ข้อมูลประชาสัมพันธ์และช่องทางรับข้อคิดเห็นหรือข้อร้องเรียน ด้านการส่งเสริมคุณธรรมและความโปร่งใสในการดำเนินการ

นโยบายต่อต้านการให้หรือรับสินบนเพื่อป้องกันการทุจริตและประพฤติมิชอบ

จรรยาบรรณของผู้ปฏิบัติงานจัดซื้อจัดจ้างและบริหารพัสดุ

ช่องทางรับข้อคิดเห็นหรือข้อร้องเรียน *

การแจ้งข้อคิดเห็นหรือข้อร้องเรียนทางเว็บไซต์ กฟผ. *

จรรยาบรรณคู่ค้า กฟผ. **

*** ไม่ใช่ช่องทางแสดงความคิดเห็นร่างขอบเขตของงานหรือรายละเอียดคุณลักษณะเฉพาะของพัสดุที่จะซื้อหรือจ้าง/ ร่างประกาศ/ ร่างเอกสารประกวดราคาฯ**

**** กฟผ. จัดทำและเผยแพร่จรรยาบรรณคู่ค้า เพื่อให้คู่ค้าของ กฟผ. ทุกรายมีแนวปฏิบัติในการดำเนินธุรกิจอย่างมีจริยธรรมและธรรมาภิบาล โดยคำนึงถึงสิ่งแวดล้อม สังคม การกำกับดูแลกิจการที่ดี ปฏิบัติตามกฎหมาย และเคารพหลักสิทธิมนุษยชน ดังมีรายละเอียดระบุใน QR Code จรรยาบรรณคู่ค้า กฟผ."**

EGAT's Privacy Notice on Procurement, Inventory Management and Contract Administration

Electricity Generating Authority of Thailand (EGAT) has performed the protection of the Personal Data regarding procurement, inventory management and contract administration to be in accordance with **the Personal Data Protection Act B.E. 2562** (the "2019 PDPA"), which comes into effect on June 1, 2022.

Details about EGAT's Privacy Notice on Procurement, Inventory Management and Contract Administration are available for you at https://www.egat.co.th/privacy-notice-procurement_en.html or the below QR Code.

The Redaction of Sensitive Personal Data

EGAT has announced the Privacy Notice on Procurement, Inventory Management and Contract Administration for the collection, use or disclosure of Personal Data, excluding the Sensitive Personal Data.

Should the documents you wish to submit to EGAT contain the Sensitive Personal Data as defined in Section 26 of the 2019 PDPA, pertaining to racial, ethnic origin, political opinions, cult, religious or philosophical beliefs, sexual behavior, criminal records, health data, disability, trade union information, genetic data, biometric data, or of any data which may affect you in the same manner, you shall redact or conceal such data before submitting to EGAT.

<u>ประกาศความเป็นส่วนตัว (Privacy Notice) สำหรับการจัดซื้อจัดจ้าง การบริหารพัสดุ และการบริหารสัญญาของ กฟผ.</u>

การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย (กฟผ.) ได้ดำเนินการคุ้มครองข้อมูลส่วนบุคคลสำหรับการจัดซื้อจัดจ้าง การบริหารพัสดุ และการบริหารสัญญา เพื่อให้เป็นไปตาม**พระราชบัญญัติคุ้มครองข้อมูลส่วนบุคคลของประเทศไทย พ.ศ. 2562** (PDPA) ซึ่งมีผลบังคับใช้อย่างครบถ้วน ตั้งแต่วันที่ 1 มิถุนายน 2565 ทั้งนี้ ท่านสามารถศึกษารายละเอียดประกาศความเป็นส่วนตัว (Privacy Notice) สำหรับการจัดซื้อจัดจ้าง การบริหารพัสดุ และการบริหารสัญญา ได้ที่ https://www.egat.co.th/privacy-notice-procurement.html หรือที่ QR Code ด้านล่าง

<u>การขีดฆ่าข้อมูลส่วนบุคคลอ่อนไหว</u>

กฟผ. มีประกาศความเป็นส่วนตัว (Privacy Notice) สำหรับการจัดซื้อจัดจ้าง การบริหารพัสดุ และการบริหารสัญญา เพื่อใช้ในการเก็บรวบรวม ใช้ หรือเปิดเผย ข้อมูลส่วนบุคคล แต่ไม่เก็บข้อมูลส่วนบุคคลอ่อนไหว หากเอกสารของท่านที่ต้องส่งมอบให้ กฟผ. มีข้อมูลส่วนบุคคลอ่อนไหวตามที่ถูกบัญญัติไว้ในมาตรา 26 ของ PDPA ดังนี้ เชื้อชาติ เผ่าพันธุ์ ความคิดเห็นทางการเมือง ความเชื่อในลัทธิ ศาสนาหรือปรัชญา พฤติกรรมทางเพศ ประวัติอาชญากรรม ข้อมูลสุขภาพ ความพิการ ข้อมูลสหภาพแรงงาน ข้อมูลพันธุกรรม ข้อมูลชีวภาพ หรือข้อมูลอื่นใด ซึ่งกระทบต่อเจ้าของข้อมูลส่วนบุคคลในทำนองเดียวกันรวมอยู่ด้วย ขอให้ท่านขีดฆ่า หรือปกปิดข้อมูลดังกล่าว ก่อนส่งมอบให้แก่ กฟผ.

1st Draft of Terms of Reference,

Announcement and Details of Medium Cost

for Invitation to Bid No. BBS1-DSS-01

Supply of Digital Substation Protection and Automation System

Transmission System for Hydro-Floating Solar Hybrid Project Bhumibol Dam Unit 1

The Electricity Generating Authority of Thailand (EGAT) plans to call for proposals for the subject Invitation to Bid. Any person who has the authorization from the company, firm, joint venture or consortium who supplies or manufactures the equipment required under the subject invitation to Bid is allowed to submit a comment against the first draft of the Terms of Reference (TOR), the Announcement and the Details of Medium Cost attached herewith.

How to Comment

Those who would like to comment shall submit an official letter signed by the authorized person(s) together with the letter of authorization or the power of attorney, and addressed to "Chief, Procurement Department - Transmission System Segment, Central Procurement and Inventory Management Division".

Comments shall be submitted via email address: ***burapat.dan@egat.co.th*** with all related documents attached (e.g. the letter of authorization and the power of attorney).

Comments shall be received by EGAT on or before ***February 19, 2026***, Bangkok Standard Time, **otherwise the comments will not be taken into consideration**.

EGAT reserves the right to change or not to change the terms and conditions contained in the Terms of Reference, the Announcement and the Details of Medium Cost subject to its consideration and such decision shall be final.

Miss Warisa Sukying

Head, Procurement Section - Transmission System Segment 1

Date February 12, 2026

Notice to Bidder

Subject : Online Payment for Purchase of Bidding Documents

Please be informed of the online payment for purchase of bidding documents as follows:

1) Fill-out the Registration Form and the proof of payment in the link provided in https://www4.egat.co.th/fprocurement/biddingeng

   Payment shall be made by bank transfer or telegraphic transfer to EGAT's account no. 109-6-01958-2 (swift code : KRTHTHBK), Krung Thai Bank Public Company Limited, Bangkruai Branch, Nonthaburi.

   All bank charges and fees incurred by the payment of bidding documents shall be under the buyer's responsibility.

2) The registration will be deemed complete only upon successful processing of the payment and confirmation of funds received.

3) After the payment has been verified for approximately 3 working days, the in-charge officer will send the link for downloading the bidding documents together with the receipt to the purchaser's email address in the Registration Form.

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Invitation to Bid No. BBS1-DSS-01

Supply of Digital Substation Protection and Automation System

Transmission System for Hydro-Floating Solar Hybrid Project Bhumibol Dam Unit 1

The Electricity Generating Authority of Thailand (EGAT) is calling for the subject Invitation to Bid to be financed by EGAT's fund. The project is on the process of the Government's Approval. The Bid may be cancelled in case the project is not approved.

Place of Delivery : EGAT's Head Office

Medium Cost (including Value Added Tax) :

Description	Medium Cost (THB)
Schedule 1 : 230 kV Digital Substation Protection and Automation Equipment	54,300,000.-
Schedule 2 : 230 kV Fault Recording System	3,200,000.-

Eligibility of Bidders

1. The Bidder shall be a local manufacturer or provide such locally manufactured materials and/or equipment and shall not be named in the List of Work Abandoners published by the Permanent Secretary, Ministry of Finance, and/or in the Debarment List and/or in the List of Work Abandoners declared by EGAT.
2. The Bidder shall not be a Jointly Interested Bidder with other Bidders as from the date of EGAT's issuance of the Invitation, or shall not be a person who undertakes any action as an "Obstruction of Fair Price Competition" for this Invitation.
3. The Bidder shall not either be EGAT's consultant or involve in EGAT's consultancy company under this Invitation to Bid, or shall not have EGAT's personnel involved in his business as shareholder having voting right that can control his business, director, manager, officer, employee, agent, or consultant except those who are officially ordered by EGAT to act or participate therein.
4. The Bidder shall not be the person who is privileged or protected not to be taken any legal proceedings under Thai Court; Provided that such Bidder's government declares that such special privilege is waived.
5. The Bidder who is a joint venture or consortium shall carry out all the work under such formation from the time of bidding until the fulfillment of the Contract.

Availability of Bidding Documents

Bidding Documents are available for online purchase during 8:00 hrs. to 15:00 hrs., Bangkok Standard Time, as from _____ to _____ at THB 300.- per copy, non-refundable.

