30kW 10sec」



b) Power Factor Control (COSϕ)

Operate by Voltage Control Switch

「INC」:Incrase Diraction LAG

「DEC」:Decrase Diraction LEAD

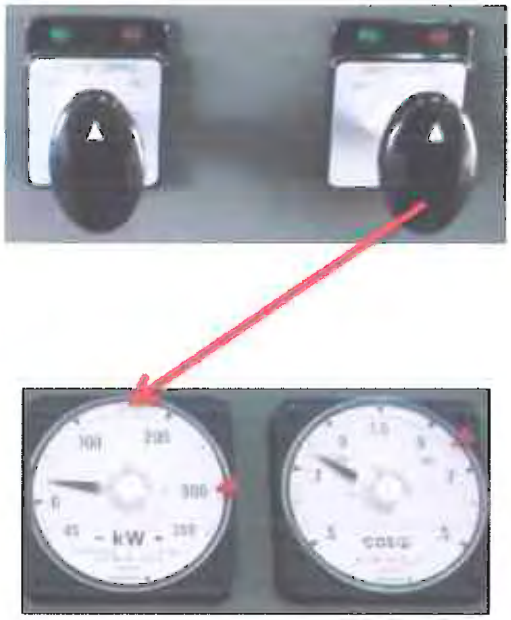
NOTICE
1) Normal Range : LAG Side 1.0～0.8
2) LEAD Side is Basically Avoid
(Must Keep Under 150A Even if LEAD Side)

8. Operatin for Open The 「ACB」

a) Turn on MODE SELECT SWITCH To "MANU"

SPEED CONTROL

b) Decrase Power Up to 15kW
Using by Speed Control Switch



c) Pull Operate "OPEN" by CB OPERATION SWITCH

d) Open ACB

9. Stop Operation for ENGINE

a) Turn on ENGINE CONTROL SWITCH
To "STOP"

b) Lighting 「ENGINE STOPPING」 90sec

c) ENGINE STOP
Lighting 「STOP」

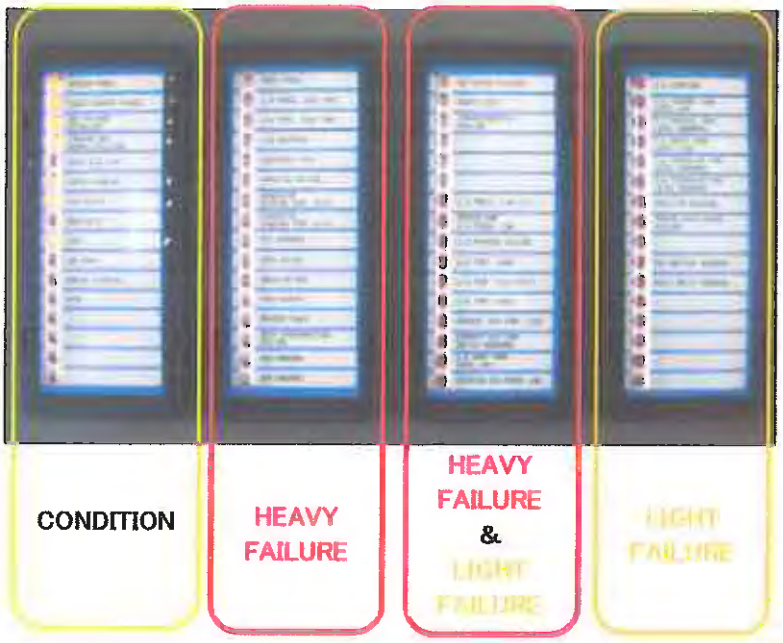
＊At The Time of HYD－POWER Supplied

Each Auxiliary Pumps are Running About 15min After Stopping for ENGINE Cooling Down

10. Trouble Shooting

RED LAMP
- HEAVY FAILURE
- ENGINE STOP
- BELL

ORANGE LAMP
- LIGHT FAILURE
- ENGINE NO STOP
- BUZZER
- ALARM ONLY



a) Trouble Occurred

b) Flicker Trouble Item

c) Push BELL/BUZZER STOP PUSH BUTTON

d) Lighting Trouble Item

e) Repaire The Trouble

f) Push ALARM RESET PUSH BUTTON

g) Turn Off The Trouble Lighting

Appendix-13 List of As Built Drawings (by Contractor)

