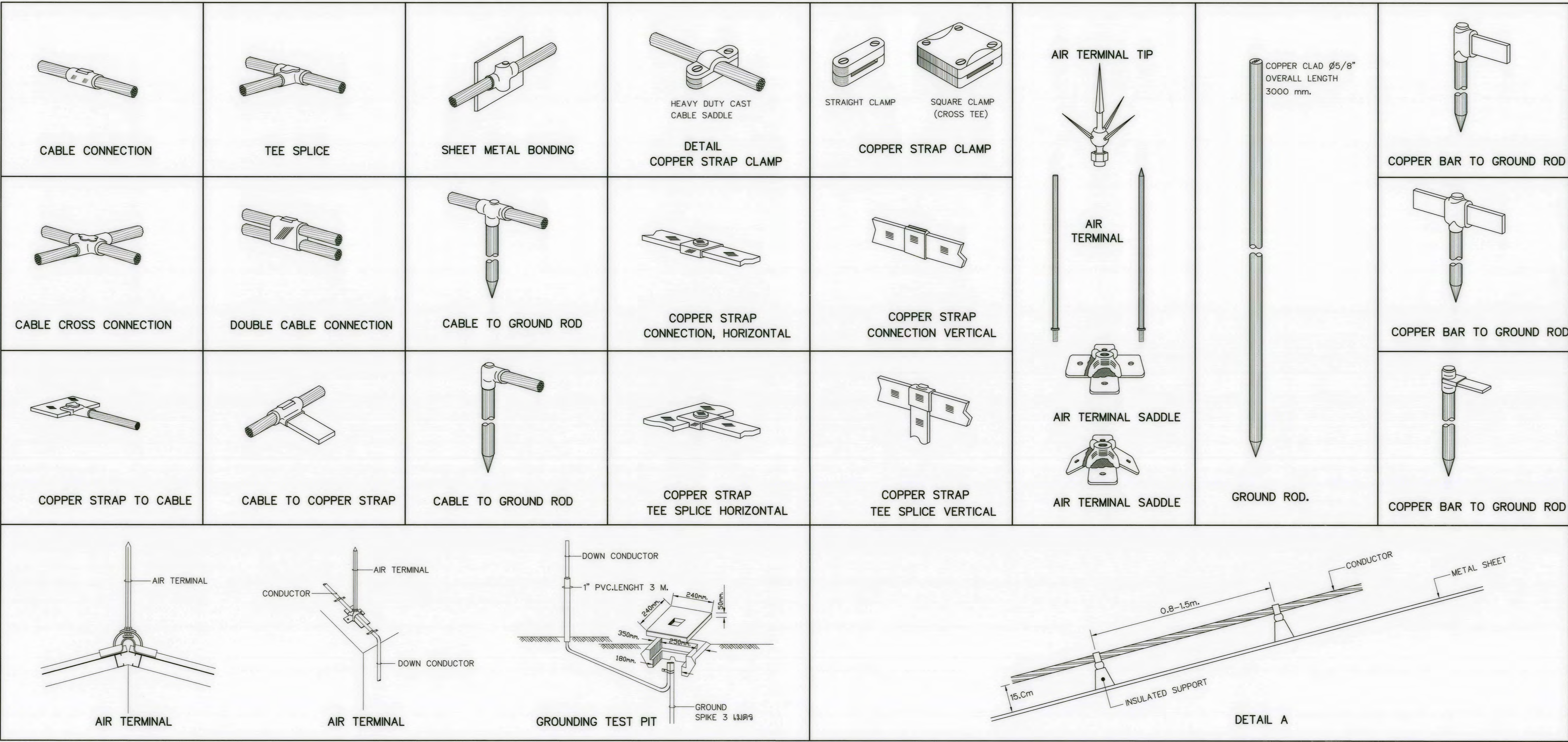






KINGDOM OF THAILAND
Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

AI KA PO HYDROPOWER PROJECT
TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT

PART 2 ELECTRO-MECHANICAL EQUIPMENT
E&M EQUIPMENT
TYPICAL DETAILS FOR INSTALLATION (SHEET 1/3)



P&C MANAGEMENT CO., LTD.
SPT CONSULTANTS CO., LTD.