Please find more details for online purchasing process at https://www4.egat.co.th/fprocurement/biddingeng or contact for further information at telephone no. 0 2436 0346 or procurement.tse@egat.co.th.

Delivery of Bids

Bids shall be submitted at Bidding Room, 1st Floor, Tor 137 Building at EGAT's Head Office, Nonthaburi during 9:00 hrs. to 10:00 hrs., Bangkok Standard Time, _____and will be opened publicly at 10:00 hrs.

ELECTRICITY GENERATING AUTHORITY OF THAILAND

(Date of Announcement)

(Miss Wallapa Chewadhnakorlkul)

Chief, Procurement Department – Transmission System Segment

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ประกาศการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย
เรื่อง ประกวดราคาซื้อ เลขที่ BBS1-DSS-01

การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย (กฟผ.) มีความประสงค์จะซื้อ Digital Substation Protection and Automation System สำหรับระบบส่งไฟฟ้าสำหรับโครงการโรงไฟฟ้าพลังงานแสงอาทิตย์ทุ่นลอยน้ำร่วมกับโรงไฟฟ้าพลังน้ำเขื่อนภูมิพล ชุดที่ 1 โดยใช้งบประมาณ กฟผ. ทั้งนี้ โครงการอยู่ระหว่างการขออนุมัติจากคณะรัฐมนตรี การจัดหาครั้งนี้จะไม่ผูกพัน กฟผ. หากโครงการไม่ได้รับอนุมัติ

สถานที่ส่งมอบ : กฟผ. สำนักงานใหญ่

ราคากลาง (รวมภาษีมูลค่าเพิ่ม) :

รายการ	ราคากลาง (บาท)
Schedule 1 : 230 kV Digital Substation Protection and Automation Equipment	54,300,000.-
Schedule 2 : 230 kV Fault Recording System	3,200,000.-

คุณสมบัติของผู้เสนอราคา

1. ต้องเป็นนิติบุคคลผู้ผลิตพัสดุ หรือผู้มีอาชีพขายพัสดุที่ผลิตในประเทศไทยตามประกาศ และต้องไม่เป็นผู้ทิ้งงานซึ่งปลัดกระทรวงการคลังได้แจ้งเวียนชื่อไว้ หรือต้องไม่เป็นผู้ที่ กฟผ. ห้ามติดต่อหรือห้ามเข้าเสนอราคา หรือต้องไม่เป็นผู้ที่ได้รับผลของการสั่งให้นิติบุคคลหรือบุคคลอื่นเป็นผู้ทิ้งงานตามคำสั่ง กฟผ.
2. ต้องไม่เป็นผู้มีผลประโยชน์ร่วมกันกับผู้เสนอราคารายอื่น ณ วันประกาศประกวดราคาครั้งนี้เป็นต้นไป หรือต้องไม่เป็นผู้กระทำการอันเป็นการขัดขวางการแข่งขันราคาอย่างเป็นธรรมในการดำเนินการประกวดราคาครั้งนี้
3. ต้องไม่เป็นที่ปรึกษาของ กฟผ. หรือมีส่วนร่วมในบริษัทที่ปรึกษาของ กฟผ. ในงานนี้ หรือต้องไม่มีผู้ปฏิบัติงาน กฟผ. เข้าไปมีส่วนร่วมในกิจการของผู้เสนอราคา ไม่ว่าจะในฐานะผู้ถือหุ้นที่มีสิทธิควบคุมการจัดการ กรรมการ ผู้อำนวยการ ผู้จัดการ พนักงาน ลูกจ้าง ตัวแทน หรือที่ปรึกษา ยกเว้น ในกรณีที่ผู้ปฏิบัติงานได้รับคำสั่งอย่างเป็นทางการจาก กฟผ. ให้ไปปฏิบัติงานหรือเข้าร่วมในกิจการของผู้เสนอราคา
4. ต้องไม่เป็นผู้ได้รับเอกสิทธิ์หรือความคุ้มกัน ซึ่งอาจปฏิเสธไม่ยอมขึ้นศาลไทย เว้นแต่รัฐบาลของผู้เสนอราคาได้มีคำสั่งให้สละสิทธิ์และความคุ้มกันเช่นว่านั้น
5. ผู้ประสงค์เข้าประกวดราคาในนามของกิจการร่วมค้าหรือกิจการค้าร่วม (Joint Venture or Consortium) จะต้องดำเนินการทุกขั้นตอนของการประกวดราคาในนามของกิจการร่วมค้าหรือกิจการค้าร่วม ตั้งแต่การเสนอราคาจนสิ้นสุดข้อผูกพันกับ กฟผ.

การขายเอกสารประกวดราคา

ผู้สนใจติดต่อซื้อเอกสารประกวดราคา ในราคาชุดละ 300.- บาท ในวันทำการระหว่างเวลา 08:00 น. ถึง 15:00 น. ตั้งแต่วันที่ _____ ถึงวันที่ _____ ทั้งนี้ สามารถดูรายละเอียดการซื้อเอกสารประกวดราคาได้ที่เว็บไซต์ https://www4.egat.co.th/fprocurement/biddingeng หรือสอบถามข้อมูลเพิ่มเติมได้ทางโทรศัพท์ หมายเลข 0 2436 0346 หรืออีเมล procurement.tse@egat.co.th

การยื่นซองประกวดราคา

กำหนดยื่นซองประกวดราคา ในวันที่ _____ เวลา 09:00 น. ถึง 10:00 น. และเปิดซองประกวดราคา เวลา 10:00 น. ณ ห้องประกวดราคา ชั้น 1 อาคาร ท.137 การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย เชิงสะพานพระราม 7 จังหวัดนนทบุรี

ประกาศ ณ วันที่

(นางสาววัลลภา ชีวธนากรณ์กุล)
หัวหน้ากองจัดซื้อจัดจ้างสายงานระบบส่ง

DRAFT

ตารางแสดงวงเงินงบประมาณที่ได้รับจัดสรรและราคากลาง(ราคาอ้างอิง)

ในการจัดซื้อจัดจ้างที่มิใช่งานก่อสร้าง

1. **ชื่อโครงการ** Bid No. BBS1-DSS-01
   การจัดซื้อ Digital Substation Protection and Automation System
   ระบบส่งไฟฟ้าสำหรับโครงการโรงไฟฟ้าพลังงานแสงอาทิตย์ทุ่นลอยน้ำ
   ร่วมกับโรงไฟฟ้าพลังน้ำเขื่อนภูมิพล ชุดที่ 1
   /หน่วยงานเจ้าของโครงการ ฝ่ายแผนงานและโครงการระบบส่ง การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย

2. **วงเงินงบประมาณที่ได้รับจัดสรร**
   ระบบส่งไฟฟ้าสำหรับโครงการโรงไฟฟ้าพลังงานแสงอาทิตย์ทุ่นลอยน้ำ
   ร่วมกับโรงไฟฟ้าพลังน้ำเขื่อนภูมิพล ชุดที่ 1 งบประมาณ 1,195.40 ล้านบาท

3. **วันที่กำหนดราคากลาง** 22 มกราคม 2569 (วันที่ อวส. อนุมัติ)
   ราคารวมภาษีมูลค่าเพิ่มเป็นเงิน 57,500,000.00 บาท **ราคา/หน่วย** ตามเอกสารแนบ

4. **แหล่งที่มาของราคากลาง**
   หลักเกณฑ์การกำหนดราคากลางการจัดซื้อและจัดจ้างงานก่อสร้างระบบส่งไฟฟ้าของสายงานพัฒนาระบบส่ง

5. **รายชื่อเจ้าหน้าที่ผู้กำหนดราคากลาง**
   5.1 นางวาสนา สุวรรณชีวะศิริ นวร-วช. กวป-ร.
   5.2 น.ส. สิรภัทร ลักขณากุล หชคป-ร. กวป-ร.

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MEDIUM COST FOR BID NO. BBS1-DSS-01

Schedule	Medium Cost (Round) (THB)
1	54,300,000
2	3,200,000
รวม	57,500,000

* Include VAT

นายสมชัย เจริญศรีเกษม
ผู้อำนวยการฝ่ายวิศวกรรมระบบส่ง
22 Jan 2026

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MEDIUM COST FOR BID NO. BBS1-DSS-01

SUMMARY OF BID PRICE

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

No.	Description	Currency	Supply of Equipment DDP EGAT 's Store (excluding VAT) Baht Amount	Foreign Currency Amount	Local Currency (excluding VAT) Baht Amount
1	Schedule 1 : 230 kV Digital Substation Protection and Automation Equipment		40,202,101.00		10,509,075.00
BID PRICE			**Baht 40,202,101.00**		**Baht 10,509,075.00**
VAT			**Baht 2,814,147.07**		**Baht 735,635.25**
SUMMARY OF MEDIUM COST			**Baht 43,016,248.07**		**Baht 11,244,710.25**
SUMMARY OF MEDIUM COST			**Baht 54,260,958.32**		
SUMMARY OF MEDIUM COST (ROUND)			**Baht 54,300,000.00**		

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นายสมชัย เจริญศรีเกษม
ผู้อำนวยการฝ่ายวิศวกรรมระบบส่ง
22 Jan 2026

MEDIUM COST FOR BID NO. BBS1-DSS-01

SUMMARY OF BID PRICE

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

No.	Description	Currency	**Supply of Equipment** DDP EGAT 's Store (excluding VAT) Baht	**Foreign Currency**	**Local Currency** (excluding VAT) Baht
			Amount	Amount	Amount
1	Schedule 2 : 230 kV Fault Recording System		2,603,812.00		387,500.00
BID PRICE			**Baht 2,603,812.00**		**Baht 387,500.00**
VAT			**Baht 182,266.84**		**Baht 27,125.00**
SUMMARY OF MEDIUM COST			**Baht 2,786,078.84**		**Baht 414,625.00**
SUMMARY OF MEDIUM COST			**Baht 3,200,703.84**		
SUMMARY OF MEDIUM COST (ROUND)			**Baht 3,200,000.00**		