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Transmission and Distribution Line Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
1	T-001		Document List for Transmission & Distribution Line	
2	T-002		MV & LV Transmission Line Inspection Report	
		Page 1	Inspection data	
		Page 2	Inspection schedule	
		Page 3	Power station step-up transformer pole location photo	
		Page 4 ~13	Pole mount transformer (PMT) pole location photo	
		Page 14 ~16	Power station step-up transformer pole position map	
		Page 17 ~18	MV & LV transmission line route map	
		Page 19 ~22	Minute of joint route survey of MV/LV lines	
3	T-003		Design Criteria on Distribution Line Works	
		I	Design Criteria	
		II	Strength calculation sheet of concrete poles at strength	
		III	Study of foundation for concrete poles	
		IV	Sag calculation sheet	
4	T-004	T-004	MV (22kV) Transmission Line Network System	
5	T-005	00 to 19	Route Map for MV and LV Line	
6	T-006		Not Applicable (N/A)	
7	T-007		Not Applicable (N/A)	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Transmission and Distribution Line Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
8	T-008		Assembly Drawing for MV Concrete Pole	
		1	Assembly Drawing for MV pole dead type	
		2	Assembly Drawing for MV pole tension Type (5° <0<30°)	
		3	Assembly Drawing for MV Pole 0=90°	
		4	Assembly Drawing for type PMT (250kVA-400kVA)	
		5	Assembly Drawing for PMT	
		6	Assembly Drawing for MV pole Type (0<0<5°)	
		7	Assembly Drawing for MV pole type with overhead ground wire	
		8	Assembly Drawing for MV pole angle type	
		9	Assembly Drawing for MV pole tension Type (5° <0<30°) with overhead ground wire	
		10	Assembly Drawing for 2 x 100kVA transformer & O.H - U.G	
		11	Assembly Drawing for MV pole angle type with overhead ground wire	
		12	Assembly Drawing for PMT with overhead ground wire	
		13	Assembly Drawing for MV type T deadend cable rising	
9	T-009		Assembly Drawing for LV Concrete Pole	
		1	Assembly Drawing for LV pole deadend	
		2	Assembly Drawing for LV ABC deadend MV pole	
		3	Assembly Drawing for LV double anchors	
		4	Assembly Drawing for LV double anchors on MV pole	
		5	Assembly Drawing for LV ABC on MV pole	
		6	Assembly Drawing for LV pole, Type (S)	
		7	Single line diagram for 250 kVA and 400 kVA	
		8	Low voltage distribution board for 10, 25 and 50 kVA Tr.	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri				
Category: Transmission and Distribution Line Facilities				
No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
			Specification for Distribution Transformer	
		BQ-TR	Bill of quantities for Transformer(Tr.)	
		C-001	3-Phase Transformer 10kVA	
		C-002	3-Phase Transformer 25kVA	
		C-003	3-Phase Transformer 50kVA	
		C-004	3-Phase Transformer 100kVA	
		C-005	3-Phase Transformer 250kVA	
		C-006	3-Phase Transformer 400kVA	
		D-001	Plan drawing for 3-Phase Tr. 10kVA	
		D-002	Plan drawing for 3-Phase Tr. 25kVA	
10	T-010	D-003	Plan drawing for 3-Phase Tr. 50kVA	
		D-004	Plan drawing for 3-Phase Tr. 100kVA	
		D-005	Plan drawing for 3-Phase Tr. 250kVA	
		D-006	Plan drawing for 3-Phase Tr. 400kVA	
		N-001	Rating plate for 3-Phase Tr. 10kVA	
		N-002	Rating plate for 3-Phase Tr. 25kVA	
		N-003	Rating plate for 3-Phase Tr. 50kVA	
		N-004	Rating plate for 3-Phase Tr. 100kVA	
		N-005	Rating plate for 3-Phase Tr. 250kVA	
		N-006	Rating plate for 3-Phase Tr. 400kVA	
			Shell letter for confirmation of [NO PCB]	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Transmission and Distribution Line Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
11	T-011		Specification for 24kV Load Break Switch (LBS)	
		BQ-LBS	Bill of quantities for LBS	
		SC C03 R01	24kV Load Break Switch (Interrupter switch)	
		C-4431A002A	Interrupter switch (Manual operated device)	
		PKDD 07/10/00	Steel supporting structure for LBS	
12	T-012		Specification for 24kV Lightning Arrester (LA)	
		BQ-LA	Bill of quantities for LA	
		UHS24100F1V1BA	LA 24kV-10kA-Polymer, class 1	
13	T-013		Specification for 24kV Fuse Cutout Switch (FCS)	
		BQ-FCS	Bill of quantities for 24kV FCS	
		SC 02 R01	24kV Fuse coutout switch	
		Type K	Specification of FCS	
14	T-014		24kV Cubicle Specification	
		BQ-24K	Bill of quantities for cubicle	
		TNC-01	Single line diagram of Hospital substation (S/S)	
		TNC-02	Single line diagram of District office substation (S/S)	
		K020709-2	Kiosk for 3L + 2T SM6-24kV	
		K020709-3	Detail of Kiosk for 3L + 2T SM6-24kV	
		K020709-1	Single line diagram of SM6-24kV	
		Index 1-4/3/2003	SM6 Technical specification	
		SM6-24	Unit for all function	
15	T-015		Specification for Wire and Conductor	
		BQ-WAC	Bill of quantities for wire and conductor	
			All Aluminum Conductor (AAC)	
			AAAC Conductor XLPE Insulated Cable	
			GSW Conductor	
			Bare Conductor	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Transmission and Distribution Line Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
16	T-016		Specification for Insulators	
		BQ-PI-A	Bill of quantities for Insulator set	
		05.0410.07	24kV Pin Insulators	
			Tensin string 24kV , 70kN (Porcelain Insulator)	
			Shackle	
			Ball Eye	
		03.0410.07	Stirng insulator (70kN)	
			Socket Eye	
			Thimble Clevies	
			Performed deadend	
17	T-017		Specification for LV Hardware	
		BQ-LVH	Bill of quantities for LV Hardware	
		SC 04 R01	Suspension assembly	
		DEC 05 R01	Dead End assembly	
18	T-018		Specification for Concrete Pole	
		BQ-PC	Bill of quantities for Concrete pole	
		No. 3441-3446	Concrete mixing plan of pre-stressed centrifuged concrete pole:12m and 9m poles	
		01A/12B-PC	Pre-stressed centrifuged concrete pole: 12m	
		01A/9B-PC	Pre-stressed centrifuged concrete pole: 9m	
		01A/14B-PC	Pre-stressed centrifuged concrete pole: 14m	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri				
Category: Transmission and Distribution Line Facilities				
No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
19	T-019		Specification for MV Cable	
		BQ-MVC	Bill of quantities for MV cable	
			Specification of 24kV Power cable AL/XLPE/PVC/STA/PVC	
			Specification of 24kV Power cable AL/XLPE/PVC	
20	T-020		Specification for MV Cable Termination	
		BQ-MVTM	Bill of quantities for MV cable Terminal kits	
		QT II(X) 4S-3C	Indoor type MV terminal kits	
		QT II(X) 6S-3C	Outdoor type MV terminal kits	
		QSE	MV straight joint kits	
		SEF.BC	Bracket for cable	
21	T-021		Specification for PG Clamp	
		BQ-PG	Bill of quantities for PG clamp	
		PKTD-01	Aluminum parallel groove clamp for 16-150mm2	
		PG 2B	Parallel clqmp for AAC 55mm2	
22	T-022		Specification for Guy Wire Set	
		BQ-GUW	Bill of quantities for PG clamp	
		D-009	Guy wire complete set	
			Collier plate	
			Strain Insulator	
			Parallel groove clamp for guys	
		TYN20 x 2400	Anchor rod	
			Spread anchors	
		PKDD07-10/00	Adjustable turnbuckle	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Transmission and Distribution Line Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
23	T-023		Specification for LV Cable	
		BQ-LVC	Bill of quantities for LV cable	
			0.6/1kV Power cable AL/XLPE/PVC/STA/PVC	
			0.6/1kV Aluminum conductor XPLE insulated Aerial Bounded Cable (AL-ABC)	
			Specification of 0.6/1kV CU/PVC	
			Specification of 0.6/1kV Power cable AL/XLPE/PVC	
24	T-024		Specification for Low Voltage Distribution Board	
		BQ-VDB	Bill of quantities for LV Distribution board	
		TNC-01 & 02	Single line diagram for Cubicle Substations	
		AC-180807-PM5001-1 ～ 6	Single line diagram for Transformer secondary	
		AC-180807-LAYOUT001-1 ～ 6	Layout for LV Distribution board	
		5.1 ～ 5.5	Particular specification and others : 5.1 Technical manual of energy meter, 5.2 MCCB, 5.3 Magnetic cintactor, 5.4 Current transformer (CT), 5.5 Timer relay	
25	T-025		Specification for Watt-hour Meter (WhM)	
		BQ-WHM	Bill of quantities for Watt-hour Meter	
		CV131	Single phase kWh meter Type CV 230V-10(3)A	
		MV3E4	3-Phase electric meter Type MV 3 x 240/400V-3 x 20(60)A	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri				
Category: Transmission and Distribution Line Facilities				
No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
26	T-026		Specification for Aggregating Meter Box	
		101058	Pole mounted type 1 single phase meter cabinet	
		300212	Pole mounted type 3 single phase meter cabinet	
		300211	Pole mounted type 5 single phase meter cabinet	
		300213 3P	Pole mounted type 3-Phase meter cabinet	
		0300212-1	Electrical wiring 1 single phase meter cabinet	
		0300212-2	Electrical wiring 3 kWh meter cabinet	
		0300212-3	Electrical wiring 5 kWh meter cabinet	
		0300212 3P	Pole mounted 3-Phase meter cabinet	
			C60N Circuit breakers	
27	T-027		Specification for Cross Arm	
		BQ-CA	Bill of quantities for Cross arm	
		SEE.PI2.6-1 & 2	Single cross arm for 24kV Pin insulator set	
		SEE.DPC2.6-1 & 2	Double cross arm for 24kV Tension insulator	
		SEE.LA2.6-1 & 2	Signle cross arm for 24kV Lightning arresator (LA)	
		SEE.CT.1.3	Cross arm for Distribution Tr. up to 25kVA (DTR)	
		SEE.CT.100K, SEE.LA-1～3	Cross arm for Distribution Tr. 2 x 100kVA, LA, Cutout	
		SEE.CT.250k-1&2	Cross arm for Distribution Tr. 250kVA	
		SEE.CT.400k-1&2	Cross arm for Distribution Tr. 400kVA	
		SEE.FCO.LA.2.6-1 &2	Signle cross arm for 24kV Lightning arresator (LA) and Cutout	
		SEE.FCO.LA.3-1 &2	Signle cross arm of 24kV Lightning arresator (LA) and Cutout for 250 and 400kVA DTR.	
		SEE.CL	Support for LVDB Type A & B	
		SEE.C	Collier for cross arm (Plate 8 x 80)	
		AEE.AT.925	Single cross arm for 14m concrete pole	
28	T-028		Not Applicable (N/A)	
29	T-029		Spare Parts List for D/L	
30	T-030		Tool and Apparatus List for D/L	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Transmission and Distribution Line Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
31	T-031		Specification for Hardware for Overhead Grounding Wire	
		BQ-OHGH	Bill of quantities for Overhead grounding wire	
		SEE.ST.2.4	Installation of tension set for GSW 38mm2	
			Tension string for ground wire-70kN	
		Cat.No.NN-7	Wedge clamps for ground wire (Type NN)	
		PKDD07-09/00	PG clamp string for ground wire GSW 38	
32	T-032	T-032	Instruction Manual for D/L Materials	
33	T-033	T-033	Factory Test Procedure for D/L Materials	
34	T-034	T-034	Factory Test report for D/L Materials	
35	T-035	T-035	Construction Procedure for D/L Works	
36	T-036	T-036	Site Test Procedure for D/L	
37	T-037	T-037	Site Test Report for D/L	
38				
39				
40				

Appendix-14 List of Operation &Instruction Manual (by Contractor)

THE PROJECT FOR THE RURAL ELECTRIFICATION ON MICRO-HYDROPOWER IN REMOTE PROVINCE OF MONDUL KIRI

THE ROYAL GOVERNMENT OF CAMBODIA

MINISTRY OF INDUSTRY, MINES AND ENERGY (MIME)

THE PROJECT FOR THE RURAL ELECTRIFICATION ON MICRO-HYDROPOWER IN REMOTE PROVINCE OF MONDUL KIRI

DEG. TITLE

DOCUMENT LIST FOR ELECTROMECHANICAL WORKS

	SIGNATURE	DATE
PREPARE	Miyashita	1st Aug 2007
CHECKEI	Sakahira	1st Aug 2007
APPROVE	Terashima	1st Aug 2007
SCALE	NONE	

DWG. NO.	G-001-3	Rev.	B

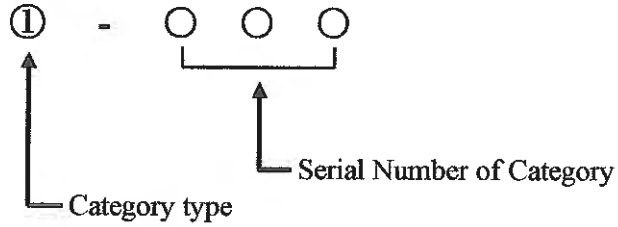
KONOIKE CONSTRUCTION CO., LTD.