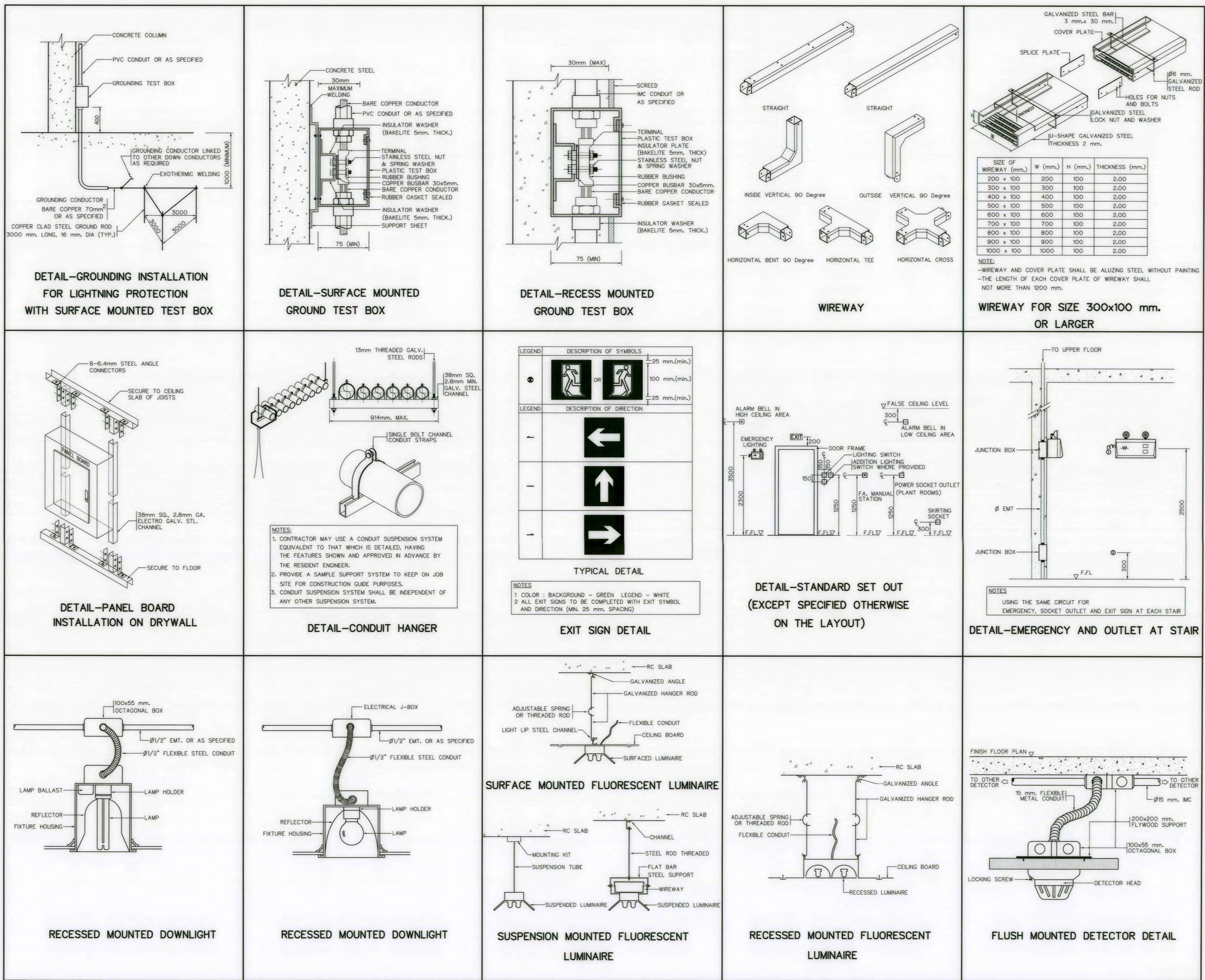


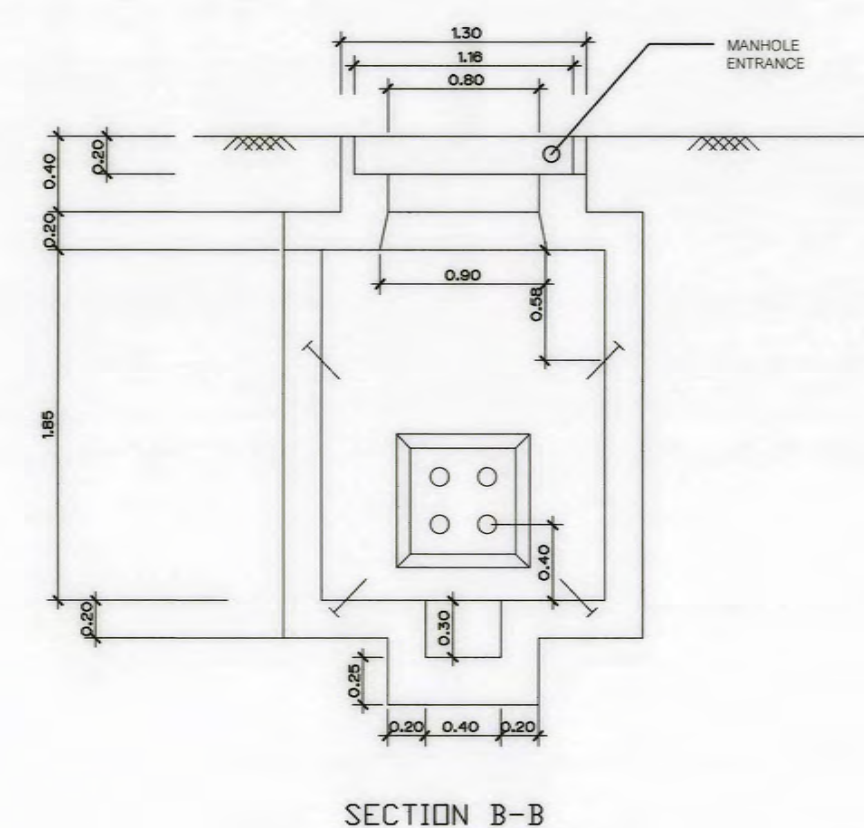
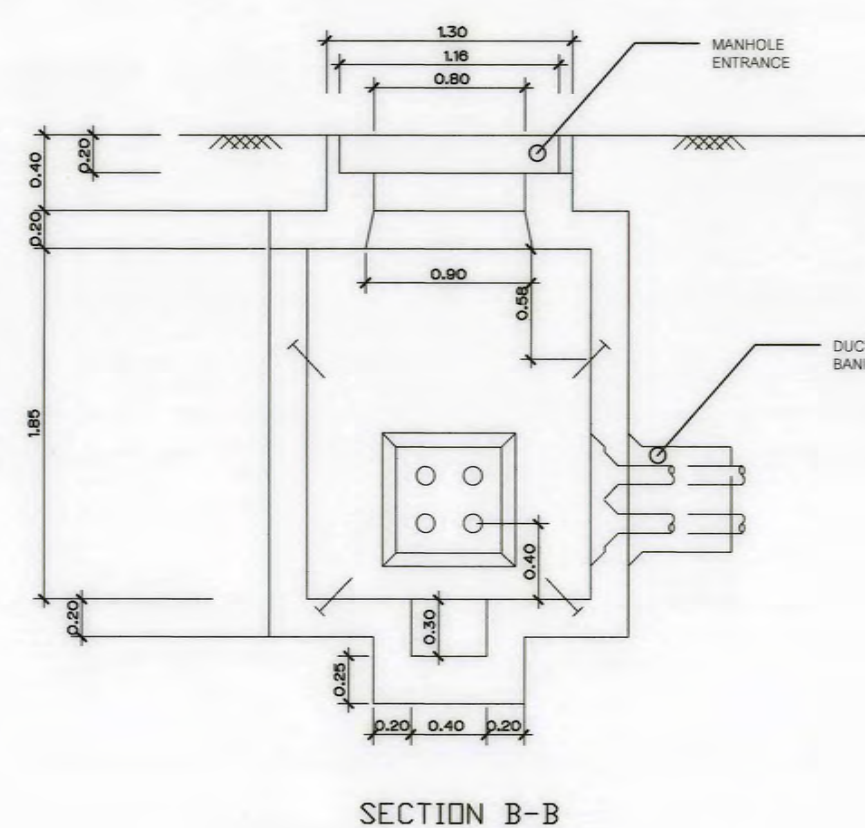
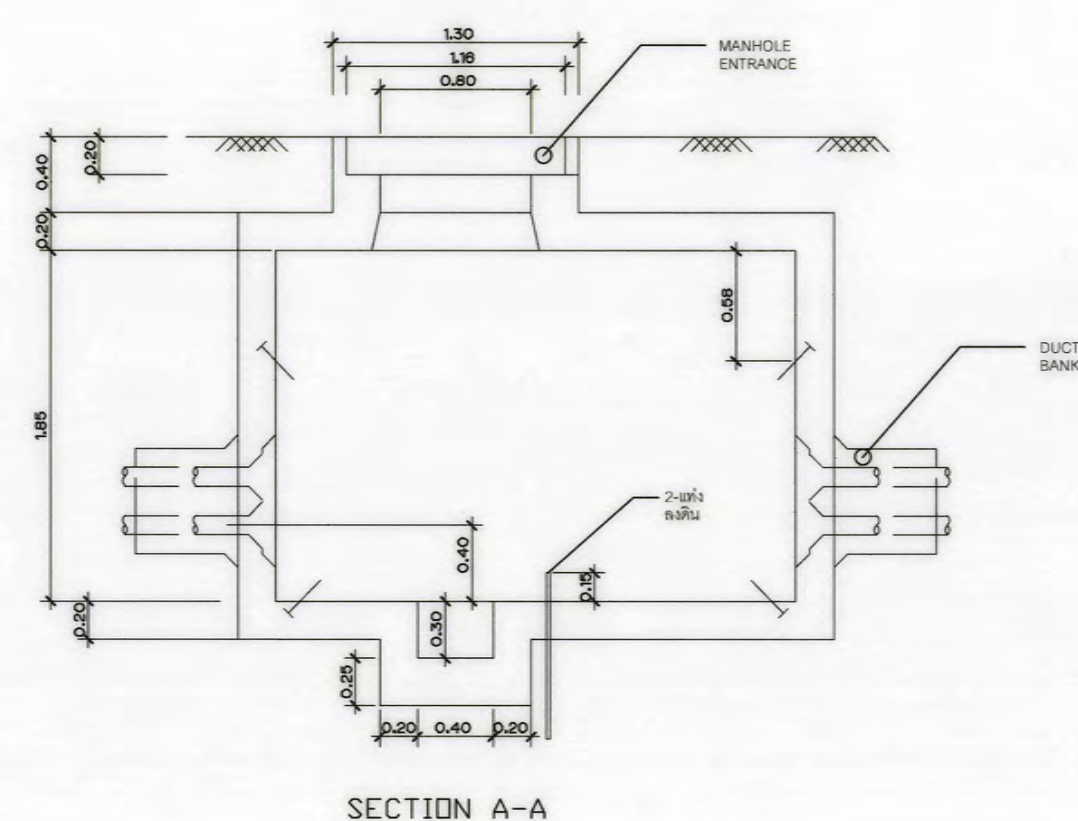
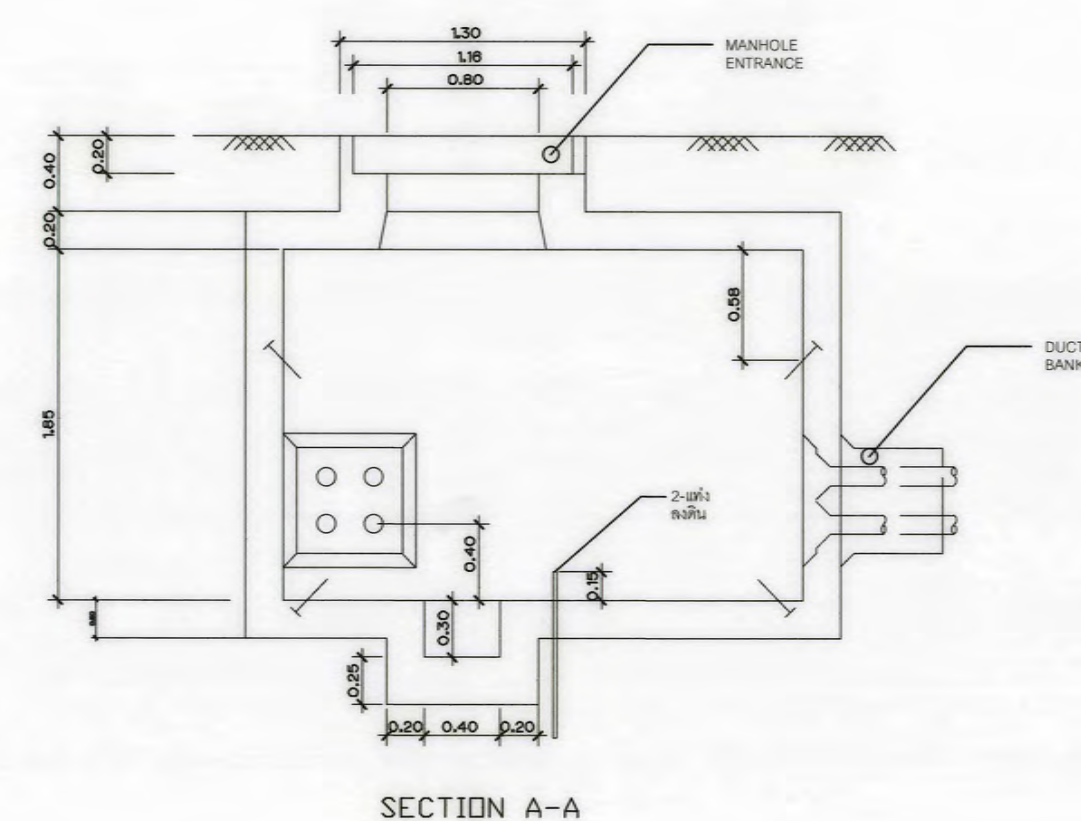
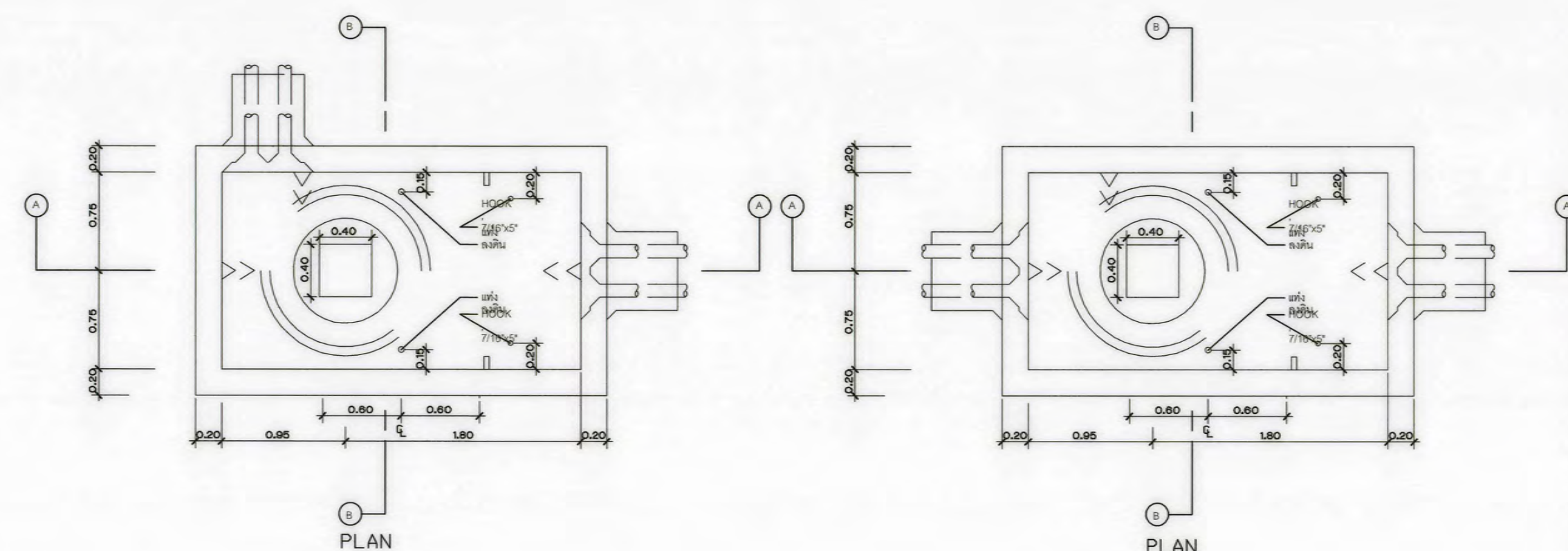
Department of Alternative
Energy Development and Efficiency
MINISTRY OF ENERGY