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นายสมชัย เจริญศรีเกษม
ผู้อำนวยการฝ่ายวิศวกรรมระบบส่ง
22 Jan 2026

MEDIUM COST FOR BID NO. BBS1-DSS-01

Schedule 1 : 230 kV Digital Substation Protection and Automation Equipment

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Drawing No. / Reference No.	Qty.	Unit	Currency	Supply of Equipment DDP EGAT 's Store (excluding VAT) Baht		Foreign Currency		Local Currency (excluding VAT) Baht	
						Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
1-1	DSS : Digital Substation System	- See Bill of Materials Item 1-1 - Specification No. 1008 - Drawing Nos. BB2-E-1 S H.1/4-4/4, and TP-E-20.3 - This item shall be considered as a major equipment.	1	SET		35,926,649.00	35,926,649.00	XXXXX	XXXXX	XXXXX	XXXXX
1-2	DSS : Spare Parts	- See Bill of Materials Item 1-2 - Specification No. 1008 - This item shall be considered as a major equipment.	1	SET		4,275,452.00	4,275,452.00	XXXXX	XXXXX	XXXXX	XXXXX
1-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 1-1 (as per Section F-4.1 a)		5	Manday		XXXXX	XXXXX			222,000.00	1,110,000.00
1-4	Cost of Technical Advisory online support Supervisor for item 1-1 (as per Section F-4.1 b)		1	Lot		XXXXX	XXXXX			2,526,000.00	2,526,000.00
1-5	Cost of EGAT-Factory Acceptance Test Supervisor for item 1-1 (as per Section F-4.1 e)		45	Manday		XXXXX	XXXXX			75,200.00	3,384,000.00
1-6	Cost of Installation Supervisor for item 1-1 (as per Section F-4.2)		45	Manday		XXXXX	XXXXX			77,535.00	3,489,075.00
Total Price for Schedule 1						**Baht**	**40,202,101.00**			**Baht**	**10,509,075.00**

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นายสมชัย เจริญศรีเกษม
ผู้อำนวยการฝ่ายวิศวกรรมระบบส่ง
22 Jan 2026

MEDIUM COST FOR BID NO. BBS1-DSS-01

Service of Installation Supervisor (Schedule 1)

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Qty.	Unit	Currency	Foreign Currency		Local Currency (excluding VAT) Baht	
					Unit Price	Amount	Unit Price	Amount
1-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 1-1 (as per Section F-4.1 a)	5.00	Manday				222,000.00	1,110,000.00
1-4	Cost of Technical Advisory online support Supervisor for item 1-1 (as per Section F-4.1 b)	1.00	Lot				2,526,000.00	2,526,000.00
1-5	Cost of EGAT-Factory Acceptance Test Supervisor for item 1-1 (as per Section F-4.1 e)	45.00	Manday				75,200.00	3,384,000.00
1-6	Cost of Installation Supervisor for item 1-1 (as per Section F-4.2)	45.00	Manday				77,535.00	3,489,075.00

Note:

1. The total man-days for supervisor shall be the number of days for all complete the activities specified in item 1-3 thru 1-6.
2. In addition to the total man-days above, EGAT will also pay the following :
   a. Travelling time from and to Supervisor's home office as well as travelling time from and to the installation site including ten (10) working days of operation, if any, which will be at the same rate as the cost quoted per man-day.
   b. Airfares round trip economy class between the Supervisor 's home office and Bangkok by the most expeditious and direct route.
3. Local transportation from and to installation site will be provided by EGAT.
4. If the working man-days are less than the total man-days, the payment shall be on the basis of actual man-days.
5. For man-days exceeding the total amount, no payment shall be made by EGAT. Any such additional man-days approved by EGAT shall be paid on the man-days rate.

นายสมชัย เจริญศรีเกษม
ผู้อำนวยการฝ่ายวิศวกรรมระบบส่ง
22 Jan 2026

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MEDIUM COST FOR BID NO. BBS1-DSS-01

Schedule 2 : 230 kV Fault Recording System

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Drawing No. / Reference No.	Qty.	Unit	Currency	**Supply of Equipment** DDP EGAT 's Store (excluding VAT) Baht		**Foreign Currency**		**Local Currency** (excluding VAT) Baht	
						Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
2-1	DSS : Fault Recording System	- See Bill of Materials Item 2-1 - Specification No. 1008 - Drawing Nos. BB2-E-1 SH.1/4-4/4 - This item shall be considered as a major equipment.	1	SET		2,045,137.00	2,045,137.00	XXXXX	XXXXX	XXXXX	XXXXX
2-2	DSS : Spare Parts for Fault Recording System	-Spare DFR equipment is same ordering number as supplied in Bill of Materials Item 2-1 -Specification No. 1008 - This item shall be considered as a major equipment.	1	EA		558,675.00	558,675.00	XXXXX	XXXXX	XXXXX	XXXXX
2-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 2-1 (as per Section F-4.1 a)		5.00	Manday		XXXXX	XXXXX			25,000.00	125,000.00
2-4	Cost of EGAT-Factory Acceptance Test Supervisor for item 2-1 (as per Section F-4.1 e)		5.00	Manday		XXXXX	XXXXX			25,000.00	125,000.00
2-5	Cost of Installation Supervisor for item 2-1 (as per Section F-4.2)		5.00	Manday		XXXXX	XXXXX			27,500.00	137,500.00
Total Price for Schedule 2						**Baht**	**2,603,812.00**			**Baht**	**387,500.00**

นายสมชัย เจริญศรีเกษม
ผู้อำนวยการฝ่ายวิศวกรรมระบบส่ง
22 Jan 2026

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MEDIUM COST FOR BID NO. BBS1-DSS-01

Service of Installation Supervisor (Schedule 2)

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Qty.	Unit	Currency	Foreign Currency		Local Currency (excluding VAT) Baht	
					Unit Price	Amount	Unit Price	Amount
2-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 2-1 (as per Section F-4.1 a)	5.00	Manday				25,000.00	125,000.00
2-4	Cost of EGAT-Factory Acceptance Test Supervisor for item 2-1 (as per Section F-4.1 e)	5.00	Manday				25,000.00	125,000.00
2-5	Cost of Installation Supervisor for item 2-1 (as per Section F-4.2)	5.00	Manday				27,500.00	137,500.00

Note:

1. The total man-days for supervisor shall be the number of days for all complete the activities specified in item 2-3 thru 2-5.
2. In addition to the total man-days above, EGAT will also pay the following :
   a. Travelling time from and to Supervisor's home office as well as travelling time from and to the installation site including ten (10) working days of operation, if any, which will be at the same rate as the cost quoted per man-day.
   b. Airfares round trip economy class between the Supervisor 's home office and Bangkok by the most expeditious and direct route.
3. Local transportation from and to installation site will be provided by EGAT.
4. If the working man-days are less than the total man-days, the payment shall be on the basis of actual man-days.
5. For man-days exceeding the total amount, no payment shall be made by EGAT. Any such additional man-days approved by EGAT shall be paid on the man-days rate.

นายสมชัย เจริญศรีเกษม
ผู้อำนวยการฝ่ายวิศวกรรมระบบส่ง
22 Jan 2026

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Contract No. **Invitation to Bid No. BBS1-DSS-01**

ELECTRICITY GENERATING AUTHORITY OF THAILAND

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BIDDING DOCUMENTS

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

EGAT'S FUND

BIDDER :_____

(2026)

TC-SUPPLY-02 (Rev.2)
(Sep.24)

INVITATION TO BID NO. BBS1-DSS-01

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

EGAT'S FUND

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CONFIRMATION FORM

(INDIVIDUAL COMPANY / JOINT VENTURE)

INVITATION TO BID NO. BBS1-DSS-01

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

By signing in the space provided below, we confirm that:-

- According to "Eligibility of Bidders" and in addition to the Documentary List attached to the bidding documents, we are not a Jointly Interested Bidder with the other bidders as from the date of EGAT's issuance of the subject Invitation and are not a person who undertakes any actions as an "Obstruction of Fair Price Competition".
- According to Article B-8. Information to be Submitted with Bid, we confirm
  - ☐ Registration with the Revenue Department as a value added tax registrant in Thailand as per certificate of value added tax registration (ภพ.20) attached.
  - ☐ Non-Registration as a value added tax registrant in Thailand, but will register later.
  - ☐ Non-Registration as a value added tax registrant in Thailand and will not register.

Confirmed :

……..……

By : ……..……..

Title : ……..…….

Date : ……..……...

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CONFIRMATION FORM

(CONSORTIUM)

INVITATION TO BID NO. BBS1-DSS-01

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Member No. … of the consortium:
By signing in the space provided below, we confirm that:-

- According to "Eligibility of Bidders" and in addition to the Documentary List attached to the bidding documents, we are not a Jointly Interested Bidder with the other bidders as from the date of EGAT's issuance of the subject Invitation and are not a person who undertakes any actions as an "Obstruction of Fair Price Competition".
- According to Article B-8. Information to be Submitted with Bid, we confirm
  - ☐ Registration with the Revenue Department as a value added tax registrant in Thailand as per certificate of value added tax registration (ภพ.20) attached.
  - ☐ Non-Registration as a value added tax registrant in Thailand, but will register later.
  - ☐ Non-Registration as a value added tax registrant in Thailand and will not register.