- CONTENTS -

Numbering of Drawing / Document

1. Project Drawing Number

Project Drawing Number will be designed as follows;



2. Description of Category type

1) Category will be designed as follows;

G: General Common
C: Civil
M: Hydro Mechanical
H: Hydro Generating Facilities
001～100: for O'Moleng Power Station
101～200: for O'Romis Power Station
201～300: Common
D: Diesel Power Generating Facilities
T: Transmission and Distribution Line Facilities

3. Title Block

Title Block will be designed as follows;

	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		
SCALE		

THE ROYAL GOVERNMENT OF CAMBODIA MINISTRY OF INDUSTRY, MINES AND ENERGY (MIME)			
THE PROJECT FOR THE RURAL ELECTRIFICATION ON MICRO-HYDROPOWER IN REMOTE PROVINCE OF MONDUL KIRI			
DWG TITLE **General Arrangement of O'Moleng Hydropower Plant Power House**			
DWG NO.	H-001	REV.	-
KONOIKE CONSTRUCTION CO., LTD.			

Remarks: Revision No. shall be from "A" to "Z" and first issue shall be "-".

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (O'Moleng)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
1	H-001		General Arrangement of O'Moleng Hydropower plant Power house	
		TMD-001	General Layout (Plan) for O'Moleng Hydropower plant	
		TMD-002	General Layout (Front & Side) for O'Moleng Hydropower plant	
2	H-002	H-002	Single Line Diagram for O'Moleng Hydropower plant	
3	H-003		Section Drawing of Turbine for O'Moleng Hydropower Plant	
		TMD-007	Section Drawing of Turbine (Front view) for O'Moleng	
		TMD-008	Section Drawing of Turbine (Side view) for O'Molemg	
4	H-004	TMD-003	Foundation Arrangement of O'Moleng Hydropower Plant	
5	H-005	TMD-004	Cable Pit Arrangement for O'Moleng Hydropower Plant	
6	H-006	TMD-009	Outline Drawing of Inlet Valve for O'Moleng Hydropower Plant	
7	H-007		Outline Drawing of Speed Changer for O'Moleng Hydropower	
		TMD-010	Outline Drawing of Speed Changer for O'Moleng Hydropower	
		TMD-S1	Setting Drawing Generator & Speed Changer for O'Moleng	
8	H-008	TMD-011	Outline Drawing of Generator for O'Moleng Hydropower Plant	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (O'Moleng)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
9	H-009	TMD-012	Construction Drawing of Generator for O'Moleng Hydropower plant	
10	H-010		Outline Drawing of G/Vane Servomechanism for O'Moleng	
		TMD-013	Assembly Drawing of G/V Servomotor for O'Moleng	
		TMD-014	AC Servo Assembly Drawing for O'Moleng	
		TMD-016	Assembly Drawing of Guidevane (2/3) Locking for O'Moleng	
11	H-011	TMD-006	Dummy Load Arrangement Drawing for O'Moleng Hydropower Plant	
12	H-012	TMD-016	Outline and Schematic Diagrams for O'Moleng Hydropower Plant	
13	H-013		Wiring Diagram and Cable List for O'Moleng Hydropower Plant	
		H-013-1	Wiring Diagram for O'Moleng Hydropower Plant	
		H-013-2	Cable List for O'Moleng Hydropower Plant	
		H-013-3	Terminal Wiring Diagram for O'Moleng Hydropower Plant	
14	H-014		Grounding System for O'Moleng Hydropower Plant	
15	H-015	FT-203	Specification for O'Moleng Hydropower Plant	
16	H-016	FR-319	Name Plate List for O'Moleng Hydropower Plant	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (O'Moleng)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
17	H-017	TMD-18	Cable Connection Diagram for O'Moleng Hydropower Plant	
18	H-018		Cable Rack Arrangement for O'Moleng Hydropower Plant	
19	H-019		Explanation Drawing of Turbine for O'Moleng Hydropower Plant	
		TMD-005-1	Explanation Drawing of Turbine (1) for O'Moleng Hydropower Plant	
		TMD-005-2	Explanation Drawing of Turbine (2) for O'Moleng Hydropower Plant	
20	H-020		Outside Cable Route for O'Moleng Hydropower Plant	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (O'Romis)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
1	H-101		General Arrangement of O'Romis Hydropower plant Power house	
		TRD-001	General Layout (Plan) for O'Romis Hydropower plant	
		TRD-002	General Layout (Front & Side) for O'Romis Hydropower plant	
2	H-102	H-102	Single Line Diagram for O'Romis Hydropower plant	
3	H-103		Section Drawing of Turbine for O'Romis Hydropower Plant	
		TRD-007	Section Drawing of Turbine (Front view) for O'Romis Hydropower Plant	
		TRD-008	Section Drawing of Turbine (Side view) for O'Romis Hydropower Plant	
4	H-104	TRD-003	Foundation Arrangement of O'Romis Hydropower Plant	
5	H-105	TRD-004	Cable Pit Arrangement for O'Romis Hydropower Plant	
6	H-106	TRD-009	Outline Drawing of Inlet Valve for O'Romis Hydropower Plant	
7	H-107	TRD-010	Outline Drawing of Speed Changer for O'Romis Hydropower Plant	
8	H-108	TRD-011	Outline Drawing of Generator for O'Romis Hydropower Plant	
9	H-109	TRD-012	Construction Drawing of Generator for O'Romis Hydropower plant	
10	H-110		Outline Drawing of Guide Vane Servomechanism for O'Romis Hydropower	
		TRD-013	Assembly Drawing of G/V Servomechanism for O'Romis Hydropower Plant	
		TRD-014	AC Servo Assembly for O'Romis Hydropower Plant	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (O'Romis)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
11	H-111	TRD-006	Dummy Load Arrangement Drawing for O'Romis Hydropower Plant	
12	H-112	TRD-016	Outline and Schematic Diagrams for O'Romis Hydropower Plant	
13	H-113		Cable List for O'Romis Hydropower Plant	
		H-113-1	Wiring Diagram for O'Romis Hydropower Plant	
		H-113-2	Cable List for O'Romis Hydropower Plant	
14	H-114	H-114	Grounding System for O'Romis Hydropower Plant	
15	H-115	FT-204	Specification for O'Romis Hydropower Plant	
16	H-116	FR-320	Name Plate List for O'Romis Hydropower Plant	
17	H-117	TRD-18	Cable Connection Diagram for O'Romis Hydropower Plant	
18	H-118	H-118	Cable Rack Arrangement for O'Romis Hydropower Plant	
19	H-119		Explanation Drawing of Turbine for O'Romis Hydropower Plant	
		TRD-005-1	Explanation Drawing of Turbine (1) for O'Romis Hydropower Plant	
		TRD-005-2	Explanation Drawing of Turbine (2) for O'Romis Hydropower Plant	
20	H-120		Outside Cable Route for O'romis Hydropower Plant	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (Common)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
1	H-201	FT-199	Instruction Manual for hydropower facilities	
2	H-202		Maintenance Manuals for O'Moleng hydropower facilities	
		FT-200	Maintenance Manuals for Turbine	
		FT-212	Maintenance Manuals for Panel	
		FT-213	Maintenance Manuals for Generator, Speed changer, Lub oil, Motor cylinder and Butterfly valve	
3	H-203		Maintenance Manuals for O'Romis hydropower facilities	
		FT-200	Maintenance Manuals for Turbine	
		FT-212	Maintenance Manuals for Panel	
		FT-213	Maintenance Manuals for Generator, Speed changer, Lub oil, Motor cylinder and Butterfly valve	
4	H-204	H-204	Electrical Construction Materials	
5	H-205	H-205	Movable Gate Type Hoist for Hydropower Facilities	
6	H-206		Not Applicable (N/A)	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (Common)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
7	H-207		Shop Test Procedure for Hydropower Facilities	
		FT-197	Shop Test Procedure for Turbine	
		FT-198	Shop Test Procedure for Generator	
8	H-208-M	FT-310	Shop Test Report for O'Moleng Hydropower Facilities	
9	H-208-R	FT-310	Shop Test Report for O'Romis Hydropower Facilities	
10	H-209-M	FT-194	Maintenance Tools and Measuring Instrument List	
11	H-209-R	FT-194	Maintenance Tools and Measuring Instrument List	
12	H-210-M	FT-195	Spare Parts List for O'Moleng Hydropower Facilities	
13	H-210-R	FT-195	Spare Parts List for O'Romis Hydropower Facilities	
14	H-211	FT-196	Specification for Painting	
15	H-212		Site Test Procedure for Hydropower Facilities	
		FT-215	Site Test Procedure for Dry test	
		FT-216	Site Test Procedure for Wet test	
16	H-213	H-213	Site Test Report for O'Moleng Hydropower Facilities	