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DRAWN		RECOMMENDED	
CHECKED	28/10/2021	APPROVED	
PROJECT MANAGER		DATE	

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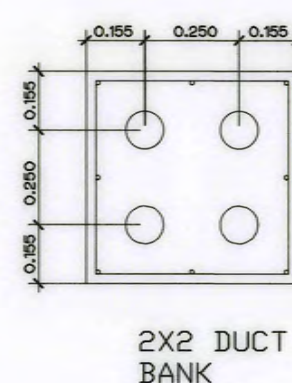
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CONSULTANTS		DEDE		



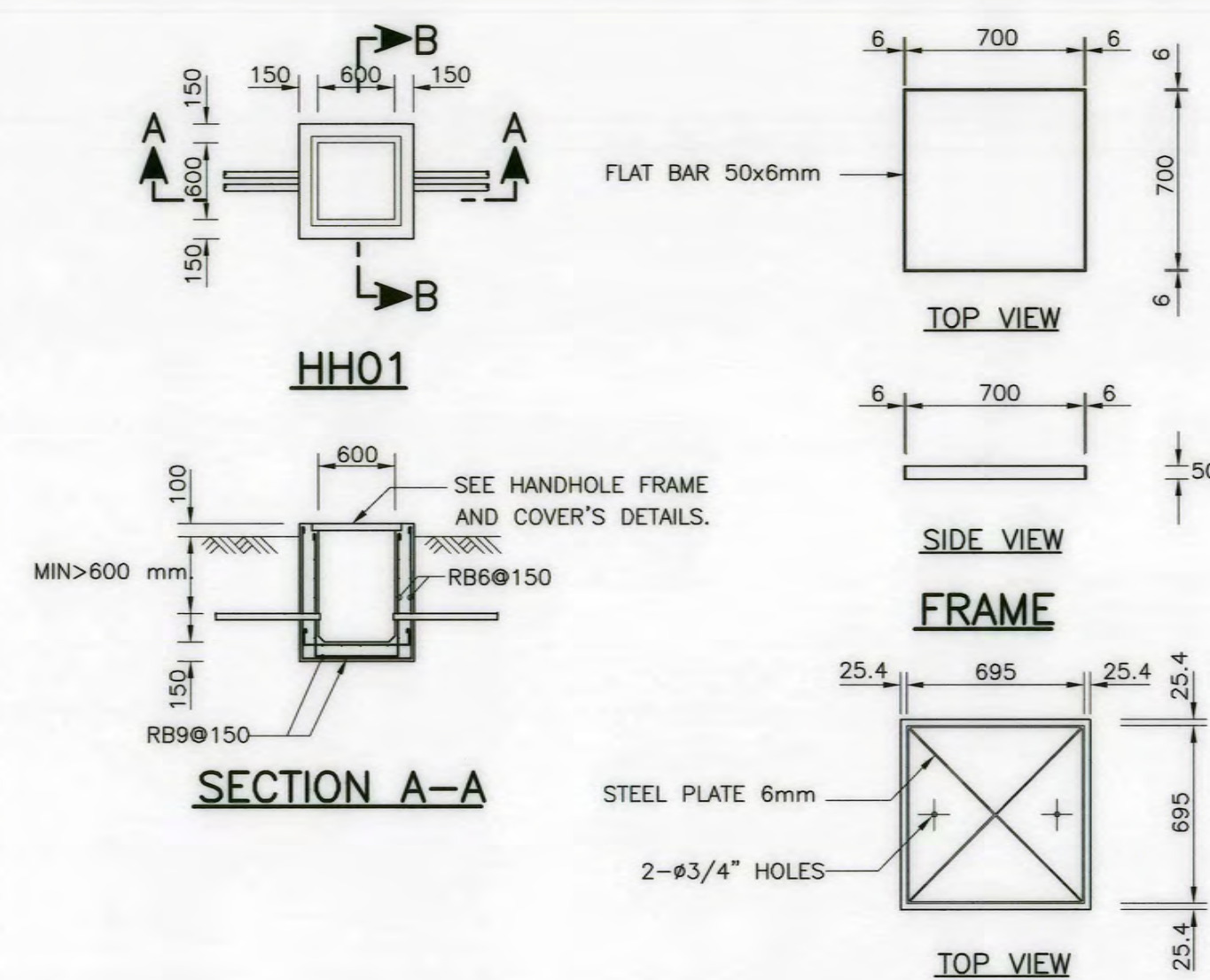