Confirmed :

……..…….

By : ……..……..

Title : ……..…….

Date : ……..……...

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DISCOUNT FORM
(Excluding VAT)

INVITATION TO BID NO. BBS1-DSS-01

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Bidder : _____

By signing in the space provided below, we confirm that:-

- ☐ we offer no discount.
- ☐ we offer discount(s) as follows:

Details of discount	Currency	Amount

Remarks :

- ***The Bidder shall apply discount(s) on any item(s), schedule(s), or the total price, excluding Value Added Tax (VAT).***
- The above discount(s) shall not be subject to any conditions. Discount with conditions shall not be considered.
- This Discount Form, together with Bidder's Summary of Bid Price, will be publicly presented on a screen to all Bidders in the bid opening room at the time of bid opening.

Confirmed by authorized person(s):

……..…….

By : ……..……..

Title : ……..…….

Date : ……..……...

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Additional Regulation

This Regulation shall apply to the Enquiry, Bid for Supply, Lease, Hire of Work, or Hire of Consultant by Way of Selection.

1. Attachments

   1.1 Definitions
   1.1.1 Jointly Interested Bidder
   1.1.2 Obstruction of Fair Price Competition

   1.2 Documentary List

2. Bidder's Qualifications

   2.1 The Bidder shall professionally be in the business of providing materials or services or leasing or consultancy services, as the case may be, and shall not be named in the list of work abandoners published by the Permanent Secretary, Ministry of Finance, and/or in the debarment list and/or the list of work abandoners declared by EGAT according to Article 5 of this Regulation.

   2.2 The Bidder shall not be a Jointly Interested Bidder with other bidders as from the date of EGAT's issuance of the Invitation for Bid/Enquiry or the Invitation Letter/ Terms of Reference for the consultancy services, as the case may be, or shall not be a person who undertakes any action as an "Obstruction of Fair Price Competition" described in Article 1.1 – Definitions.

   2.3 The Bidder shall not have EGAT's personnel involve in his business as shareholder having voting right that can control his business, director, manager, officer, employee, agent or consultant except for the ones who are officially ordered by EGAT to act or participate therein.

3. Information to be Submitted with Bid

   The Bidder shall submit with his bid the documents according to Article 1.2 - Documentary List, including but not limited to, the following documents :-

   3.1 Where the Bidder is a juristic person :

   (a) ordinary partnership or limited partnership

   a certified copy of affidavit of incorporation, name list of managing partners, list of persons entrusted with controlling power (if any), as well as a certified copy of registration for value added tax (if any).

   (b) limited company or public limited company

   a certified copy of affidavit of incorporation, memorandum of association, name list of managing directors, list of persons entrusted with controlling power (if any) and name list of major shareholders, as well as a certified copy of registration for value added tax (if any).

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Such certified copy of affidavit of incorporation with the validity of not more than six (6) months from the date of certification to the opening date of Bid/Enquiry or the date of Invitation Letter/Terms of Reference in case of consultancy services, as the case may be, shall certify at least the following information :

(i) Type of a juristic person : an ordinary partnership, a limited partnership, a limited company, a public limited company,

(ii) Name according to (i),

(iii) Number and names of managing partners or managing directors,

(iv) Number and names of managing partners or managing directors authorized to act on behalf of the company,

(v) Amount of shareholders' equity or registered capital,

(vi) Authority of managing partner in case of partnership,

(vii) Location of head office,

(viii) Registration purposes,

(ix) Scope of work indicated in business permit license of a foreign juristic person who registers in Thailand,

(x) Other documents e.g. changes or additions to the above documents, branches (if any).

3.2 Where the Bidder is a natural person or a group of persons other than a juristic person :

a certified copy of :
- identity card ***or passport (if non-Thai national)***
- partnership agreement or contract (if any)
- partners' identity cards ***or passport (if non-Thai national)***
- registration required by Ministry of Commerce of Thailand
- registration for value added tax (if any)

3.3 Where the Bidder is a joint venture / consortium :

a certified copy of :
- association agreement
- identity card or passport (if non Thai national)
  (The participant in the joint venture or consortium is <u>not</u> a juristic person.)
- all documents specified in *Item 3.1* of Additional Regulation
  (The participant in the joint venture or consortium is a juristic person.)

3.4 Other documentary evidence as required per *Item 3, 6 or 8* of <u>Documentary List</u> (if any).

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4. Preliminary Examination

4.1 EGAT shall examine the qualification of all bidders to determine whether any bidder is a Jointly Interested Bidder as from the date of EGAT's issuance of the Invitation for Bid/Enquiry or the Invitation Letter/Terms of Reference for the consultancy services, as the case may be, and/or undertakes any action as an "Obstruction of Fair Price Competition" before or during the bid opening. If there is evidence showing that any bidder is a Jointly Interested Bidder or undertakes any action as an "Obstruction of Fair Price Competition", EGAT shall delete his name from the list of bidders and inform such bidder by written notice hereof.

4.2 The Bidder whose name is deleted according to Article 4.1, may, within fifteen (15) calendar days from the date of receipt of EGAT's written notice, appeal to EGAT, explaining reasons together with relevant documents for EGAT's reconsideration.

In case EGAT agrees with the objection of the appellant but considers that the cancellation of enquiry/bidding will be beneficial to EGAT, EGAT may, at its sole discretion, cancel such bid. In the event that the Bidder who undertakes any action as an "Obstruction of Fair Price Competition" does not appeal or, after his appeal, EGAT does not agree with his objection, such Bidder shall be regarded as a work abandoner.

EGAT's decision shall be notified to the appellant in writing and such decision shall be final and conclusive.

5. Reservation of the Right for Proposal and Others

In case any juristic person is regarded as a work abandoner by EGAT and such abandonment is caused by the manager, the managing partner, the managing director, the executive or the person authorized to manage the business of that juristic person, EGAT shall also include his name as a work abandoner.

In case any juristic person is regarded as a work abandoner by EGAT, such decision shall also be applied to other juristic persons of the same business where its manager, managing partner, managing director, executive, or person authorized to manage the business is the same person who is the manager, managing partner, managing director, executive, or person authorized to manage the business of the juristic person who is regarded as a work abandoner by EGAT as aforesaid.

In case any natural person is regarded as a work abandoner by EGAT, such decision shall also be applied to other juristic persons who submit the proposal and have such natural person as the manager, managing partner, managing director, executive or person authorized to manage the business of such juristic persons

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1.1 Definitions

These definitions shall apply to the Enquiry, Bid for Supply, Lease, Hire or Work, or Hire of Consultant by Way of Selection.

1.1.1 ***"Jointly Interested Bidder"*** means a natural person or juristic person who submits bid to EGAT for the supply of goods, lease, hire of work, or hire of consultant by way of selection, as the case may be, and who has an interest, either directly or indirectly, in the business of another natural person or juristic person whose bid is also submitted to EGAT in this bidding.

The interest, either direct or indirect, in another natural person or juristic person as aforesaid includes the relationship in the following manners :

(1) Management relationship, whereby the manager, the managing partner, the managing director, the executive or the person authorized to manage the business of a natural person or a juristic person has the power, or is able to exercise the power, in managing the business of the other one or more natural persons or juristic persons whose bids are also submitted to EGAT in this bidding.

(2) Capital relationship, whereby a partner in an ordinary partnership or a partner with unlimited liability in a limited partnership or a major shareholder in a limited company or a public limited company is a partner in the other one or more ordinary partnerships or limited partnerships, or is a major shareholder in the other one or more limited companies or public limited companies whose bids are also submitted to EGAT in this bidding.

(3) Cross relationship between (1) and (2), whereby the manager, managing partner, managing director, executive or person authorized to manage the business of a natural person or juristic person is a partner in the other one or more ordinary partnerships or limited partnerships, or is a major shareholder in the other one or more limited companies or public limited companies whose bids are also submitted to EGAT in this bidding, or *vice versa*.

"*Major shareholder*" means a shareholder who holds more than twenty five (25) percent of stake in such an enterprise or at another percentage determined by the Governor as he deems expedient for some types or sizes of enterprises.

Holding of position, being a partner or shareholding as aforesaid by the spouse or minor of the person in (1), (2) or (3) shall be deemed the holding of position, being a partner or shareholding by such person.

If any bidder uses the name of another person as the manager, managing partner, managing director, executive, partner or shareholder, but in which case he himself in fact exercises the power in management or he himself is the real partner or shareholder of the partnership or limited company or public limited company, as the case may be, and the related partnership or limited company or public limited company whose bid is also submitted to EGAT in this bidding, that bidder shall be deemed to have a relationship under (1), (2) or (3), as the case may be.

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1.1.2 ***"Obstruction of Fair Price Competition"*** means any act committed by a bidder or bidders causing hindrance or obstruction or impeding the opportunity for fair price competition in the tendering of bid to EGAT, whether done by collusion, or by granting, requesting, or agreeing to grant, demand, accept or agreeing to accept money or property or other benefit or by committing an act of violence or by threatening to commit an act of violence or presenting a false document or doing any act in bad faith, with the objective of acquiring benefit among the other bidders or in order to give benefit to any specific bidder so that such person will be entitled to enter into a contract with EGAT or in order to avoid fair price competition, or in order to take advantage to EGAT which not being usual business practices.

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1.2 Documentary List

This documentary list shall apply to the Enquiry, Bid for Supply, Lease, Hire of Work, or Hire of Consultant by Way of Selection.