Document List

Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Hydro Generating Facilities (Common)

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
17	H-214	H-214	Site Test Report for O'Romis Hydropower Facilities	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Diesel Power Generating Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
1	D-001	AQL10001925	Key Flow Diagram for Diesel Generator Power Station	
2	D-002	D-002	Single Line Diagram for Diesel Generator Power Station	
3	D-003		General Arrangement of Diesel Generator Power Station	
		AQL10001655	Layout (1/2)	
		AQL10001656	Layout (2/2)	
4	D-004	D-004	Cable Route Plan for Diesel Generator Power Station	
5	D-005	D-005	Terminal Arrangement for Diesel Generator Power Station	
6	D-006	D-006	Cable Rack Arrangement for Diesel Generator Power Station	
7	D-007	D-007	Grounding System for Diesel Generator Power Station	
8	D-008	D-008	Cable List for Diesel Generator Power Station	
9	D-009	AQL10001640	Specification for Diesel Engine Generator	

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Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri				
Category: Diesel Power Generating Facilities				
No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
10	D-010		Outline of Diesel Engine Generator	
		AQL10001652	Outline of Diesel Engine Generator	
		AQL10001653	Arrangement of fitting	
		AQL10001654	Coupling assembly	
11	D-011	AQL 10001658 - 1663	Piping Flow Diagram of Diesel Engine Generator	
12	D-012	AQL 10001664 - 1668	Piping Layout for Diesel Engine Generator	
13	D-013	AQL20001574	Monitoring Equipment List	
14	D-014	AQL10001941	Converter for Exhaust Gas Temperature Sensor	
15	D-015	AQL10001921	Flexible Hose List	
16	D-016		Wiring Diagram for Diesel Engine Generator	
		AQL10001669	Wiring Diagram (1)	
		AQL10001670	Wiring Diagram (2)	
17	D-017-1		Fuel Oil System-1	
		AQL10001694	Stand structure for Fuel oil service tank (390 Litters)	
		AQL10001671	Fuel oil service tank (390 Litters)	
		AQL10001672	Tank for Fuel drain (300 Litters)	
		AQL10001673	F.O Piping for air separator (80A)	
		AQL10001674	Damper for Accumulator	

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Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri				
Category: Diesel Power Generating Facilities				
No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
		AQL10002561	Fuel oil unloading pump	
		AQL10002562	Fuel oil transfer pump	
		AQL10002563	Fuel oil drain pump	
		AQL10002564	Fuel oil flow meter	
		AQL10002565	Energency stop valve	
		AQL10001642	Fuel oil filter list	
		AQL20001938	Control switch & switch box for Fuel oil unloading pump	
18	D-017-2		Fuel Oil System-2	
		AQL10001919	Acessory for fuel oil service tank	
		AQL10001922	Acessory for fuel oil drain tank	
19	D-018-1	AQL20001566	Lubrication Oil System-1	
20	D-018-2		Lubrication Oil System-2	
		AQL10001644 (2/6)	Lubrication oil filter list	
		AQL10001644 (3/6)	Lubrication oil filter	
		AQL10001644 (4/6)	Lubrication oil filter for Turbocharger	
		AQL10001644 (5/6)	Lubrication oil filter for Rocker arm	
		AQL10001644 (6/6)	Lubrication oil filter for Baypass filter	
		AQL10001675	Oil cooler (11.4 m2)	
		AQL10001676	Thermostat vlve for lublicating oil	
		AQL10001677	Wing pump for lub oil (15A)	
		AQL10001920	Accessory for diesel engine mist gas	

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Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Diesel Power Generating Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
		AQL20001567	Lubrication oil for hand pump	
21	D-019		Exhaust Gas System	
		AQL20001579B	Silence for exhaust gas (NRS-250VX)	
		AQL10001678A	Joint for exhaust gas (Engine outlet)	
		AQL10001679A	Joint for exhaust gas (Piping)	
22	D-020-1		Starting Air System-1	
		AQL20001568B	Engine drive air compressor	
		AQL20001569A	Motor driven air compressor	
		AQL1001680B	Air reservoir (250 Litters)	
		AQL1001681A	Control box for shutdown valve	
		AQL1001704A	Stand for shutdown valve box	
		AQL20001580A	Reducing valve unit	
23	D-020-2	AQL10001923	Starting Air System-2	
24	D-021-1		Cooling Water System-1	
		AQL20001570B	Cooling water pump	
		AQL20001571A	Jacket water thermostat valve	
		AQL20001572A	Jacket water flow relay	
		AQL20001573B	Pit drin discharge pump	
		AQL20001654A	Cooler water flow relay	
		AQL20001939B	Control switch & switch box for Pit drain discharge pump	
		AQL10001645C	Radiator	
		AQL10001682A	Tank for Jacket water expansion (200 Litters)	
		AQL10001683A	Tank for Cooling water expansion (200 Litters)	
		AQL10001684A	Stand for expansion tank	

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Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Diesel Power Generating Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
25	D-021-2	AQL10001924	Cooling Water System-2	
26	D-022	AQL10001646	Foundation Bolt List Diesel Engine Generator	
27	D-023	AQL20001575	Piping Material List for Diesel Engine Generator	
28	D-024	AQL20001576	Valve List for Diesel Engine Generator	
29	D-025	AQL10001647	Painting Specification for Diesel Engine Generator	
30	D-026	AQL10001648	Tool List for Diesel Engine	
31	D-027	AQL20001577	Tool List for Turbo Charger	
32	D-028	AQL10001649	Spare Parts for Diesel Engine (Standard)	
33	D-029		Spare Parts for Diesel Engine (12000HRS)	
		AQL20002108B	Spare Parts for Turbocharger (12000HRS)	
		AQL20002109A	Spare Parts for Cooling water pump (12000HRS)	
		AQL10001650B	Spare Parts for Diesel Engine (12000HRS)	
34	D-030	AQL20001578	Spare Parts for Turbo Charger	
35	D-031	AQL20002107	Thermometer	
36	D-032	AQL10001651	Factory Test Procedure for Diesel Engine Generator	

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Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Diesel Power Generating Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
37	D-033	LDL16-0217	Factory Test Report for Diesel Engine Generator	
38	D-034		Not Applicable (N/A)	
39	D-035		Not Applicable (N/A)	
40	D-036		Foundation of Diesel Engine Generator Facilities	
		AQL10001657E	Foundation arrangement	
		AQL10001685C	Foundation arrangement for diesel engine	
		AQL10001686E	Foundation arrangement for radiator	
		AQL10001687E	Foundation arrangement for cooling water pump, etc.	
		AQL10001688C	Foundation arrangement for exhaust gas silencer	
		AQL10001933E	Foundation arrangement for panels	
		AQL10001934E	Foundation arrangement for fuel oil unloading pum, etc.	
		AQL10001935E	Foundation arrangement for fuel oil service tank	
		AQL10001936E	Foundation arrangement for air compressor	
		AQL10001657E	Pipe support, etc.	
		AQL10001657E	Diesel engine loading data	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri				
Category: Diesel Power Generating Facilities				
No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
41	D-037	07-3266-01	A.C. Generator	
42	D-038-1		Generator Panel -1 : Single Line Diagram	
		LB-2301	Symbol list	
		LB-2302	Device function number list	
		L3-16653-SL	Single Line Diagram for Diesel Generator Power Station	
43	D-038-2		Generator Panel -2 : Outline of Generator Panels	
		L3-16653-OL	Outline of Diesel Engine Generator panel	
		L3-16653-FA	Face arrangement	
		L3-16653-LA (1/2)	Group signal lamp	
		L3-16653-LA (2/2)	Group signal lamp	
44	D-038-3		Generator Panel -3 : Protection Alarm List	
		L3-16653-PL (1/2)	Protection alarm list	
		L3-16653-PL (2/2)	Protection alarm list	
		L4-16653-RL	Protection relay list	
		L4-16653-TCA	Annunciator function	