DETAIL OF MH2 (MANHOLE TYPE A-3) 2 WAYS, 90 DEGREE

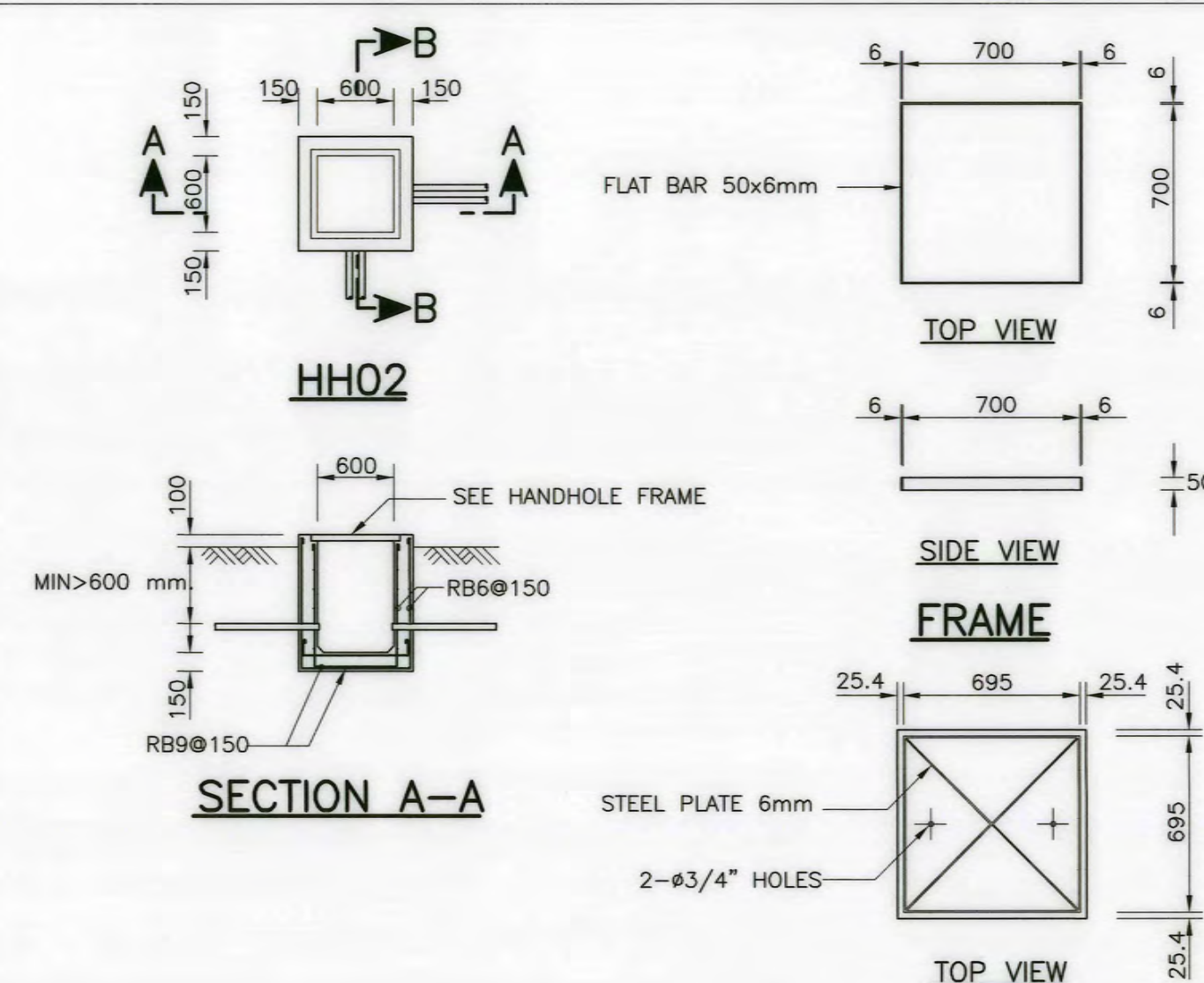
DETAIL OF MH1 (MANHOLE TYPE A-3) 2 WAYS



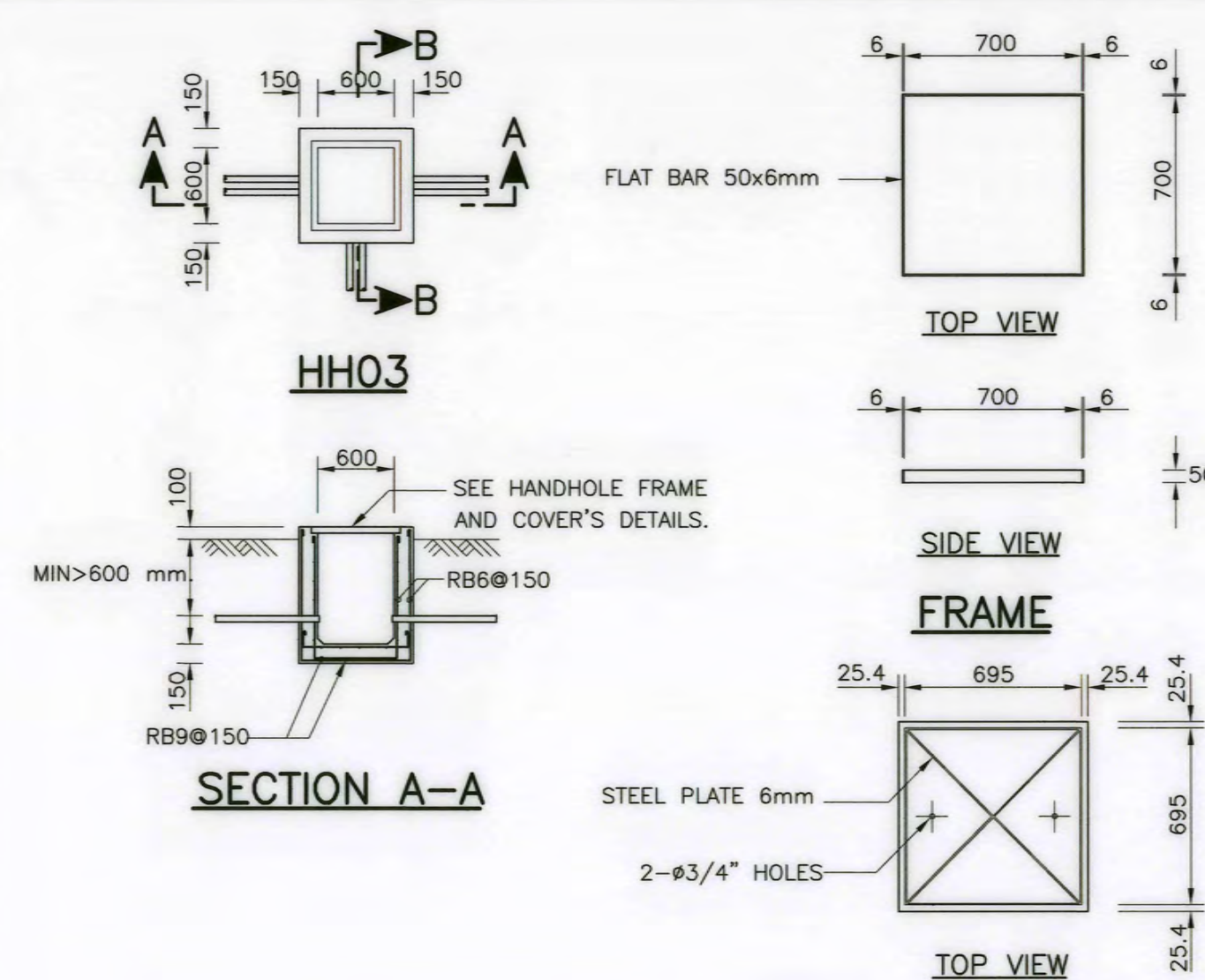
TYPICAL DETAIL FOR HIGH VOLTAGE MANHOLE



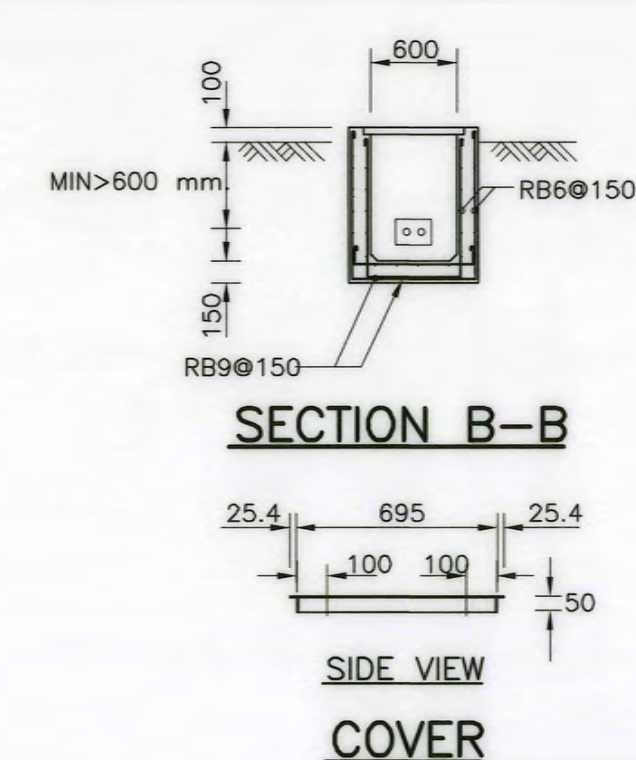
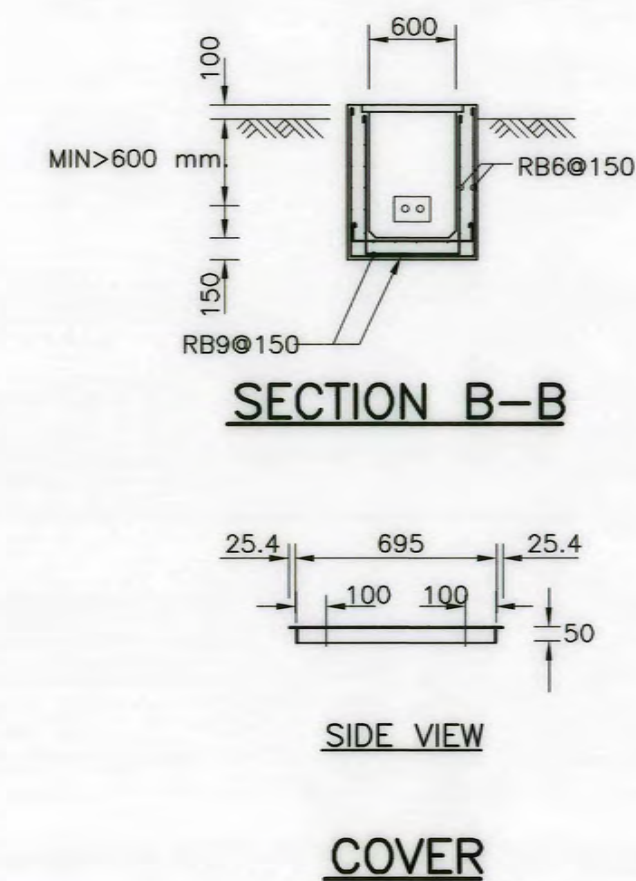
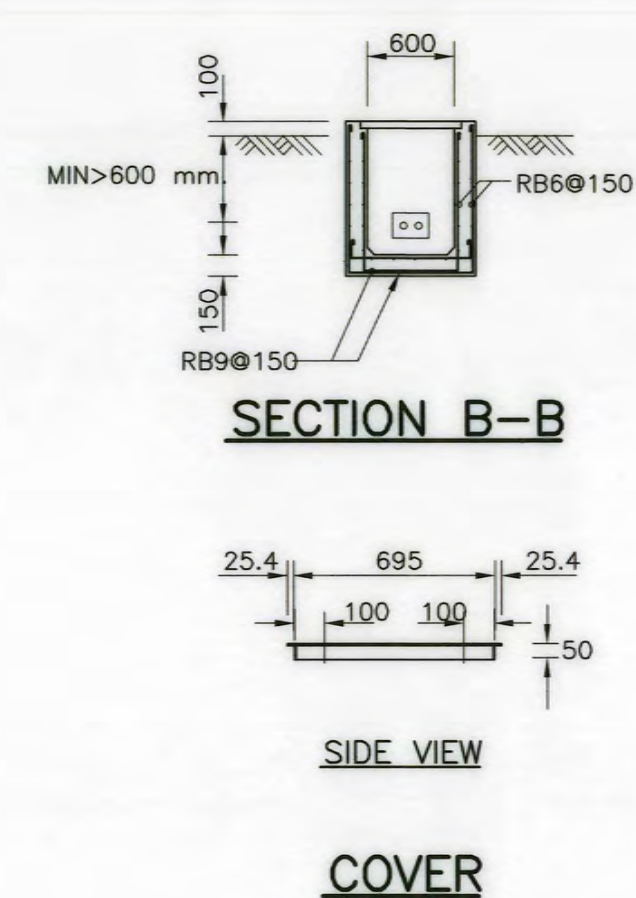
DETAIL HANDHOLE TYPE 1