		No. of page(s)	For EGAT only	
	Thai National Bidder			
[ ]	1. Where the Bidder is a natural person or a group of persons other than a juristic person			
	( ) (a) Natural Person		Yes	No
	- Certified copy of identity card	……	☐	☐
	( ) (b) Group of persons			
	- Certified copy of partnership agreement or contract (if any)	……	☐	☐
	- Certified copy of identity card(s) of partners or related documents according to Item 2 (a) and (b) of each participant of the group	……	☐	☐
[ ]	2. Where the Bidder is a juristic person			
	( ) (a) Ordinary partnership or limited partnership			
	- Certified copy of affidavit of incorporation	……	☐	☐
	- Name list of managing partners and list of persons entrusted with controlling power (if any) (Please fill in the form on page 10.)	……	☐	☐
	( ) (b) Limited company or public limited company			
	- Certified copy of affidavit of incorporation	……	☐	☐
	- Memorandum of Association	……	☐	☐
	- Name list of managing directors and list of persons entrusted with controlling power (if any) (Please fill in the form on page 10.)	……	☐	☐
	- Name list of major shareholders (Please fill in the form on page 11.)	……	☐	☐
[ ]	3. Other documents (if any)			
	( ) Certified copy of any other registration required by Ministry of Commerce of Thailand	……	☐	☐
	( ) Certified copy of registration for value added tax	……	☐	☐
	( ) …….	……	☐	☐
	( ) ……..	……	☐	☐

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	No. of page(s)	For EGAT only	
Non-Thai National Bidder			
[ ] 4. Where the Bidder is a natural person or a group of persons other than a juristic person			
( ) (a) Natural Person		Yes	No
- Certified copy of passport	……	☐	☐
( ) (b) Group of persons			
- Certified copy of partnership agreement or contract (if any)	……	☐	☐
- Certified copy of passport of partners or related documents according to Item 5 of each participant of the group	……	☐	☐
[ ] 5. Where the Bidder is a juristic person			
- Certified copy of affidavit of incorporation	……	☐	☐
- Name list of managing partners, directors, etc., as the case may be, and list of persons entrusted with controlling power (if any)	……	☐	☐
- Memorandum of Association (if any) (Please fill in the form on page 10.)	……	☐	☐
- Name list of major shareholders (if any) (Please fill in the form on page 11.)	……	☐	☐
[ ] 6. Other documents (if any)			
( ) ……	……	☐	☐
( ) ……	……	☐	☐
( ) ……	……	☐	☐
( ) ……			
( ) ……			

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	No. of page(s)	For EGAT only	
Thai and Non-Thai National Bidder			
[ ] 7. Where the Bidder is a joint venture / consortium		Yes	No
- Certified copy of association agreement	……	☐	☐
( ) (a) If participant of a joint venture / consortium is not a juristic person			
(i) Thai national			
- Certified copy of identity card	……	☐	☐
(ii) Non-Thai national			
- Certified copy of passport	……	☐	☐
( ) (b) If participant of a joint venture / consortium is a Thai-national juristic person			
( ) (i) Ordinary partnership or limited partnership			
- Certified copy of affidavit of incorporation	……	☐	☐
- Name list of managing partners, and list of persons entrusted with controlling power (if any) (Please fill in the form on page 10.)	……	☐	☐
( ) (ii) Limited company or public limited company			
- Certified copy of affidavit of incorporation	……	☐	☐
- Memorandum of Association	……	☐	☐
- Name list of managing directors, and list of persons entrusted with controlling power (if any) (Please fill in the form on page 10.)	……	☐	☐
- Name list of major shareholders (Please fill in the form on page 11.)	……	☐	☐

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	No. of page(s)	For EGAT only	
( ) (c) If member of a joint venture / consortium is a Non-Thai national juristic person		Yes	No
- Certified copy of affidavit of incorporation	……	☐	☐
- Name list of managing partners, directors, etc., as the case may be, and list of persons entrusted with controlling power (if any) (Please fill in the form on page 10.)	……	☐	☐
- Memorandum of Association (if any)	……	☐	☐
- Name list of major shareholders (if any) (Please fill in the form on page 11.)	……	☐	☐
[ ] 8. Other documents (if any)			
( ) Certified copy of any other registration required by Ministry of Commerce of Thailand	……	☐	☐
( ) Certified copy of registration for value added tax in Thailand	……	☐	☐
( ) ……	……	☐	☐
( ) ……	……	☐	☐
( ) ……	……	☐	☐

We hereby confirm that all documents detailed above are true and correct.

Signed

_____

(Name of Bidder)

stamp company seal (if any)

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List of Names of Manager / Managing Partner / Managing Director / Executive /
Person Who Is Authorized to Manage the Business
(Relationship in Management)

Bidder shall fill in and submit this form with his bid

Enquiry / Bid No :……..…. Enquiry / Bid Opening Date : ……...

Name of Company / Partnership / Juristic Person :……

No.	Name – Surname	Position	Name – Surname of Spouse	Name – Surname of Minor

We hereby confirm that all documents submitted are true and correct.

Signed _____
(Name of Bidder)

Stamp company seal (if any)

Remarks
1. The unused wordings shall be struck out.
2. Duplicate this page as necessary.

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List of Partner in Ordinary Partnership / Partner with Unlimited Liability in Limited Partnership /
Major Shareholder in Limited Company or Public Limited Company
(Relationship in Capital)

Bidder shall fill in and submit this form with his bid

Enquiry / Bid No. : ..... Enquiry / Bid Opening Date : .....

Name of Company / Partnership / Juristic Person : .....

Registered Capital : (currency) ..... Number of Share : ..... Price per Share : (currency) .....

No.	Name - Surname	Position	Number of Share (%) or Amount of Shareholder's Equity	Name – Surname of Spouse	Number of Share (%) or Amount of Shareholder's Equity	Name – Surname of Minor	Number of Share (%) or Amount of Shareholder's Equity

We hereby confirm that all documents submitted are true and correct.

Signed_____

(Name of Bidder)

Stamp company seal (if any)

Remarks

1. The unused wordings shall be struck out.
2. "Major Shareholder" means a shareholder who holds more than twenty-five (25) per cent of stake in an enterprise. The shareholding of spouse or minor of a person shall be regarded as being the shareholding of such person. In case of no major shareholder, please specify "No major shareholder" in the tabulation above.
3. Duplicate this page as necessary.
4. The Bidder shall submit List of Names of Manager/ Managing Partner/ Managing Director/ Executive/ Person Who Is Authorized to Manage the Business (Relationship in Management)/ and List of Partner in Ordinary Partnership/ Partner with Unlimited Liability in Limited Partnership/ Major Shareholder in Limited Company or Public Limited Company (Relationship in Capital) of the Bidder as per page 10-11 of this Additional Regulation.

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Important Information

for

Invitation to Bid No. BBS1-DSS-01

The purpose of this section is to inform the Bidders to **carefully study** the details of the revised terms and conditions in the bidding documents. The following provisions have been **recently revised** as stated hereunder:

Article A-5. Preparation and Delivery of Bids and Article B-1. Preparation of Bids

Details on how to prepare the proposal have been revised. Bids shall be prepared in accordance with the Instructions to Bidders contained in the Bidding Documents in one (1) original hard copy and one (1) electronic copy contained in USB flash drive.

Article A-5. Preparation and Delivery of Bids

Details of bid opening time and place shall be specified in the Tentative Schedule.

Article A-6. Availability of Bidding Documents

Availability of Bidding Documents has been changed from CD-ROM to electronic files for download via link provided by EGAT.

Channel of Documents Submission

For channel of document submission in the hereunder Articles, facsimile and telex has been replaced with letters submitted electronically or electronic mails (E-mails).

- Article B-1. Preparation of Bids
- Article B-4. Validity of Bids
- Article D-9. Notices
- Article F-8. Payment

Article E-14. Preparation for Delivery

The Instructions for Packaging attached at the end of Section E. General Conditions has been revised in item 8. Shunt Capacitor Bank.

Article E-15. Shipment

The Maritime Promotion Bureau has been updated to the Maritime Promotion Division and its contact information has also been updated.

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Article F-8. <u>Payment</u>

After each payment is made, the Contractor or beneficiary shall issue and submit the receipt to EGAT as detailed in the paragraph added at the end of this article.

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DATA SHEET

DRAFT

DATA SHEET

for

Invitation to Bid No. BBS1-DSS-01

This section consists of provisions that are specific to each procurement and supplement the information or requirements included in bidding documents.

Article A-1. Invitation

Insert the following as the second and third paragraphs of this article respectively:

" The Letter of Award of Contract to be issued to the successful Bidder will be made after EGAT obtains the Project approval from the Government of Thailand, and the approval for Project implementation from the Government's authority and/or other related entities as required (if any) by Thai laws.

Unless EGAT gets approval as such, the Project and the work under this invitation has to be cancelled. In the event such cancellation is required, all costs incurred by the Bidder in purchasing documents and preparing his bid shall be at his own account and will not be reimbursed by EGAT."

Article B-3. Bid Security

Schedule 1

The amount of bid security shall be THB 3,315,000.-.

Schedule 2

The amount of bid security shall be THB 177,500.-.

Article B-4. Validity of Bids

The validity of the bid shall be for one hundred and fifty (150) Days from the date specified for opening of bid.

Article B-12. Evaluation and Comparison of Bids:

The evaluation of bid prices shall be on schedule basis.

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Article E-27. <u>Failure to Meet Requirements</u> and F-10. <u>Maintenance Guarantee</u>

The contract conditions shall be revised as follows:

EGAT shall have the right to require the Contractor to make any changes in the Equipment or Work covered by this Contract, which may be necessary in the opinion of EGAT, to make the Equipment or Work conform to the requirements of the Contract Documents, without additional cost to EGAT. Any defects in the Equipment or workmanship or other failure, to meet the requirements of the Contract, including errors and omissions on the part of the Contractor, which are disclosed prior to final payment or prior to acceptance by EGAT, or after completion of all tests, whichever occurs at the later date, shall, if so directed by EGAT, be corrected or replaced promptly by the Contractor at the expense of the Contractor.