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Project: The Project for the Rural Electrification on
Micro-Hydropower in Remote Province of Mondul Kiri
Category: Diesel Power Generating Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
45	D-038-4		Generator Panel -4 : Block Diagram	
		L4-16142-B0	Symbol list of block diagram	
		L3-16653-B1	Block diagram for engine start	
		L3-16653-B2	Block diagram for genertor synchronous	
		L3-16653-B3	Block diagram for engine stop	
		L3-16653-B4	Block diagram for auxiliary equipment operation	
		L3-16653-B5	Block diagram for auxiliary equipment operation	
		L3-16653-B6	Block diagram for auxiliary equipment operation	
46	D-039		Schematic Diagram for Generator Panels	
		L3-16653-PA (31-1)	Parts arrangement	
		L3-16653-PLC(31-2)	Parts arrangement	
		L3-16653-PLC(31-3)	PLC arrangement	
		L3-16653-BT(31-4)	Battery arrangement	
		LB-2303 (23-3)	Legend of schematic diagram	
		L3-16653-S (S1～S96)	Schematic Diagram	
		L3-16654-TA(32-1,2)	Terminal Arrangement	
		LP-16653 (35-1～8)	Parts list	
		LT-16653 (36)	Transfer switch list	
		LP-16653 (37-1～4)	Name plate table	
47	D-040		Not Applicable (N/A)	
48	D-041	LS-16653	Spare Parts List for Generator Panel	

Document List

Project: The Project for the Rural Electrification on Micro-Hydropower in Remote Province of Mondul Kiri

Category: Diesel Power Generating Facilities

No.	Project DWG No.	Manufacture DWG No.	Title	Khmer
49	D-042		Not Applicable (N/A)	
50	D-043		Not Applicable (N/A)	
51	D-044		Not Applicable (N/A)	
52	D-045		Not Applicable (N/A)	
53	D-046		Not Applicable (N/A)	
54	D-047		Not Applicable (N/A)	
55	D-048	AQL10001840	Abbreviation Symbol List for Diesel Engine Generator Facilities	
56	D-049	AQL10001942	Warning Setting Device for Exhaust Gas Temperature Switch	
57	D-050	AQL20001919	Arrow Marks for Piping	
58	D-051	D-051	Fuel Oil Strage Tank	
59	D-052		Not Applicable (N/A)	
60	D-053		Not Applicable (N/A)	

Section IV:

Distribution Facilities

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	(Distribution)
AP-S-IV-06	**Trial Charge Pattern A : (From DG up to 300kW)**
AP-S-IV-07	**Trial Charge Pattern B : (From DG from 300kW to 400kW)**
AP-S-IV-08	**Trial Charge Pattern C : (From OM up to 370kW)**
AP-S-IV-09	**Detail Check Items for Distribution Facilities' Inspection**
AP-S-IV-10	**Transformer Station Check Sheet**
AP-S-IV-11	**Sample Form of SPARE PARTS LIST OF DISTRIBUTION**
AP-S-IV-12	**Sample Form of TOOLS LIST OF DISTRIBUTION IN WAREHOUSE**
AP-S-IV-13	**Sample Form of TOOLS LIST OF DISTRIBUTION IN BUCKET CAR**
AP-S-IV-14	**Sample Form of COMPLAINTS ON VOLTAGE RECORD**
AP-S-IV-15	**Sample Form of COMPLAINTS ON INCORRECT METER READING RECORD**
AP-S-IV-16	**REPLACEMENT OF DEFECTIVE METER RECORD**
AP-S-IV-17	**Sample Form of TESTING OF METER RECORD**

Section IV DISTRIBUTION FACILITIES

Chapter 1 General Matter

1.1 Mission of Distribution Line Section

Chief, Deputy Chief of Technique, and all staff of Distribution Line Section shall understand the mission of Distribution Line Section as shown below.

Mission of EDC Mondul Kiri

Stable Supply of Electricity of Good Quality
High- Efficiency and Low Cost of Supplying Electricity
Safety, Healthy and Good Communication (Customer, EDC Staff)

Mission of Distribution Line Section

(1) "Prevent Black-Out Accident" and "Increase Electricity Quality (Reduce Power Loss, etc.)

- Inspection (Watch carefully)
  - Pole, Line, Cable, Lightning Arrester, Switch, Fuse Cutout, Transformer, Watt-Hour Meter, Circuit Breaker, Trees near the Line
- Measuring (Voltage, Current, etc.)
- Repairing

(2) "Recover Black-Out Accident quickly"

- Prepare Spare Parts
- Keep Tools in good condition
- Knowing How to recover quickly

(3) Routine Work

- Reading Meters
- Delivering Invoice

- Disconnecting and Reconnecting Pay-Delaying-Customers
- Technical-Reviewing of Application for New Customers
- Connecting Wire

(4) Improve Work Methods

- Keeping and Updating Equipment Lists and Drawings to Show the Current Situation
- Appropriate Locating of Transformers
- Well-Planned Schedule
- Skill Up of Distribution personnel
- Knowing How to Keep Safety

1.2 Safety Policy for Distribution Activity

1.2.1 Preventing the received electrical shock

In order to prevent the received electrical shock, the maintenance staff must take care near by the distribution line and pole mounted transformers when they have a trimming the trees or taking out the some goods on the lines. Therefore, they must stop the line charging and follow the basic rule below if the staff enters within the minimum safety distance as 40cm at 22kV.

Basic Rule at the MV-Line Work for Safety

(1) To Confirm that all person is keeping away from MV Line.

(2) To Open LBS in order to Shutdown Electric Supply to the Working MV-Circuit

*For Example, open F2 LBS in Hospital S/S for working in C12(North East Line)

(3) To Ground the Working MV-Circuit by LBS in S/S

*This Procedure is impossible in case of LBS-1 and LBS-2 Operation.

(4) To Ground Both Sides of Working Place of MV Line

*Please note using 22kV-insulated equipment for grounding.

*Reason why Both Sides is that Customer's Stand-by Generators might charge MV Line.

(5) To Do MV-Line Work

(6) To Remove the Ground Both Sides of Working Place of MV Line

* If forget it, Short Circuit Accident occurs when Re-Charging.

(7) To Remove the Grounding by LBS in S/S

(8) To Confirm that all person is keeping away from MV Line.

(9) To Close LBS in order to Electric Re-Supply to the Working MV-Circuit

1.2.2 Preventing the falling-down accidents from a electric pole

If the maintenance staff needs to climb the concrete pole for maintenance, they must get permission from Deputy Chief of Technique and/or Chief of Technical Division, and follow the basic rule below.

Basic Rule of Climbing an Electric Pole for Safety

(1) To confirm that any of conductive equipments and wet equipments are discharged before you are getting close to them, by using Voltage Detector.

* If equipment is charged, stop working and report to Deputy Chief of Technique and/ or Chief of Technical Division.

(2) To use a Safety Belt, gloves and boots when climbing

1.3 Organization of Distribution Line Section

Organization system of Distribution Line section shall be followed to "Regulation on Organization and Powers and Duties". Mainly,

- Chief, Deputy Chief of Technique and Chief of Technical Division shall be mainly responsible for "Planning, Budget, Order/Command, Approval, Trouble Shooting and Negotiation to outsiders".
- Staff of Distribution Line Section shall be mainly responsible for "Implementation, Report, Record and Suggestion".

Chapter 2 Specific Matter

2.1 Working Control (Task Code : TT1)

2.1.1 Working Regulation

Working Regulation for Distribution Line Section shall be considered and suggested to Chief, who approves the regulation, by Deputy Chief of Technique.

2.1.2 Attendance Sheet

Each employee of EDC Mondul Kiri shall record his/her own attendance on the Attendance Sheet, and Submit it to his/her Superior, according to Working Regulation.

2.2 Planning of Distribution Activity (Task Code : TT2)

2.2.1 Long and Mid-term Plan & Budget

Deputy Chief of Technique shall make "Facility Plan", "Maintenance Plan", "Operation Plan", "Personnel Plan" and related budget as Long and Mid term plan, paying attention to "Basic Policy for making Long and Mid-term Plan of Distribution Activity" as shown below.