DETAIL HANDHOLE TYPE 2

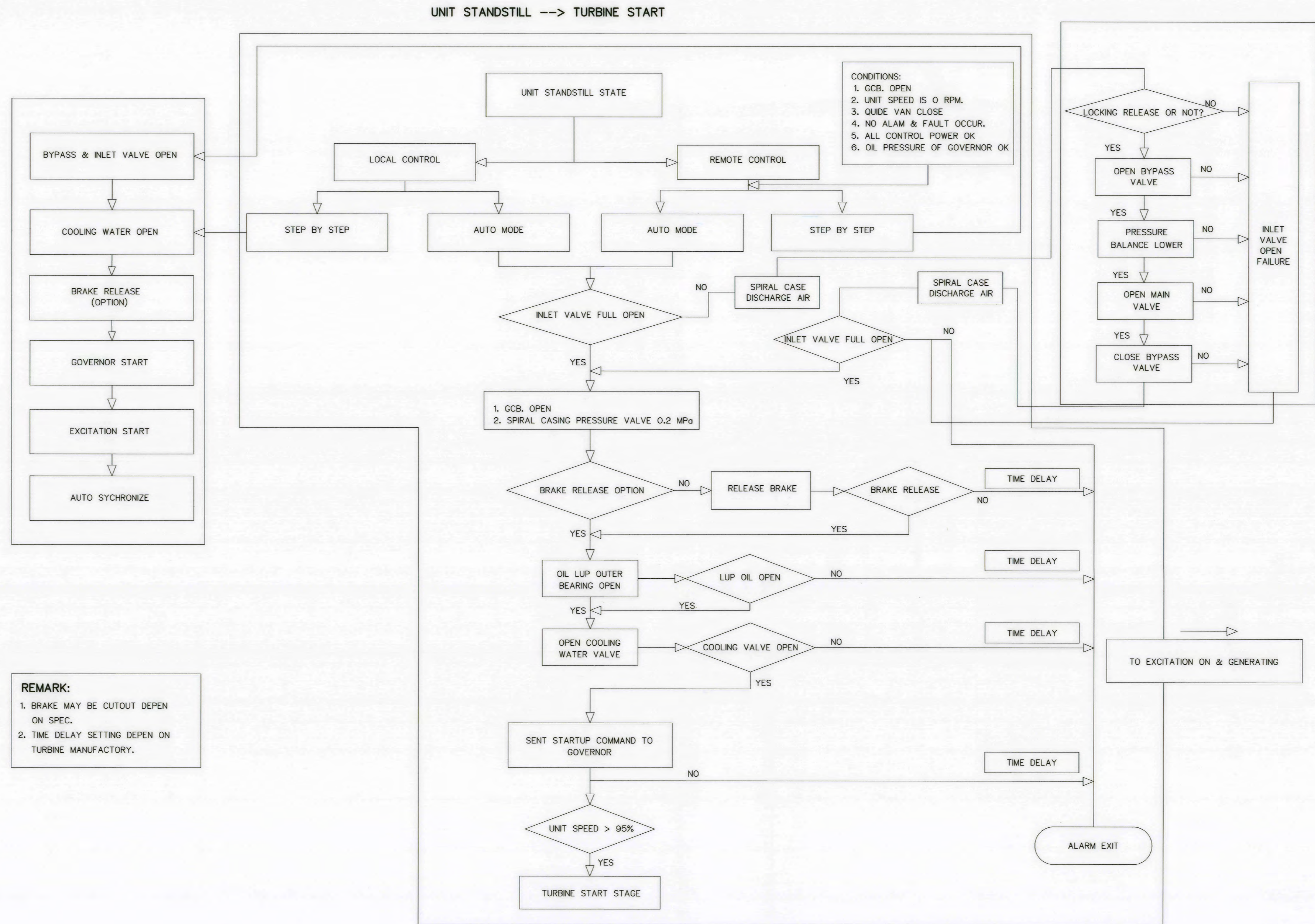


DETAIL HANDHOLE TYPE 3



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AI KA PO HYDROPOWER PROJECT TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT	
PART 2 ELECTRO-MECHANICAL EQUIPMENT E&M EQUIPMENT TYPICAL DETAILS FOR INSTALLATION (SHEET 3/3)	
P&C MANAGEMENT CO., LTD. SPT CONSULTANTS CO., LTD.	Department of Alternative Energy Development and Efficiency MINISTRY OF ENERGY
DESIGNED: <i>[Signature]</i> 28/10/2021 DRAWN: <i>[Signature]</i> CHECKED: <i>[Signature]</i> 28/10/2021 PROJECT MANAGER	REVIEWED: <i>[Signature]</i> SUBMITTED: <i>[Signature]</i> RECOMMENDED: <i>[Signature]</i> APPROVED: <i>[Signature]</i> SHEET NO. 119 OF 129

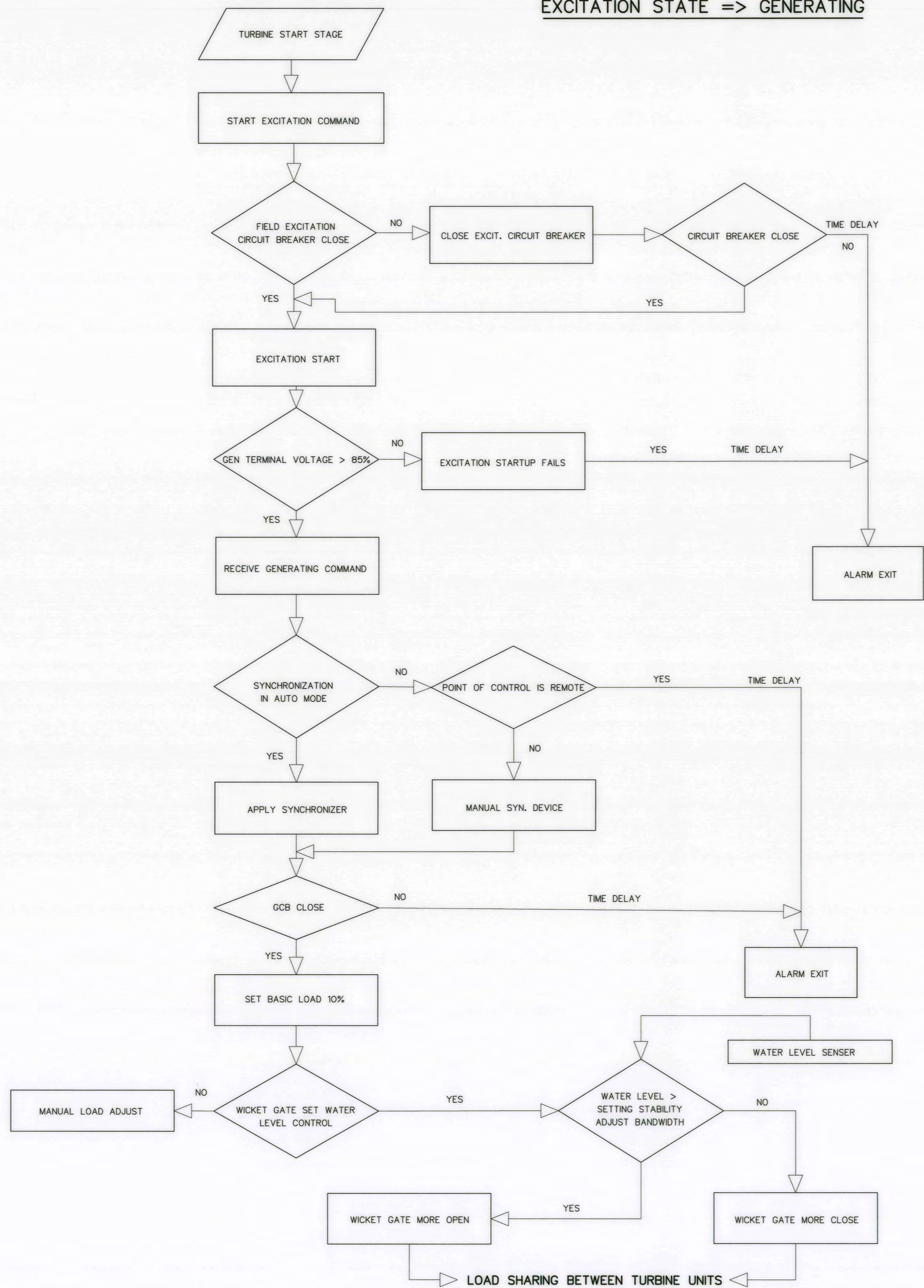
AI KA PO HYDROPOWER PROJECT FRANCIS TURBINE 2 UNITS



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AI KA PO HYDROPOWER PROJECT TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT	
PART 2 ELECTRO-MECHANICAL EQUIPMENT E&M EQUIPMENT TURBINE START	
PCM P&C MANAGEMENT CO., LTD. SPT CONSULTANTS CO., LTD. MINISTRY OF ENERGY	
DESIGNED	28/10/2021
DRAWN	28/10/2021
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PROJECT MANAGER	DATE
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RECOMMENDED	APPROVED
DRAWING NO.	SHEET NO.
AKP-EM-12	120 OF 129