Any latent defects not disclosed prior to the date of final payment or prior to acceptance or after completion of all tests, whichever occurs at the later date, but disclosed within the guarantee period as specified in Article F-10.a., shall be corrected or replaced promptly by the Contractor at the expense of the Contractor, except that the cost of installation for the replacement parts of the Equipment will be borne by EGAT.

The Contractor shall extend the provisions of his liability to cover all repair and replacement parts furnished under this Article as follows:

(1) All Equipment except Control and Protection Equipment and Fault Recording System

- Any malfunctioning and/or defect found within the guarantee period	:	For a new period of one (1) Year from the day immediately following the date of completion of such repair or replacement

(2) Control and Protection Equipment and Fault Recording System***, as well as Digital Substation Protection and Automation System***

- Any malfunctioning and/or defect found within the first Year of guarantee period	:	For a new period of two (2) Years from the day immediately following the date of completion of such repair or replacement
- Any malfunctioning and/or defect found within the second Year of guarantee period	:	For a new period of one (1) Year from the day immediately following the date of completion of such repair or replacement

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The Contractor shall, if required by EGAT in writing, search under the directions of EGAT for the cause of any defect, imperfection or fault appearing prior to the acceptance of Equipment or in the period of maintenance guarantee. Unless such defect, imperfection or fault shall be one for which the Contractor is liable under the Contract, the cost of the work carried out by the Contractor in searching as aforesaid shall be borne by EGAT. If such defect, imperfection or fault shall be one for which the Contractor is liable under the Contract, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case repair, rectify and make good such defect, imperfection or fault at his own expense.

Article *F-4. <u>Supervision of Installation</u>

The article shall be revised as follows:

F-4. <u>Supervision</u>

The Supervisor assigned to each item as specified in the Price Schedule: Service of Supervisor (Schedule 1) may be the same or different personnel. However, for each specific item, only one (1) Supervisor shall be assigned and shall remain the same personnel, in order to ensure work continuity and prevent disruption. In the event of an accident or force majeure, the Contractor shall notify EGAT within the same day and shall assign a replacement Supervisor within three (3) Days upon EGAT approval. The profile of the replacement Supervisor shall be submitted to EGAT in advance for review and acceptance.

F-4.1 Supervision of Configuration and EGAT-Factory Acceptance Test (E-FAT)

Subject to the desire and decision of EGAT, the Contractor may be required to furnish the services of qualified and experienced supervisor(s) who has at least three years experience on the particular Work required under the Contract and shall be the permanent employee of the manufacturer of the Equipment. ***For works related to 230kV (or lower) Digital Substation Configuration, IEC 61850-based Protection and Control Systems,*** and Substation Automation Systems, the permanent employee of the representative of the manufacturer is acceptable ***refer to <u>Manufacturers and Representatives for Protective Relay list Jan 2023</u>,*** provided that such employee is certified by the manufacturer. Unless otherwise specified, the Contractor shall provide a sufficient number of personnel with the necessary skills to perform the work under this Contract, in accordance with the requirements specified in the Price Schedule and Delivery Schedule

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The scope of responsibility of the supervisor on behalf of the Contractor is as follows:

a. The Contractor shall be responsible for providing an on-site complete product and software Technical instruction and Hands-on guidance (if necessary) of the configuration process and the functionality of the proposed product(s) to be used under this Contract. The description shall include, but not be limited to, the following:

1. Digital substation network configuration, monitoring systems, and product technical related knowledge.

2. Hardware maintenance, troubleshooting, and system recovery procedures

3. Initial software installation, software configuration, system programming, and maintenance practices.

4. Provide training and necessary knowledge related to test tools, test software, and testing procedures to support EGAT in performing system verification and testing activities.

b. Provide Technical Advisory online support for enquiry and technical clarification after completion of the F-4.1 a. activity until thirty (30) Days after the completion of the EGAT-Factory Acceptance Test (hereinafter called "E-FAT") but not later than the tenth (10^{th}) Months after Technical instruction, to ensure that EGAT personnel receive adequate real-time technical guidance. The support shall be available during normal Working Days, (Monday to Friday) from 08.00 to 17.00 UTC+7 (for Foreign supervisor, the time can be adjusted base on both party time zone), with reasonable advance notice in case of Online meeting needed.

c. Supervisor shall Prepare and submit to EGAT a detailed product and software description, which shall include the following:

1. Instruction schedule indicating duration of each session

2. List of topics and time allocations

3. Names, qualifications profile, and experience of the assigned instructors

4. Requirements for classroom space, equipment, and other necessary facilities

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d. Upon completion of the network configuration, the Supervisor shall provide a test procedure of their product and/or software, along with a verification method or solution to demonstrate that the configuration has been correctly implemented.

e. During E-FAT stage, supervisor shall supervise and provide technical advice during the E-FAT.

f. All costs related to the on-site and Technical Advisory online support, including instructor fees, materials, and supporting services, shall be deemed included in the Bid Price.

F-4.2 Supervision of installation and Site Acceptance test

Subject to the desire and decision of EGAT, the Contractor may be required to furnish the services of qualified and experienced supervisor(s) who has at least three years experience on the particular Work required under the Contract and shall be the permanent employee of the manufacturer of the Equipment. ***For 230 kV (or lower) Control and Protection related***, the permanent employee of the representative of the manufacturer is acceptable, provided that such employee is certified by the manufacturer. Unless otherwise specified, the Contractor shall provide a sufficient number of personnel with the necessary skills to perform the work under this Contract, in accordance with the requirements specified in the Price Schedule and Delivery Schedule.

The scope of responsibility of the supervisor on behalf of the Contractor is as follows :

a. Supervise and be responsible for the start-up, field test and commissioning of the Equipment.

b. Prepare formulation sheets for a check list, test sheet, release form and field report to be discussed with EGAT before performing the installation work.

c. Submit one copy of report summarizing the work performance, from the beginning to the completion of the supervisory period, to EGAT within fifteen (15) days after finish the installation work or final inspection. The report shall include the following:

    1. Note on pending matter i.e. faulty and omitted equipment, performance deficiency etc.

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2. Problem concerning installation performance.

3. Photographs showing progress of the installation work periodically until the work is completed.

d. During SAT stage, supervisor shall supervise and provide technical advice during the SAT. The actual testing shall be performed by EGAT.

The Contractor shall, in each and every instance, cooperate fully with the construction personnel installing and/or operating the Equipment and the Work, the operations of the supervisor shall be coordinated with the program of construction at the site as directed by EGAT.

The supervisor shall report at EGAT in Nonthaburi, Thailand, on the date designated by EGAT after a reasonable advance notice from EGAT, and shall remain until the Equipment have been in satisfactory operation for at least ten (10) working days as determined by EGAT, unless released earlier by EGAT.

The installation supervisor must be able to understand, speak, read and write the English language fluently. Should an interpreter be necessary, the cost of such interpretation service shall be at the Contractor's expense.

*If installation supervisor is required as specified in Price Schedule, this provision shall apply to this Contract.

Article F-8. <u>Payment</u>

Payment for Equipment shall be revised as follows :

<u>Payment for Equipment</u>

Payment in local currency will be made directly by EGAT in the following manner:

1. Eighty (80) per cent of the Contract price will be paid on the basis of pro rata value of each delivery against presentation of the Contractor’s statement or delivery order confirming the delivery of Equipment at EGAT’s store duly certified by EGAT’s representative*, EGAT’s letters of approval for delivery, EGAT's letter of approval for test report** of the relevant Equipment including EGAT’s letter(s) of approval for final drawings only for Control and Protection Equipment and Fault Recording System, ***as well as Digital Substation Protection and Automation System.***

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*EGAT's representative means the authorized EGAT's Store personnel to verify the quantity of Equipment according to the packing list to be delivered to the Site.

**Test report means the report of tests specified in Article E-13. Inspection and Tests.

2. Ten (10) per cent of the Contract Price of each Schedule will be paid against presentation of Drawing and Document Acceptance Certificate to be issued by EGAT to certify the receipt of all drawings and documents required from the Contractor under Article F-11. Drawings and Documents to be Furnished by Contractor for such schedule, provided that payment shall not be made until EGAT has received from the Contractor the statement or delivery order and appertaining documents giving evidence of delivery of the main Equipment of that Schedule.

3. Ten (10) per cent of the Contract Price of each Schedule will be paid after the Equipment have been installed, tested and operated or used for a period of 30 Days and the acceptance of the said Equipment has been made by EGAT against presentation of Acceptance Certificate to be issued by EGAT and submission of maintenance security by the Contractor. EGAT will list the minor pending claim(s), if any, and payment will be made by deducting such claimed amount.

However, if, through no fault of the Contractor or of the Equipment, such installation, test and operation or use of the Equipment are delayed beyond a period of six (6) Months after complete delivery at EGAT's store; payment of this ten (10) per cent will be made as soon as possible but not later than the ninth (9^{th}) Month after complete delivery and it shall be deemed as if acceptance of Equipment is made by EGAT at the end of the said sixth (6^{th}) Month and the guarantee period shall start therefrom against submission of maintenance security by the Contractor.

In case there is some minor claim(s) or minor fault of the Contractor, the payment of this ten (10) per cent shall be made by deducting such claimed amount and the guarantee period of this part will start after such minor claim(s) has been settled by the Contractor and acceptance of which has been made by EGAT.