Basic Policy for making Long and Mid-term Plan of Distribution Activity

(1) Facility Plan

- ✧ Basically, MV Line, LV Line, Transformer and MV Switches shall not be upgraded, but only replacement is acceptable.
- ✧ Basically, Distribution system can be connected to the number and capacity of customers, each for Residential and Commercial, up to the number and capacity which are indicated in the "Demand Forecast" included in the "Long and Mid-term Plan".
- ✧ Basically, Manufactures and model of Equipment and Parts do not have to be the same as those which were installed before. The method of Construction also does not have to be the same as those for which were applied before. The cost, efficiency and quality must be considered.

(2) Maintenance Plan

- ✧ Replacement of equipment and parts shall be planned before it breaks. The time they will be break shall be predicted as accurately as possible, referring to the records of patrol & inspection and the experience of other electric utilities, such as EDC.
- ✧ Tools for safety work (such as Bucket Car, helmet, Rubber Groves, Rubber Shoes, Working Uniform, MV Voltage Detector, Earthing Tool, Measuring Devices) shall be periodically inspected by manufactures, or be replaced.

- ✧ Recovery Methods from each facility's damage shall be simulated in advance, in case of natural disasters like thunders or public fault like car accidents.

(3) Operation Plan

- ✧ Scheduled Outage Operation shall be planned as avoiding severe weather season, local events and so on.
- ✧ "Scheduled Outage Reports", "Fault Outage Recovery Log Sheets" in the past and demand forecast shall be reviewed before making Long and Mid-term Plan. If there is extreme inconvenience, re-location of MV-Switch may be planned and reflected to "Facility Plan". In this case, it is important that the re-Location plan is well-coordinated with budget.
- ✧ Metering Data, Measuring Data of Current in the past and demand forecast shall be reviewed before making Long and Mid-term Plan. If the lack of Line or Transformer capacity is predicted, revising of facilities (such as re-location of Transformer or LV line, etc.) shall be planned and reflected to "Facility Plan". In this case, it is important that the revising plan is well-coordinated with budget.

(4) Personnel Plan

- ✧ Personnel Plan shall reflect all of other Distribution Activity Plan (Facility Plan, Maintenance Plan, Operation Plan). If lack for number of staff or decreasing of personnel ability because of old age is predicted, new employment shall be planned. In this case, it is important to be well-coordinated with budget.
- ✧ Training and Skill-Up program shall be planned for improvement of activity, quick solution of trouble, etc.
- ✧ Periodical replacement of personnel shall be planned for bringing up alternate personnel in case of personnel absence by illness or injury.
- ✧ Minimizing of number of personnel shall be planned by improvement of work efficiency.

2.2.2 Annual Plan

Every year, Deputy Chief of Technique shall make an actual Annual Plan, referring to "Long and Mid-term Plan", "Standard of annual schedule of Distribution Activity" and "Points of view for making Annual Plan of Distribution Activity" as shown below.

- ➢ refer to Appendix AS-P-IV-1

Points of view for making Plan of Distribution Activity For Annual Plan

- Scheduled Outage Operation shall be planned as avoiding severe weather season, local events and so on.
- Construction Work with heavy equipments shall be planned during the Dry season.
- Work of Cutting & Trimming Tree shall be planned during suitable season, considering the growth of trees.

2.2.3 Monthly Plan

Every month, Deputy Chief of Technique shall make an actual Monthly Plan, referring to "Annual Plan", "Standard of monthly schedule of Distribution Activity" and "Points of view for making Monthly Plan of Distribution Activity"..

- refer to Appendix AS-P-IV-2

Points of view for making Plan of Distribution Activity For Monthly Plan

- The days of Metering, Delivery of Invoice, Temporary Disconnection and Re-Connection shall be planned at first. Other activities shall be planned in the other days.
- Margin of the Schedule shall be considered for sudden absence of staff, local festival, etc.

2.2.4 Weekly Plan

Every week, Deputy Chief of Technique shall make an actual Weekly Plan, referring to "Monthly Plan" and "Points of view for making Weekly Plan of Distribution Activity"..

Points of view for making Plan of Distribution Activity For Weekly Plan

- It is desirable that each staff can have a rest at least once a week, for his/her health and prevention from accidents because of tiring.
- It is desirable that a meeting of Distribution Line Section is held at least once a week for sharing the necessary information.

2.2.5 Daily Plan

Everyday, Deputy Chief of Technique shall make an actual Daily Plan, referring to "Weekly Plan" and "Points of view for making Daily Plan of Distribution Activity"..

Points of view for making Plan of Distribution Activity For Daily Plan

- It is desirable that at least one staff member from administration stands by in night time with mobile-phone, without alcohol, so that he/she can receive any claim from customer. Then he/she shall inform the claim related to Distribution to Deputy Chief of Technique in order to gather staff of Distribution Line Section and tackle the matter immediately in case of emergency.

2.3 Check of Distribution Operation (Task Code : TT3)

2.3.1 Measuring of Current, Voltage, etc.

In order to confirm that Distribution system keeps normal condition, or, in order to solve the problem of Distribution system, maintenance staff shall measure voltage, current, resistance, etc. and report the results, following the direction from Deputy Chief of Technique and/or Chief of Technical Division.

- Appendix AS-P-IV-3 is the table which shows typical usage of "Measuring Instruments" stationed at EDC. Regarding to the way how to use each measuring instrument, refer to Instruction Manual.

2.3.2 Analyzing of operating condition

Based on the reports of measuring, meter-reading, operation of power stations, maintenance staff shall analyze the condition of Distribution system, and report the results, following the direction from Deputy Chief of Technique and/or Chief of Technical Division. Below are main items to be analyzed.

(1) Load

- Whole System
  - Active energy (kWh) can be calculated to sum active energies of 3 Power Station.

- Pole Transformer (PMT)
  - Monthly Active energy (kWh) can be calculated as difference of Watt-hour Meter indication between last month and this month.
  - Daily Load Curve, Current, Voltage, Power Factor can be measured by measuring instruments.

- Each customer
  - Monthly Active energy (kWh) can be calculated as difference of Watt-hour Meter indication between last month and this month.
  - Daily Load Curve, Current, Voltage, Power Factor can be measured by measuring instruments.

(2) Distribution Loss

- Calculation
  - Monthly MV Loss can be calculated as difference of Total energy between 3 Power Stations and all of Pole Transformers.
  - Monthly LV Loss can be calculated as difference of Total energy between all of Pole Transformers and all customers.

    * Refer to Volume III (Appendix II-4-1)

- Analysis
  - Comparing with the data in the past, Considering New Customers' Load, etc. If abnormal Distribution Loss is found, check the Distribution facilities.

(3) Voltage Drop

- Measuring of LV Voltage at each of Pole Transformer (PMT) and End of LV Line
  - Voltage can be measured by measuring instruments.

- Analysis
  - Generally, voltage of upstream (ex. PMT) is higher than that of downstream (ex. End of LV Line). Both voltage of PMT and End of LV Line shall be in the range that the National Regulation shows. If out of the range, repair shall be carried out.

2.4 Scheduled Outage Operation (Task Code : TT4)

When EDC are planning to work near transmission lines or other Distribution facilities which are normally charged, scheduled outage operation shall be implemented by following each step as shown below.

2.4.1 STEP 1 : Making a Switching & Grounding Procedure

- Confirm the location of working place and the kind of work.
- Decide the Range of Outage on the single diagram, Start time and Finish Time.
- Making a Switching & Grounding Procedure (before the work and after the work)
- Making a planned "Scheduled Outage Report*", "Outage Customer List" and "Single

Diagram indicating Outage Range", and receive the approval of Chief.

2.4.2 STEP 2: Notification to Customers

- Notify the time of outage according to "Outage Customer List"
- If a customer claims, report to Deputy Chief of Technique.
- Record the date of notification on the "Scheduled Outage Report*"

2.4.3 STEP 3: Switching & Grounding Operation

- Deputy Chief of Technique commands switching & grounding operation to operators step by step, according to "Scheduled Outage Report*"
- Operators operate as commanded by Deputy Chief of Technique after checking "Scheduled Outage Report*", and report the result to Deputy Chief of Technique.
  - ✧ One operation, One Report
- Deputy Chief of Technique receives the report, then record the time on the "Scheduled Outage Report*"
- Repeat

2.4.4 STEP 4: Review and recording

- Deputy Chief of Technique and operators have a meeting, review the series of operation and record the opinion on the "Scheduled Outage Report*".
- Deputy Chief of Technique submits completed "Scheduled Outage Report*" to Chief, receives his approval and keep the set of "Scheduled Outage Report*", "Outage Customer List" and "Single Diagram indicating Outage Range" into specified file.