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			CONSULTANTS	DEDE

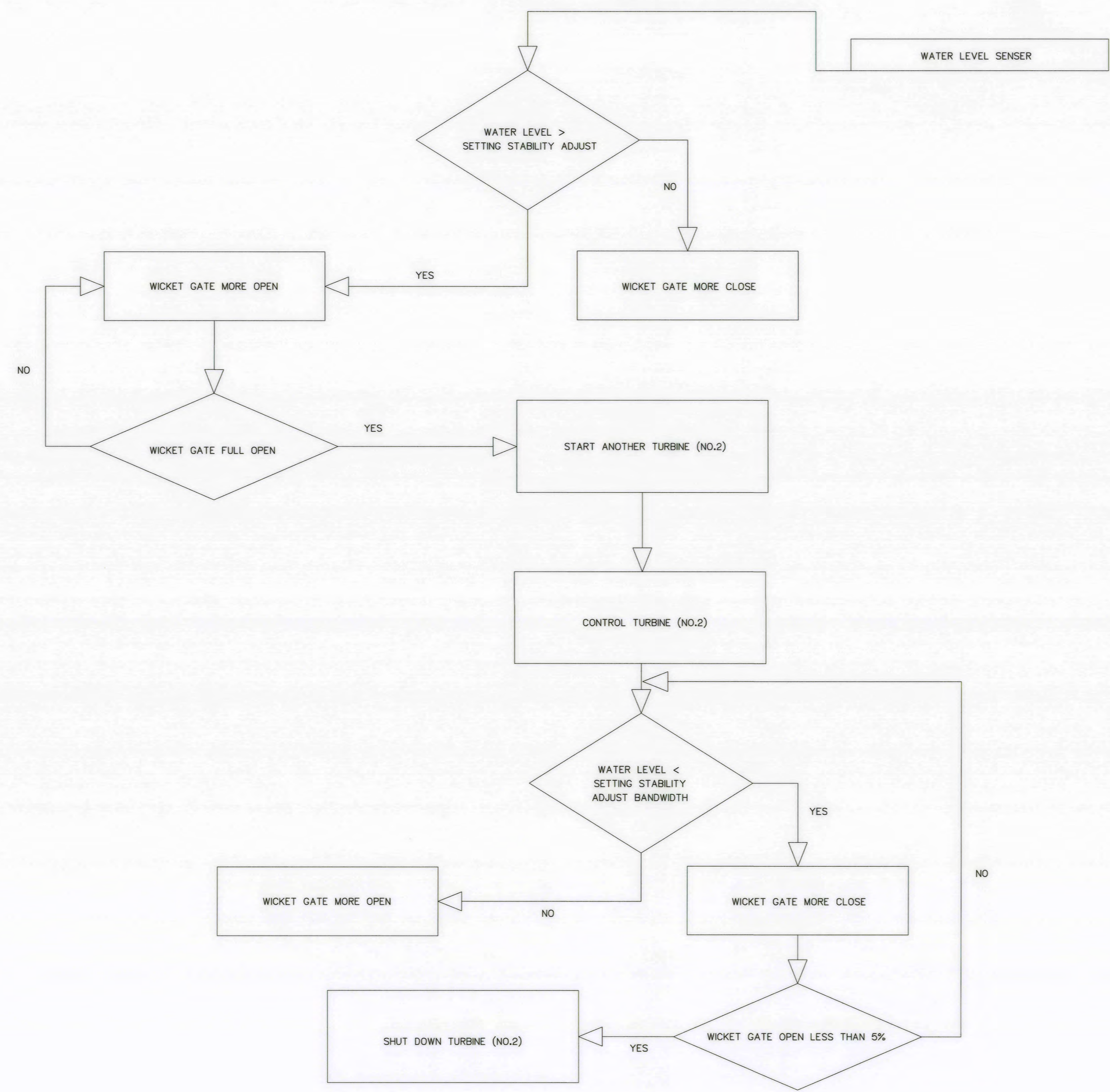
EXCITATION STATE => GENERATING



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AI KA PO HYDROPOWER PROJECT TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT			
PART 2 ELECTRO-MECHANICAL EQUIPMENT E&M EQUIPMENT EXCITATION			
PCM P&C MANAGEMENT CO., LTD. SPT CONSULTANTS CO., LTD.		Department of Alternative Energy Development and Efficiency MINISTRY OF ENERGY	
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CHECKED 28/10/2021		RECOMMENDED	
APPROVED		APPROVED	
PROJECT MANAGER		DRAWING NO. AKP-EM-13	
DATE		SHEET NO. 121 OF 129	

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CONSULTANTS		DEDE		

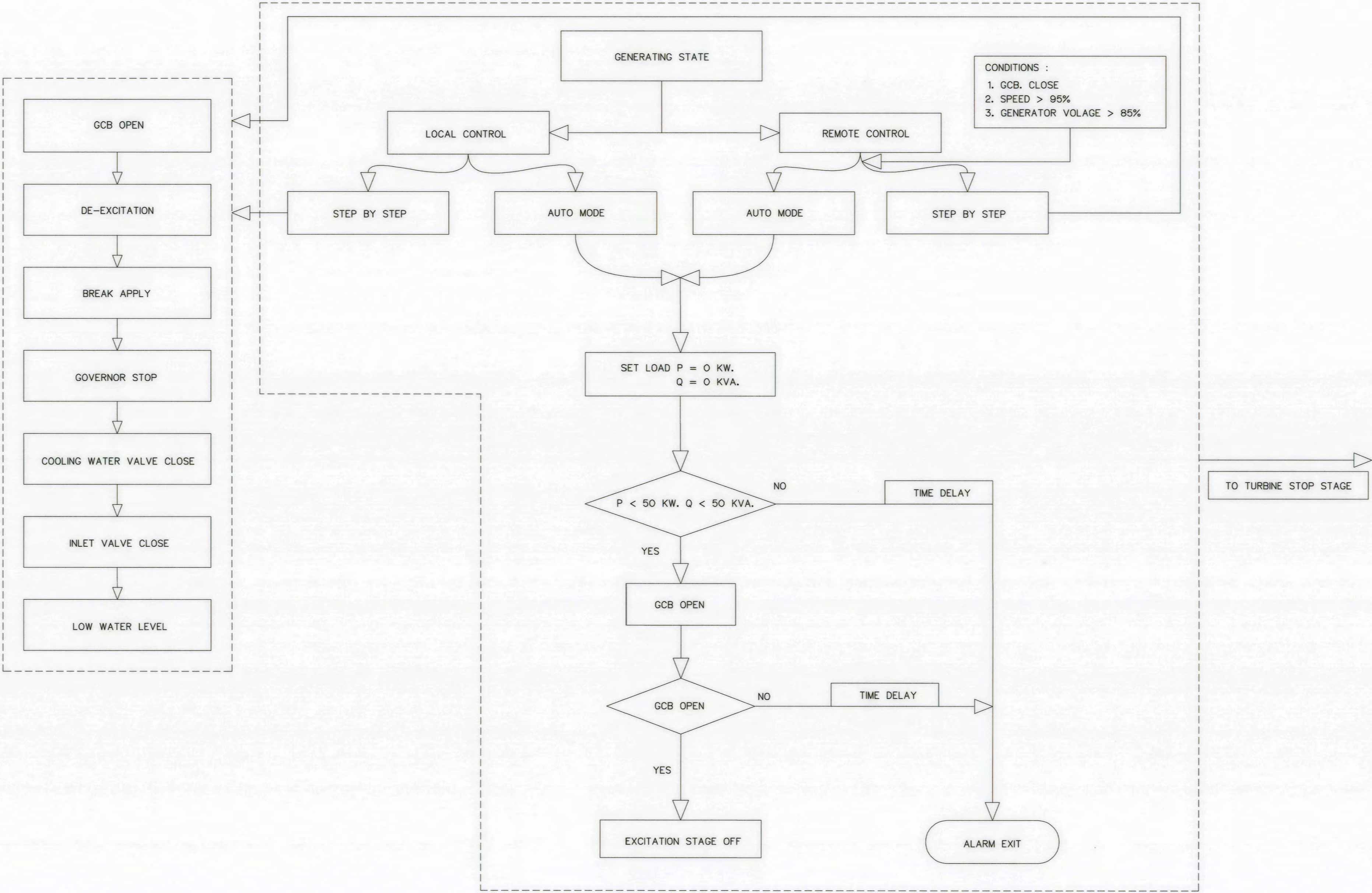
LOAD SHARING BETWEEN TURBINE UNITS



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AI KA PO HYDROPOWER PROJECT TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT	
PART 2 ELECTRO-MECHANICAL EQUIPMENT E&M EQUIPMENT LOAD CONTROL	
PCM P&C MANAGEMENT CO., LTD. SPT CONSULTANTS CO., LTD.	REVIEWED SUBMITTED RECOMMENDED APPROVED
DESIGNED DRAWN CHECKED	DATE 28/10/2021 DATE
PROJECT MANAGER	AKP-EM-14
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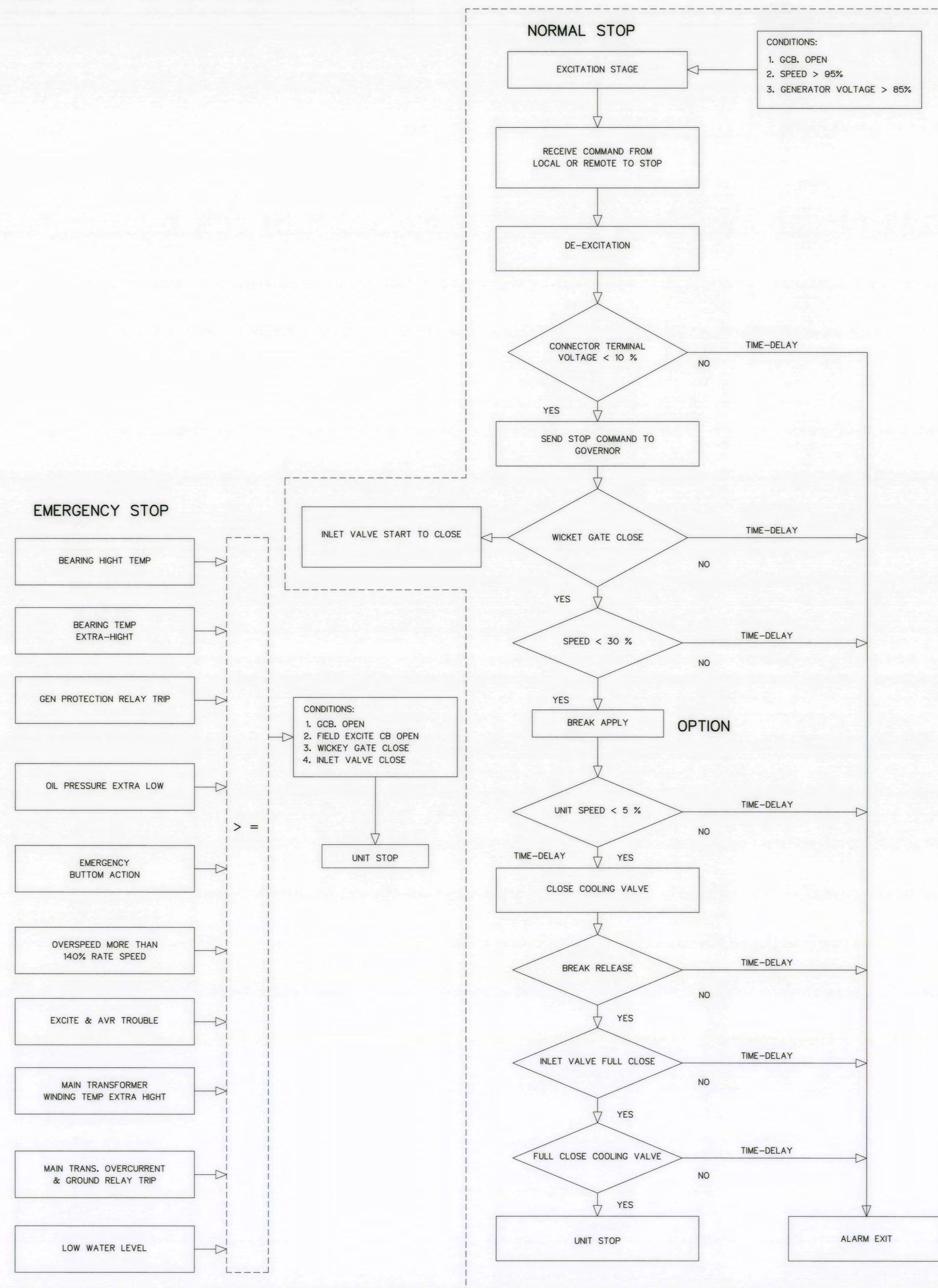
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			CONSULTANTS	DEDE