Payment for Service

Payment in foreign currency will be made in the currency or currencies in which the price has been stated in the price schedules. The Contractor has to inform EGAT the mode of payment he requires for payment for foreign currency portion together with detail of bank account No., beneficiary's name and address etc.

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In case the local Contractor requires foreign currency or currencies to be paid directly to him, payment of such foreign currency or currencies will be made to the local Contractor in Thai baht by using the selling exchange rate published by the Bank of Thailand on the payment date.

In case the Contractor requires the payment of foreign currency portion to be made through letter of credit, EGAT will, if there is no fault or any delay caused by the Contractor, establish the letter of credit in the name of the Contractor or Suppliers not later than thirty (30) Days after signing the Contract. The Contractor shall be responsible for all bank charges inside and outside Thailand and including opening, amendment, reimbursing charges, payment commission, cable charges, discrepancy fee, acceptance commission and others (if any) arising from Letter of Credit.

Payment in local currency will be made directly by EGAT.

The Contractor or beneficiary has to inform EGAT by mailed letter or ***letter submitted electronically or by electronic mail (E-mail)*** immediately the date upon which he has received the original letter of credit ***to be*** opened in his favour.

Payment for the services of supervisor will be made within thirty (30) Days after his release by EGAT. Payment will be made on the basis of actual working man-days at the quoted cost per man-day up to a maximum equal to the total man-days quoted. For man-days exceeding the quoted total man-days, no payment shall be made by EGAT unless the Contractor can claim for any delays in the progress of the work caused by EGAT. Any such additional man-days approved by EGAT shall be paid on the basis of the quoted man-day rate.

Payment for Technical advisory online as specified in the Price Schedule: Service of Supervisor in item 1-4 will be made within thirty (30) Days after the completion of work and satisfied by EGAT. The Payment will be made on the basis of Lump sum price.

The number of quoted man-days shall include Sundays and shall cover a seven (7) day workweek, if required by the construction program. The working hours shall be forty-eight (48) hours per week, eight (8) hours per day, the working hours over 8 hours per day if requested by EGAT will be counted as overtime at 1½ times the regular hourly rate.

The amount to be paid for each Day for the services of the supervisor shall include for all salary, subsistence expense, insurance, compensations and personal expense of the supervisor, and all liabilities and responsibilities thereto.

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EGAT will pay for round-trip economy class air transportation for the installation supervisor between the Contractor's home office and Bangkok by the most expeditious and direct route on trip basis by draft after receipt of the Contractor's invoice supported with the used air ticket of such supervisor. The remission of immigration fees and taxes collectible by the Kingdom of Thailand shall not be paid by EGAT, as described in Article E-11. Fees and Duties."

After each payment is made, the Contractor or beneficiary shall issue and submit the receipt to EGAT at e-mail : FFMS@egat.co.th within three (3) calendar days upon receipt of such payment. The details of receipt shall include but not be limited to the following:

- ***Company name and address***
- ***The receipt date of payment***
- ***Lists of Goods/Services the payment is made for***
- ***Payment amount in numbers and in words***
- ***Recipient signature***

Article F-9. Liquidated Damages for Late Delivery of Equipment

The Liquidated Damages shall be at the rate of one-tenth of one (0.10) per cent of the price of each complete Schedule of Equipment not timely delivered for each Day of delay. This sum is payable regardless of the actual loss and/or damages incurred.

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SECTION A

INVITATION TO BID

E L E C T R I C I T Y G E N E R A T I N G A U T H O R I T Y O F T H A I L A N D
Nonthaburi
Thailand

INVITATION TO BID NO. BBS1-DSS-01

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

A-1. Invitation

The Electricity Generating Authority of Thailand (EGAT) hereby invites sealed bids for furnishing and delivering of Digital Substation Protection and Automation System under Transmission System for Hydro-Floating Solar Hybrid Project Bhumibol Dam Unit 1 hereinafter called Equipment in accordance with the terms, conditions and Specifications described in these Bidding Documents.

A-2. Eligibility of Bidders: General Requirements

All Bidders shall meet the following requirements; failure to so comply shall constitute sufficient ground for rejection.

a. The Bidder shall be a partnership, firm or company, either alone or in joint venture or in consortium.

b. The Bidder must have purchased the bidding documents from EGAT. For a joint venture or a consortium, only one (1) member of the joint venture or consortium is required to purchase the bidding documents.

   In case the Bidder's name is not exactly the same as the purchaser's name, the purchaser shall notify EGAT of the name of the Bidder in writing prior to the bid opening time.

c. The Bidder shall be well-established and maintain a permanent place of business. For a joint venture or consortium, all members of the joint venture or consortium are required to meet this qualification.

d. The Bidder shall not be named in the List of Work Abandoners published by the Permanent Secretary, Ministry of Finance, and/or in the Debarment List and/or in the List of Work Abandoners declared by EGAT.

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e. For the Bidder who changes name before submitting the bid, his experience records in previous name shall be considered as the experience records of the Bidder.

f. The Bidder shall not be a Jointly Interested Bidder with other Bidders as from the date of EGAT's issuance of this invitation to bid, or shall not be a person who undertakes any action as an "Obstruction of Fair Price Competition" as defined in Additional Regulation for this invitation.

g. The Bidder shall not either be EGAT's consultant or involve in EGAT's consultancy company under this invitation, or have EGAT's personnel involved in his business as shareholder having voting right that can control his business, director, manager, officer, employee, agent or consultant except the ones who are officially ordered by EGAT to act or participate therein.

h. The Bidder shall not be the person who is privileged or protected not to be taken any legal proceeding under Thai court; provided that such Bidder's government declares that such special privilege is waived.

i. In case of a joint venture or consortium, the Bidder shall carry out all the provision of the Equipment and all Work under such formation from the time of bidding until the fulfillment of the Contract and the parties to the joint venture or the consortium shall accept joint and several liability for performing all obligations under the bid and the Contract.

j. The Bidder shall not propose to supply the Equipment from the country under the state of war whether declared or not.

k. The Bidder shall have adequate fund to meet financial obligations incidental to this Contract.

l. The Bidder shall submit documentary evidence established in accordance with Article B-8. Information to be Submitted with Bid to demonstrate the Bidder's sufficient eligibility to bid and qualification to perform the Contract.

A-3. Eligibility of Bidders: Technical Requirements

I. All Bidders shall meet the following requirements; failure to so comply shall constitute sufficient ground for rejection.

a. The Bidder shall manufacture or supply the Equipment or Work as required under this invitation to bid.

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b. If the Bidder is a new company formed by acquisition of or merger with other companies or business units before submitting the Bid, the experience records of any of such previous companies or business units that meet the requirements set forth herein are acceptable as the experience records of the Bidder.

Reference records of either the parent or affiliated companies shall not be considered as the record of such Bidder.

c. The Bidder shall have no just or proper claims pending against him with respect to breach in the performance of Contract on other similar works awarded by EGAT.

If the Bidder is a new company formed by acquisition of or merger with other companies or business units, the pending claim of any of such previous companies or business units shall be considered as pending claim of the Bidder.

d. The Bidder shall have sufficient capacity to carry out the Work.

e. The Bidder shall propose the Equipment/Works which are manufactured/performed by the qualified manufacturers who shall fulfill the following requirements:

1. Being well-established and maintaining a permanent place of business.

2. Regular manufacturing of the Equipment of the type and similar rating proposed.

3. The manufacturer shall have the experience records that meet the requirements set forth herein.

If the manufacturer is a new company formed by acquisition of or merger with other companies or business units, and any of such previous companies or other business units has the experience records that meet the requirements set forth herein, such experience records are acceptable as the experience records of the new company. However, each Equipment/service to be supplied/performed under this Bid shall be manufactured/provided from the same source of supply and be the same company respectively as indicated in each of such relevant experience records as described in Item I.e.5 thru I.e.11 below. Otherwise, it shall not be acceptable and shall be sufficient grounds for rejection.

For the avoidance of doubt, it is not allowed to combine the experience records of the previous companies or business units in order to meet the experience requirements.

Reference records of either parent or affiliated companies shall not be considered as the records of such manufacturer.

4. The manufacturer shall have no just or proper claims pending against Equipment on other similar works.

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In case the manufacturer is a new company formed by acquisition of or merger with other companies or business units, the pending claim of any of such previous companies or business units shall be considered as pending claim of the manufacturer.

5. For 230 kV Control and Protection Panel and below, having the following qualifications:

   5.1 Being local manufacturer.

   5.2 Having one of the following qualifications:

      5.2.1 Having a letter of acceptance for manufacturing of Control and Protection Boards and/or fabrication of the specific Equipment issued by EGAT within the scope specified therein.

      OR

      5.2.2 Being listed in EGAT ACCEPTED MANUFACTURER LIST FOR CONTROL AND PROTECTION PANEL (LOCAL MANUFACTURER) attached at the end of Section A. Invitation to Bid.

      The design of Equipment layout shall be performed by the manufacturer of control and protection panel under the Substation Control and Protection System Integrator's supervision. However, the design and engineering of the complete substation protection and automation system shall be performed by the Substation Control and Protection System Integrator.

6. For Substation Control and Protection System Integrator, having one of the following qualifications:

   6.1 Having successful experience in EGAT's digital substation.

   OR

   6.2 Having at least two (2) records of practical experience on design and implementation of an IEC 61850 based control and protection system of a complete conventional or GIS with 110 kV or above digital substation (both station bus and process bus) with at least two (2) consecutive years of successful operation in overseas utilities (not his own country).