* See Appendix AP-S-IV-4

2.5 Fault Outage Operation (Task Code : TT5)

EDC shall restore Fault Outage as quick as possible.

- Fault Outage is impossible to be avoided perfectly, because of natural condition (such as thunder, storm, etc.), public accidents (such as car crash, etc.) and so on.
- Stable supply of Electricity is the Mission of EDC.
- In many cases, Fault Outage is caused by the destruction of Electric Facilities, which may become the factor of human injury such as electrical shock or falling down of heavy equipments.

Because of these reason, all the staff shall understand the basic flow how to restore fault outage as shown in this clause, and be ready to do it anytime.

2.5.1 Preparation for quick restoration

Preparation for Fault Outage, such as items below, is very important for quick restoration, because nobody knows when Fault Outage happens.

Things to prepare :

(1) Decide the role

- ✧ Decide the Procedure, Command, Record
  - ● Deputy Chief of Technique
    - ➢ (Subordinate : Chief of Technical Division)
- ✧ Responsible Person of Operation, Patrol, Repair of Distribution Facilities
  - ● Chief of Distribution Line Section
- ✧ Person of Operation, Patrol, Repair of Distribution Facilities
  - ● Staff of Distribution Line Section
- ✧ Responsible Person of Operation, Supervising of Power Stations
  - ● Chief of Power Stations Section
    - ➢ (Subordinate : Staff of Power Stations Section)

(2) Prepare enough materials and keep them good condition

- ✧ Spare Parts, Tools, Facility Book and Record Format*

  * See Appendix AP-S-IV-5

(3) Understand the Load Condition and Staff Condition so well

- ✧ Daily Load Curve, Load of MV Section and Transformer, Demand Forecast, Personnel Schedule, etc.

(4) Keep good health condition

2.5.2 Restoration of Fault Outage

(1) STEP 1 : Emergency shut down

- ✧ When Grounding Alarm of Distribution Line sounds, shut down all MCB of three PS immediately.

(2) STEP 2: Getting the current condition

- ✧ When Blackout happens, at first Deputy Chief of Technique shall get the information from all PS about Alarm indication, Relay condition, Output (kW)

(3) STEP 3 : Judgment of the factor of blackout

- ✧ Deputy Chief of Technique shall judge what the factor of Blackout is. "Inside the Power Station", "Overload" or "Distribution Facilities"
  - PS Problem : Supply power from other good PSs
  - Overload : Increase the PS output if possible, otherwise partial Outage
  - Distribution Problem : Search the Fault Section by Trial-Charge

- ✧ If the factor is Distribution problem, go to the next step.

(4) STEP 4 : Choosing the pattern of Trial-Charge for finding Fault Section

- ✧ The procedure depends on the PS Conditions and Whole Demand
  - If DG is available, ---
    - ➢ If Whole Demand Less than 300kW, **Pattern A**
      - ✧ Refer to Appendix AP-S-IV-6(Trial Charge from DG for 1 series)
    - ➢ If Whole Demand More than 300kW up to 400kW, **Pattern B**
      - ✧ Refer to Appendix AP-S-IV-7 (Trial Charge from DG, and additionally, OM and OR)
  - If DG is Not available, ---
    - ➢ Full Operation of OM & OR is available, **Pattern C**
      - ✧ Refer to Appendix AP-S-IV-8 (Trial Charge from OM, and additionally, OR)
  - (Just the Reference) Most-divided Trial Charge Procedure : Pattern Z
    - ➢ This procedure is usually used only after whole replacement of T&D Facilities
      - ✧ Refer to Volume III (Appendix II-4-2)

(5) STEP 5 : Procedure of Trial Charge for minimizing Fault Section

- ✧ Deputy Chief of Technique shall decide the procedure of Trial-Charge, command each switch-operation, confirmation of PS condition, record each procedure and operating time on the Fault Log Sheet, according to Trial-Charge Pattern applied, step by step.

- ✧ Each Operator shall carry out switch operation, observe PS condition and report it, according to the command of Deputy Chief of Technique.

(6) STEP 6 : Finding Fault Point in the minimized Fault Section

- ✧ Deputy Chief of Technique shall command "Incidental Patrol" of Fault Section to Distribution Line Section, and record the result, step by step.

- ✧ Distribution Line Section shall carry out "Incidental Patrol", find the Fault Point and report the result, according to the Command of Deputy Chief of Technique.

(7) STEP 7 : Restoration of Fault Point

- ✧ Deputy Chief of Technique shall decide the method of restoration, command the safety process (such as barricades, earthing, disconnection of customers with generator) and restoration work to Distribution Line Section via Chief of Technical Division, and record the result step by step.
  - ● It is desirable that Chief of Technical Division supervises the Restoration Work for the safety.

- ✧ Distribution Line Section shall carry out the safety process and restoration work, according to the command of Deputy Chief of Technique.

(8) STEP 8 : Supply electricity again

- ✧ Deputy Chief of Technique shall command to disconnect earthing, keep away from charged places, operate the switch for charging and confirm the supply of electricity, for the Distribution Line Section, and record the result and charged time, step by step.

- ✧ Distribution Line Section shall carry out to disconnect earthing, keep away from Charged places, operate the switch for charging and confirm the supply of electricity, according to the command of Deputy Chief of Technique.

2.5.3 Review and Preventing Next Fault Outage

Deputy Chief of Technique, Chief of Technical Division and Technical staff who are engaged in the restoration shall have a meeting, review their activities and record the opinion into the Fault Log Sheet, for improvement of their performance.

Deputy Chief of Technique shall submit the Fault Log Sheet and receive the approval of Chief, and keep it to the specified file.

2.6 Maintenance of Distribution Facilities (Task Code : TT6)

Maintenance is quite important mission for Distribution staff for stable power supply.

2.6.1 Patrol & Inspection of Distribution Facilities

Basically, Patrol & Inspection of Distribution Facilities is carried out without interruption of power supply. Patrol & Inspection of Distribution Facilities are classified into 3 types below:

Type of Patrol

(1) Weekly Patrol

- ✧ Rough Patrol for whole Distribution Facilities for finding flying-obstacles, facility broken, tree falling down, building construction, etc.

(2) Annual Inspection

- ✧ Detail Inspection for observation of degradation and damage

(3) Incidental Patrol

- ✧ Patrol for finding fault point

Deputy Chief of Technique shall prepare "Weekly Patrol Check List", "Annual Patrol Check List" and "Incidental Patrol Check List". Check items in each check list are to be chosen from the "Detail Check Items for Distribution Facilities' Inspection" attached as. Appendix AP-S-IV-9.

Main points of view of patrol

(1) Distribution lines

- ✧ Check of break the insulators on the line poles
- ✧ Oil leakage of distribution transformers
- ✧ Check of touching the trees and conductors or other goods such as kites and vinyl
- ✧ Check of unusual noise, vibration on the line fittings
- ✧ Check of steal the electricity or wrong connection from the Wh-meter boxes

(2) Outdoor substation cubicle

- ✧ Check of oil leakage, break of insulator, etc on 22kV/400V transformer
- ✧ Check of some goods and vinyl, etc. on the conductor or transformer
- ✧ Check of noise, vibration slack of terminal screws, etc.

- ✧ Check of doors or cubicle on kiosk

Distribution Line Section shall carry out patrol & inspection, record the condition on the check sheet, and submit it to Deputy Chief of Technique.

- ➢ For patrol of transformers, it is desirable to use "Transformer station check sheet" (Appendix AP-S-IV-10) as reference.

Deputy Chief of Technique shall review submitted check sheet, approve it and keep it into the specified file.

2.6.2 Maintenance Work of Distribution Facilities

Maintenance Work of Distribution Facilities shall be carried out according to "2.8 Construction of Distribution Facilities" in this chapter.

Case Study : Removing an obstacle from 22kV overhead line

In the case of removing obstacles on the 22kV lines or transformers, the staff should go to the objective place immediately, and to move the obstacles by using elevated working car, after line de-energizing with earthing by earthing tools. Refer to the instruction manual below.