GENERATING => EXCITATION OFF
(FRANCIS TURBINE 2 UNITS)

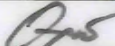
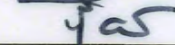
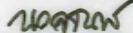


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AI KA PO HYDROPOWER PROJECT TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT	
PART 2 ELECTRO-MECHANICAL EQUIPMENT E&M EQUIPMENT GENERATING LOAD	
PCM P&C MANAGEMENT CO., LTD. SPT CONSULTANTS CO., LTD.	Department of Alternative Energy Development and Efficiency MINISTRY OF ENERGY
DESIGNED DRAWN CHECKED PROJECT MANAGER	REVIEWED SUBMITTED RECOMMENDED APPROVED DRAWING NO. SHEET NO.
3 2 1 NO. DATE REVISIONS CHECKED APPROVED	28/10/2021 AKP-EM-15 123 OF 129

TURBINE STOP : DE-EXCITATION ==> UNIT STOP



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AI KA PO HYDROPOWER PROJECT TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT	
PART 2 ELECTRO-MECHANICAL EQUIPMENT E&M EQUIPMENT TURBINE STOP	
 P&C MANAGEMENT CO., LTD.  SPT CONSULTANTS CO., LTD.	 Department of Alternative Energy Development and Efficiency MINISTRY OF ENERGY
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PROJECT MANAGER _____ DATE _____ AKK-EM-16	SHEET NO. 124 OF 129

SYMBOL LEGEND							
NAME	ISOLATION VALVE	ISOLATION VALVE NORMALLY CLOSE	THROTTLE VALVE	PRESSURE RELIEF VALVE	PUMP	ELECTRIC MOTOR	PRESSURE REDUCING VALVE
SYMBOL							
NAME	3/2 DIRECTIONAL POPPET VALVE	3 WAY HAND OPERATED VALVE	THROTTLE CHECK VALVE	PRESSURE TRANSDUCER	FLOAT	SOLINOID OPERATED	SPRING OPERATED
SYMBOL							
NAME	SOLINOID VARIABLE OPERATED	MINI-MISS COUPLING	QUICK RELEASE COUPLING	ELECTRIC JUNCTION BOX	FLEXIBLE HOSE PIPE	PRESSURE SWITCH	THERMOMETER
SYMBOL							
NAME	TEMPERATURE INDICATOR	4/2 WAYS DIRECTIONAL CONTROL VALVE	THROTTLE CHECK VALVE	NON-RETURN VALVE			
SYMBOL							
NAME	MANUAL 3 WAY VALVE	ADJUST SWITCH	NON-ADJUST SWITCH	SPRING VARIABLE OPERATED			
SYMBOL							
NAME	LEVEL INDICATOR SIDE MOUNTED	BLADDER ACCUMULATOR	FILLING FILTER	AIR DRY FILTER			
SYMBOL							

LINE LEGEND			
PRESSURE LINE	_____		
PILOT LINE	_____		
TANK RETURN LINE	_____		

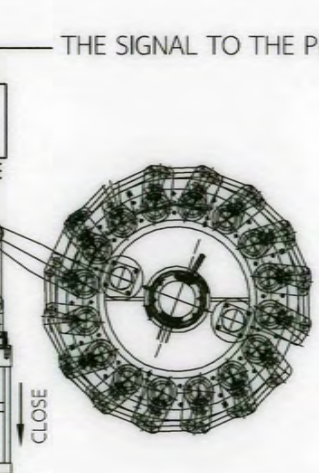
ALPHABET LEGEND			
D - DIFFERENTIAL	S - SWITCH		
I - INDICATOR	TT - TRANSMITTER		
L - LEVEL	T - TEMPERATURE		
P - PRESSURE			

BY-PASS VALVE SERVOMOTOR - 1 Nos.
 OPENING AND CLOSING BY OIL
 OPENING TIME = 10 Sec.
 CLOSING TIME = 10 Sec.

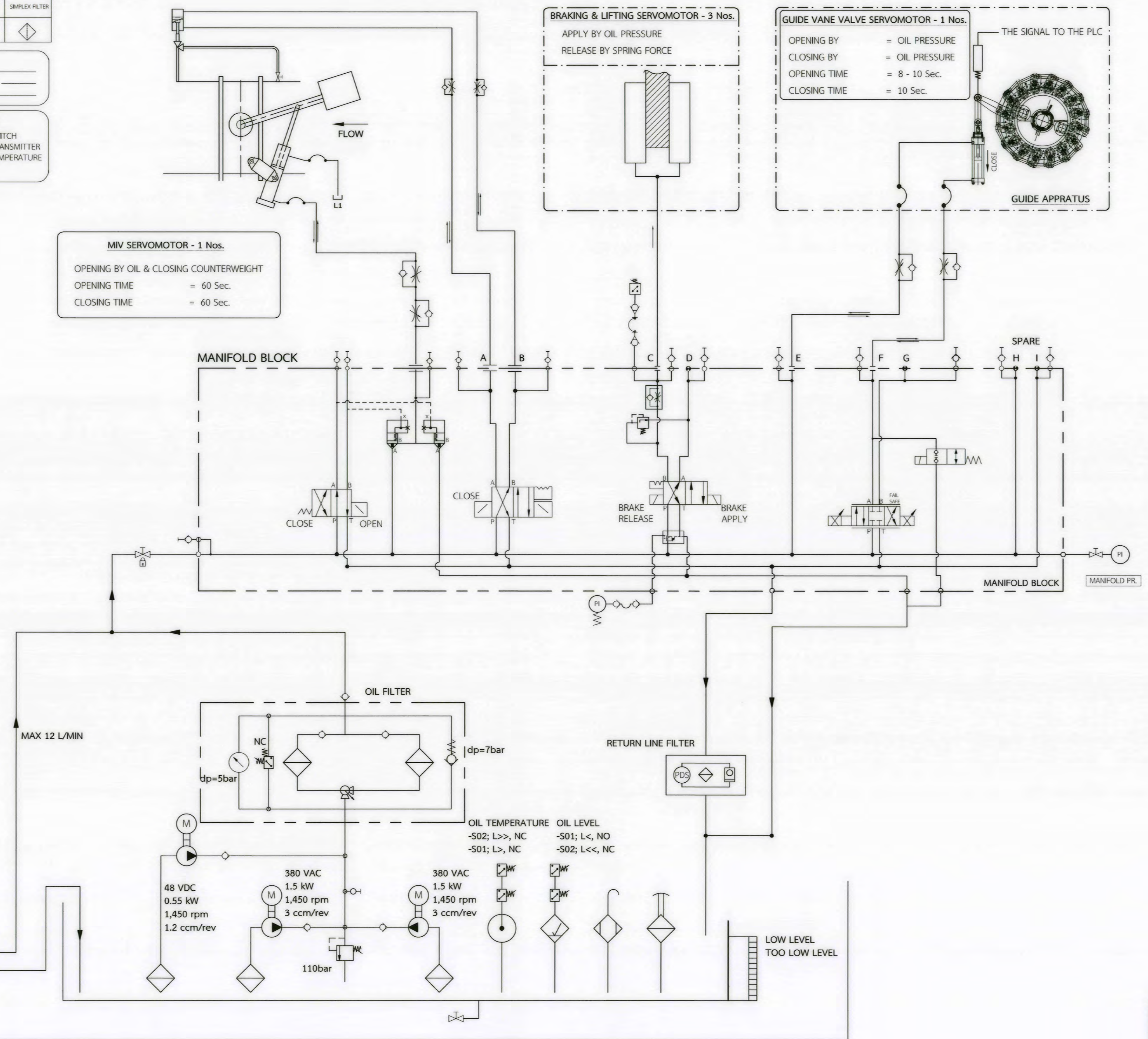
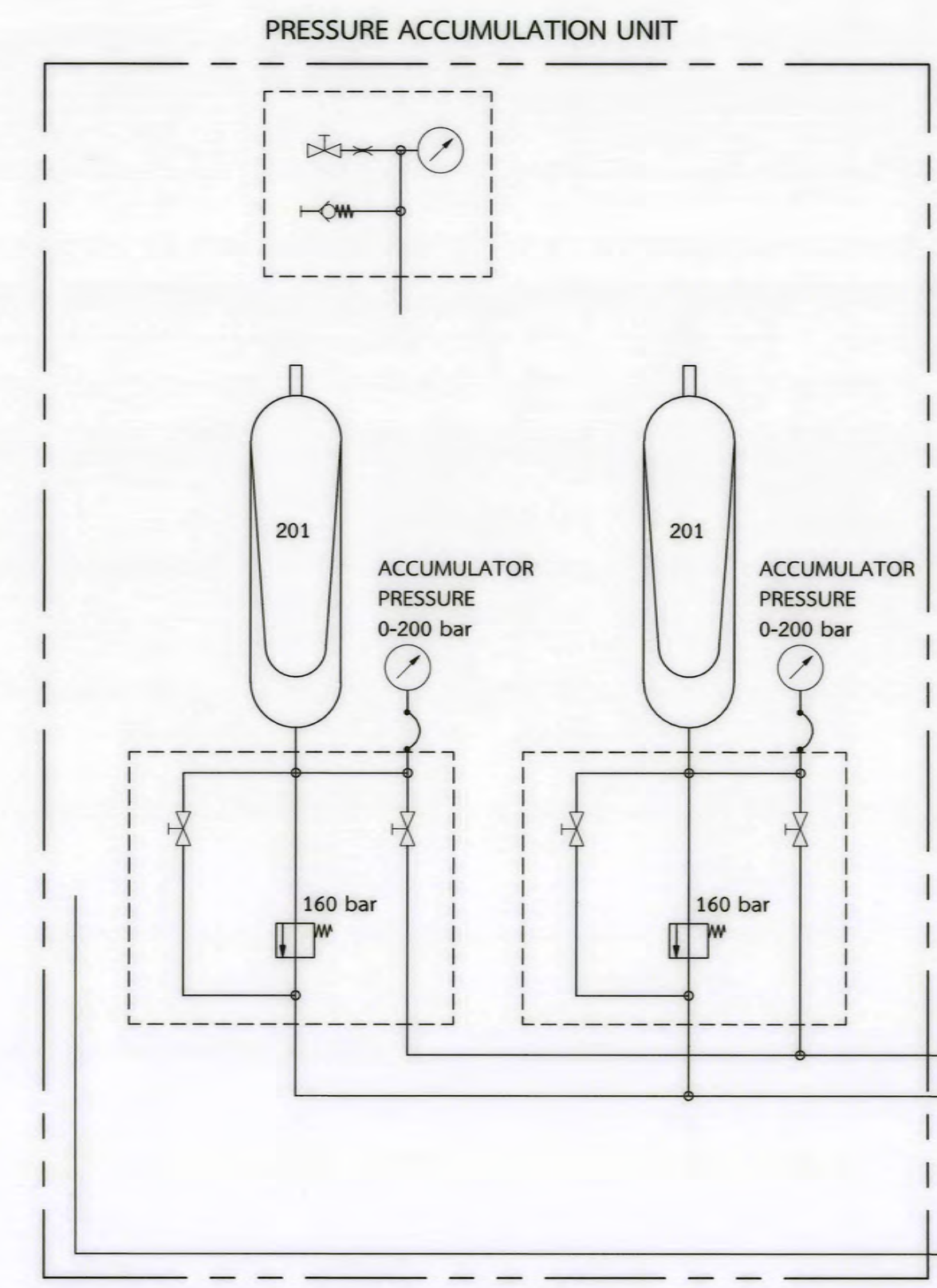
MIV SERVOMOTOR - 1 Nos.
 OPENING BY OIL & CLOSING COUNTERWEIGHT
 OPENING TIME = 60 Sec.
 CLOSING TIME = 60 Sec.

BRAKING & LIFTING SERVOMOTOR - 3 Nos.
 APPLY BY OIL PRESSURE
 RELEASE BY SPRING FORCE

GUIDE VANE VALVE SERVOMOTOR - 1 Nos.
 OPENING BY = OIL PRESSURE
 CLOSING BY = OIL PRESSURE
 OPENING TIME = 8 - 10 Sec.
 CLOSING TIME = 10 Sec.



GUIDE APPRATUS



PUMPS, MOTORS, HEATERS TECHNICAL DATA

oil pump (AC motor) capacity/ type	2x3ccm/rev (2x4 /min) / gear
AC electromotor for pump	2x1.5kW (400VAC 50HZ)
oil pump (DC motor) capacity / type:	1x1.2 ccm/rev (1x1.6 /min)/ gear
DC electromotor for pump:	1x0.55kW (48VDC)
electrical heater	NA

TECHNICAL DATA:

minimum sump tank capacity	150 L
minimum oil pressure	120 Bar
operating pressure	140 Bar
maximum pressure	170 Bar
nitrogen pre-charge pressure	160 Bar
bladder accumulator capacity	
DC voltage	48 Volt
DC coils	48 V.+10%
oil filtration (ISO 4406-1999)	ISO V46/68

NOTE :
 1. THIS DRAWING IS DESIGNED FOR GUIDE LINE ONLY.

KINGDOM OF THAILAND
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AI KA PO HYDROPOWER PROJECT
TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT

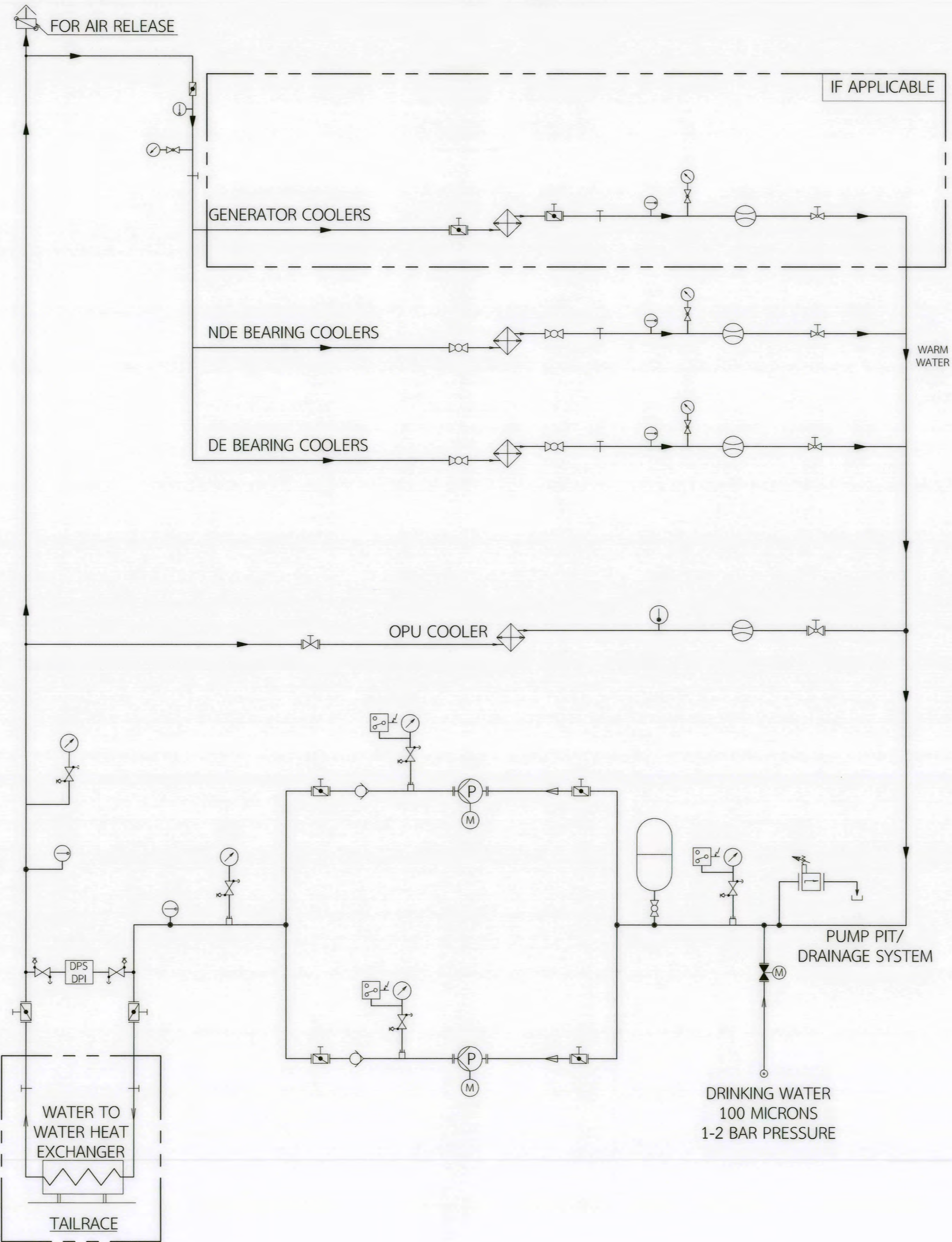
PART 2 ELECTRO-MECHANICAL EQUIPMENT
E&M EQUIPMENT

SCHEMATIC DIAGRAM OF OIL PRESSURE UNIT FOR TURBINE, BRAKE AND MIV

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		AKP-EM-17	125 OF 129

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SYMBOL LEGEND					
NAME	CENTRIFUGAL PUMP MOTOR SET	ISOLATION VALVE (GATE TYPE)	CHECK VALVE	INSTRUMENT ISOLATION VALVE	WATER TO WATER HEAT EXCHANGER
SYMBOL					
NAME	CONTROL VALVE (GLOBE TYPE)	ISOLATION VALVE (BALL TYPE)	PRESSURE SWITCH	PRESSURE GAUGE	FLOW INDICATOR
SYMBOL					
NAME	DIFFERENTIAL PRESSURE SWITCH	TEMPERATURE GAUGE	MOTORIZED GATE VALVE	PRESSURE RELIEF VALVE	RTD
SYMBOL					

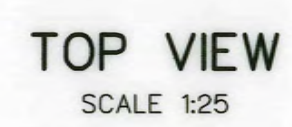


NOTE:

- ALL ELEVATIONS ARE IN METER.
- SUPPLY VOLTAGE: 400 VAC $\pm 10\%$ 3PH, 50 HZ -3% TO $+5\%$.
- MATERIAL OF CONSTRUCTION OF PIPES SHALL BE SEAMLESS STAINLESS STEEL AS PER ASTM A 312 OR ISO 1127.
- ALL FITTINGS SHALL BE OF SS AS PER ASME B 16.9, ASME A403, ASME M 16.5, ASTM A182.
- MOC FOR ALL VALVES SHALL BE BODY-CAST STEEL & INTERNAL-SS.
- TURBINE SHAFT SEAL SYSTEM SHALL BE DESIGNED AS FOLLOW THE MANUFACTURER STANDARD.

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AI KA PO HYDROPOWER PROJECT TAMBON PHUKHAO THONG AMPHOE SUKHIRIN CHANGWAT NARATHIWAT			
PART 2 ELECTRO-MECHANICAL EQUIPMENT E&M EQUIPMENT SCHEMATIC DIAGRAM FOR COOLING WATER SYSTEM			
PCM P&C MANAGEMENT CO., LTD. SPT CONSULTANTS CO., LTD.	DESIGNED DRAWN CHECKED PROJECT MANAGER	REVIEWED SUBMITTED RECOMMENDED APPROVED DRAWING NO. DATE	SHEET NO. 126 OF 129



SECTION A-A
SCALE 1:25