(a) Removing an Obstacle from 22kV Overhead line
(on the 22kV line near the PMT-11 Transformer)

- ➢ Refer to Volume III (Appendix II-4-3)

(b) Removing an Obstacle from 22kV Overhead line
(on the 22kV line from O'Romis Power Station)

- ➢ Refer to Volume III (Appendix II-4-4)

2.6.3 Cutting & Trimming Trees

Distribution Line Section shall make and keep the "Cutting & Trimming Trees Map", which shows the places necessary to cut and trim trees for preventing trees from touching to Distribution Facilities.

- ➢ "Cutting & Trimming Trees Map" shall be based on the Patrol & Inspection Records of Distribution Facilities.
- ➢ "Cutting & Trimming Trees Map" shall be revised when finding new trees approach.

Deputy Chief of Technique shall make the plan of cutting & trimming trees, and command

cutting & trimming work to Distribution Line Section according to the plan.
Cutting & Trimming Work will carry out by "Scheduled Outage Work" or "Non-Scheduled Outage Work".

- "Schedule Outage Work" shall be applied if Trees, Bucket Car or a person is possibly close to the Charged places (MV/LV).
- "Non-Schedule Outage Work" can be applied only if you are perfectly not to approach to the charged places.

After the work, Distribution Line Section shall make a report, submit it to Deputy Chief of Technique, and if necessary, revise the "Cutting & Trimming Trees Map".

2.6.4 Negotiation with the Owner of Obstruct near Distribution Facilities

EDC staff shall report to Deputy Chief of Technique if finding Construction Work, Digging Work and other activities planning or ongoing near Distribution Facilities.
Deputy Chief of Technique shall negotiate with the owner of the work, so that the owner stops the work or change the work plan, if the situation is below ---

- In case that a person might possibly touch the charged place and be affected by electric shock, during or after the work
- In case that a Distribution Facility might be broken by the work
- In case that the Clearance between an Object and a Distribution Facilities might not satisfy requirements by National Regulation.

2.6.5 Control & Maintenance of Spare Parts

Deputy Chief of Technique shall suggest the type and minimum number of spare parts for emergency, and receive the approval of Chief.
Management of spare parts shall be conducted by Inventory Section.
Distribution Line Section shall report to Inventory Section when they need to use for work.
Distribution Line Section shall check and confirm that spare parts are well-stored (such as no-ruin, no-break, etc.) with Inventory Section, at least once a month.

* See Appendix AP-S-IV-11

2.6.6 Control & Maintenance of Working Tools

Deputy Chief of Technique shall prepare "Tool List" and nominate "Tool-Keeping Person", for each storing place.
Tool-Keeping Person has responsibility for

- checking the number of tools by Tool List every day

- Submit Tool List to Chief of Technical Division every week
- Maintain tools so as always to be ready for using

* See Appendix AP-S-IV-12, 13

2.6.7 Control & Maintenance of Facility Book

Deputy Chief of Technique shall prepare "Facility Book" which is basically based on "As-Built Drawings" for necessary place.

After Construction Work, Repair of equipment, etc., Facility Book shall be revised immediately through the approval of Deputy Chief of Technique.

At Annual-Inspection, Distribution Line Section shall check Distribution Facilities against Facility Book. If there is a difference because of stealing, flooding, etc., Distribution Section shall take the safety measure, report to Deputy Chief of Technique and repair it, and (if necessary) revise Facility Book through the approval of Deputy Chief of Technique.

2.7 Customers' Request or Claim (Task Code : TT7)

When EDC receives customers' request or claim about the issues below, Distribution Line Section has responsibility for investigating.

Type of Customers' Request or Claim

(1) Complaints on Voltage (Include Interruption of Power Supply)
(2) Incorrect Watt-hour Meter Reading
(3) Replacement of Defective Watt-hour Meter
(4) Testing of Watt-hour Meter

Basic flow is shown below.

Basic flow to deal with Customers' Request or Claim

- ✧ Deputy Chief of Technique commands to operators to investigate.
- ✧ Operators carry out the investigation and repair.
- ✧ Operators make the report using the specified format, and submit to Deputy Chief of Technique.
- ✧ Deputy Chief of Technique notes the comments on the format, receives the approval of Chief and file it into the specified file.

Please Note : Customers' Request and Claim of (1), (2), (3) and (4) shall be reported to EAC

every year. So recording is very important.

* See Appendix AP-S-IV- 14, 15, 16, 17

2.8 Construction of Distribution Facilities (Task Code : TT8)

EDC Mondul Kiri cannot construct any Distribution facilities by themselves. A Construction Work of Distribution Facilities has to be carried out by the sub-constructer selected by bidding process.

2.8.1 Making a Specification of Constructions

Basically EDC Mondul Kiri shall discuss the construction plan with related organizations and authorities. Then Deputy Chief of Technique shall decide the route, the specification and budget of construction work, and receive the approval of Chief. After that, Chief shall request for approval of the construction to Headquarters.

2.8.2 Approval for Design of Construction

Only Managing Director of EDC can approve the design and construction.

2.8.3 Constructing

After bidding, selected sub-constructer shall carry out the construction work according to the approved design.

2.8.4 Supervising of Construction Work

EDC Mondul Kiri shall organize the Team for supervising the construction work and cooperating to the sub-constructer. The Team normally consists of Deputy Chief of Technique, staff of EDC Mondul Kiri and staff of Headquarters.

The Team shall check the safety of workers and public, supervise the construction and verify that the construction is going as same as design. The Team shall also control supply of construction material to the sub-constructer.

- If there are some problems, the Team shall command to the sub-constructer for correcting the condition. Then the Team shall report this matter to Chief of EDC Mondul Kiri.

2.8.5 Inspection of Achievement

After finishing the construction, the sub-constructer shall submit the "As-Built Drawings" to EDC and ask the inspection for commissioning.

The Team shall approve the construction to the sub-constructer if no problem. Then the Team

shall report to Chief of EDC Mondul Kiri and Chief of EDC Mondul Kiri shall report to Managing Director. Normally warranty period of sub-constructer is one year after commissioning.

2.8.6 Updating of Facility Book

Distribution Line Section shall revise the Facility Book according to the As-Built Drawings, and submit it to Deputy Chief of Technique.

Deputy Chief of Technique shall review it, and if no problem, approve it and replace the Facility Book.

- If revising of "Asset register" is necessary, Deputy Chief of Technique shall submit the necessary information to Administration Division.

2.9 Customer Contract Issues (Task Code : TT9)

"Customer Contract Issue" shall be implemented according to "Tariff Charge System". In this system, Distribution Line Section has responsibility for carrying out the tasks of ---

(1) Technical Review of Supply Application
(2) Connection Work
(3) Metering
(4) Delivery of Invoices
(5) Temporary Disconnection & Re-Connection
(6) Removal of Watt-hour Meter from Ex-Customers

When carrying out those tasks, Distribution Line Section Staff shall pay attention not only to "Tariff Charge System" but also the check points below.

2.9.1 Technical Review of Supply Application

- Confirm the capacity of Transformer and LV Line is enough after connection
- Confirm that the Voltage is within the range that the National Regulation shows

2.9.2 Connection Work

- Connect each phase as well-balanced as possible
- Record the phase of connection and type of Meter Box, and revise the Facility Book.

2.9.3 Metering

- The method of metering is shown in Volume III (Appendix II-4-5, 6, 7)

- Outline of metering

(a) Reading of Wh-meters on Transformer distribution panel

The Wh-meters installed in the distribution panels which use the current transformers (CT) for measuring.

In such case, the real energy consumption is conducted by multiplication of the CT ratio and the indicated kilo-watt hour (kWh).

For example, the Wh-meter of 50kVA transformer, there are CTs with 100/5A ratios. If the indicated value is 45kWh, the real value can be corresponded as follows;

$$45 \times 100/5 = 45 \times 20 = 900 \text{ (kWh)}$$

CT ratio is referred as multiplying factor for calculation. (referred to multiplying factor for CTs ratio in Volume III (Appendix II-4-5)

(b) Last digit reading manner for Watt-hour meters in household

Reading manner of last digit of the Watt-hour meters should be kept constantly. The 1/10 digit number should be read to the smaller number as per attached instruction manual (attached in Volume III (Appendix II-4-6)).

- Schedule of Transformers' metering should be well-collaborated to that of Customers' metering, for avoiding miss-calculation of Distribution Loss because of time lag.

2.9.4 Delivery of Invoices

- Nothing special

2.9.5 Temporary Disconnection & Re-Connection

- Keep cool for avoiding electrical-shock, even the customer upset you

2.9.6 Removal of Watt-hour Meter & Service Wire from Ex-Customers

- Remember the last metering before the meter is stored into the warehouse.

End