7. The proposed protective relays shall be the products from the manufacturers as listed in EGAT ACCEPTED MANUFACTURER LIST FOR PROTECTIVE RELAY attached at the end of Section A. Invitation to Bid and shall be in compliance with the details specified in EGAT's Specifications. Type/Model of the proposed protective relays shall be as specified in EGAT ACCEPTED MULTIFUNCTION RELAY LIST attached at the end of Section A. Invitation to Bid.

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8. For Fault Recording System (FRS).

8.1 Having one of the following qualifications:

8.1.1 The cabinet and all Equipment are completely wired by the FRS manufacturer before shipping to Thailand.

OR

8.1.2 The cabinet and the Equipment are wired in Thailand by the local cabinet manufacturer who has one of the following qualifications:

8.1.2.1 Having a letter of acceptance for manufacturing of Control and Protection Boards and/or fabrication of the specific Equipment issued by EGAT within the scope specified therein.

OR

8.1.2.2 Being listed in EGAT ACCEPTED MANUFACTURER LIST FOR CONTROL AND PROTECTION PANEL (LOCAL MANUFACTURER) attached at the end of Section A. Invitation to Bid.

The design and engineering shall be performed by the FRS manufacturer. The assembly, factory test and commissioning shall be in accordance with the FRS manufacturer's standard and shall be performed under the FRS manufacturer's supervisor.

8.2 The proposed FRS shall be the product from the manufacturers as listed in EGAT ACCEPTED MANUFACTURER LIST FOR FAULT RECORDING SYSTEM attached at the end of Section A. Invitation to Bid and shall be in compliance with the details specified in EGAT's Specifications. Type/model of the proposed FRS shall be as specified in EGAT ACCEPTED FAULT RECORDING SYSTEM LIST attached at the end of section A. Invitation to Bid.

9. For supervisory software of IEC 61850 based substation control and protection system:

Having at least one (1) supply record of implementing supervisory software in IEC 61850 based substation control and protection system which comprises at least two (2) manufacturers of protective Intelligent Electronic Device (IED) with successful operation and use of at least one (1) year.

10. For Merging Unit (MU), having one of the following qualifications:

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10.1 Proposing the MU of the type and rating which has already been successfully operated in EGAT's digital substation.

OR

10.2 Proposing the MU from the manufacturers as listed in EGAT ACCEPTED MANUFACTURER LIST FOR PROTECTIVE RELAY (regardless of country) attached at the end of Section A. Invitation to Bid and shall be in compliance with the details specified in EGAT's Specifications.

AND

Having supply records of at least three (3) digital substations (both station bus and process bus) of the type proposed with at least three (3) consecutive years of successful operation at nominal system voltage of 110 kV or above in overseas utilities and/or overseas power generations with total installed capacity of at least 1000 MW (not his own country).

In case of the newly developed or modified type of MU, the detailed information of the development or modification shall be submitted with supply records of at least three (3) digital substations (both station bus and process bus) of the type proposed with at least one (1) consecutive year of successful operation at nominal system voltage of 110 kV or above in overseas utilities and/or overseas power generations with total installed capacity of at least 1000 MW (not his own country). EGAT, however, reserves the right and will make its own judgment whether or not to consider or accept the proposed developed or modified type.

11. For Bay Control Unit (BCU), having one of the following qualifications:

11.1 Proposing the BCU of the type and rating which has already been successfully operated in EGAT's digital substation.

OR

11.2 Proposing the BCU from the manufacturers as listed in EGAT ACCEPTED MANUFACTURER LIST FOR PROTECTIVE RELAY (regardless of country) attached at the end of Section A. Invitation to Bid and shall be in compliance with the details specified in EGAT's Specifications.

AND

Having supply records of at least three (3) digital substations (both station bus and process bus) of the type proposed with at least three (3) consecutive years of successful operation at nominal system voltage of 110 kV or above in overseas utilities and/or overseas power generations with total installed capacity of at least 1000 MW (not his own country).

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In case of the newly developed or modified type of BCU, the detailed information of the development or modification shall be submitted with supply records of at least three (3) digital substations (both station bus and process bus) of the type proposed with at least one (1) consecutive year of successful operation at nominal system voltage of 110 kV or above in overseas utilities and/or overseas power generations with total installed capacity of at least 1000 MW (not his own country). EGAT, however, reserves the right and will make its own judgment whether or not to consider or accept the proposed developed or modified type.

A-4. Joint Venture or Consortium

In the event that the successful Bidder is a joint venture or a consortium formed of two or more companies, EGAT requires that the parties to the joint venture or the consortium accept joint and several liability for all obligations under the Contract.

A-5. Preparation and Delivery of Bids

Bids shall be prepared in accordance with the Instructions to Bidders contained in the Bidding Documents in one (1) original ***hard copy and one (1) electronic copy contained in USB flash drive,*** in English, on the bid forms included for this purpose and shall be accompanied with a bid security as required under Article B-3. Bid Security in a separate sealed envelope.

For preparation of original hard copy, each page of the original hard copy shall be marked with the volume number and the page number in the lower right-hand corner, for example, Volume 1 of 10 and Page 1 of 100.

For preparation of electronic copy, each volume of the signed original hard copy shall be scanned into one (1) PDF file and each PDF file shall be named according to the volume number.

The USB flash drive shall contain electronic files of the proposal in the following formats :-

- ***PDF files of all pages of each volume of the proposal, and***

- ***Excel files of filled-in Proposal Data, and***

- ***Excel files of filled-in Price Schedule***

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In the event of any discrepancy between the original hard copy and the electronic file(s), the original hard copy shall govern.

The envelope of the bids will be marked in capital letters in the lower left-hand corner as follows :

INVITATION TO BID NO. BBS1-DSS-01

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

and shall be addressed and delivered to ***EGAT*** on or before 10:00 a.m., Bangkok Standard Time, *see Tentative Schedule*

If the envelope(s) is not sealed, marked and addressed as required above, EGAT will assume no responsibility for the bid misplacement or premature opening.

Bids will be opened publicly at the ***place and*** time specified ***in Tentative Schedule***.

Bids received after the time stipulated herein shall be rejected and returned unopened.

A-6. Availability of Bidding Documents

The Bidding Documents are available for examination ***and online purchase at http://www4.egat.co.th/fprocurement/biddingeng/*** and can be obtained ***by downloading via link provided by EGAT*** upon payment to EGAT, non-refundable, in the amount of USD - or Baht 300.-. These prices include the value added tax.

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EGAT ACCEPTED FAULT RECORDING SYSTEM LIST

Accepted Type	Manufacturer
IDM+	Qualitrol
M871	GE
7KE85 (*)	Siemens
TESLA 4000 (*)	ERL Phase
TR 2100	Rochester (RIS)
TR 3000 (**)	

Remarks

(*) Applicable to IEC 61850 for both station bus and process bus with the certification issued by the third party laboratory and specifying that the said FRS conforms to "IEC 61850 edition 2 parts 6, 7-1, 7-2, 7-3, 7-4, and 8-1".

(**) Applicable to IEC 61850 only for station bus with the certification issued by the third party laboratory and specifying that the said FRS conforms to "IEC 61850 edition 2 parts 6, 7-1, 7-2, 7-3, 7-4, and 8-1".

Notes

1. The procedures for being listed in EGAT ACCEPTED FAULT RECORDING SYSTEM LIST are specified in the EGAT's Pre-Qualification (PQ) process, of which the details can be provided by Transmission System Engineering Division on request.

2. If any types of FRS in the list are planned to discontinue the manufacturing, the manufacturer or the representative is responsible for informing EGAT at least 1 year before the unavailable date.

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Bidding Document

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ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

EGAT ACCEPTED MANUFACTURER LIST FOR

CONTROL AND PROTECTION PANEL (LOCAL MANUFACTURER)

Description	Manufacturer	Designed by
500 kV Control and Protection Panel	Hitachi Energy (Thailand) Limited	Hitachi Energy (Thailand) Limited
	Precise System and Project Co., Ltd.	Precise System and Project Co., Ltd.
	U-tah Industry Limited Partnership	U-tah Industry Limited Partnership
	SCI Electric Public Company Limited	Siemens Limited
230 kV and below Control and Protection Panel	Hitachi Energy (Thailand) Limited	Hitachi Energy (Thailand) Limited
	C&T Metal Products Co., Ltd.	Easun Reyrolle Limited, India
	Precise System and Project Co., Ltd.	Precise System and Project Co., Ltd.
	U-tah Industry Limited Partnership	U-tah Industry Limited Partnership
	SCI Electric Public Company Limited	SCI Electric Public Company Limited
	Timpano Electrical Co., Ltd.	Timpano Electrical Co., Ltd.
	Mantra Switchgear Co., Ltd.	Siemens Limited

Notes

1. The procedures for being listed in EGAT ACCEPTED MANUFACTURER LIST FOR CONTROL AND PROTECTION PANEL (LOCAL MANUFACTURER) can be provided by Transmission System Planning and Project Division on request.
2. The control and protection panel shall be manufactured and designed by the manufacturer/company written in the same row.

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Bid No. BBY-DSF-01

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14 ตุลาคม 2568

EGAT ACCEPTED MANUFACTURER LIST FOR FAULT RECORDING SYSTEM

Description	Manufacturer / Country
Fault Recording System	Qualitrol / UK
	Siemens / Germany
	Rochester / USA
	GE / USA
	ERL Phase / Canada

DRAFT
BidNo.BBA1-DSS-01

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14 ตุลาคม 2568

EGAT ACCEPTED MANUFACTURER LIST FOR PROTECTIVE RELAY

Description	Manufacturer / Country
Protective Relay	ABB / Sweden, Switzerland, USA
	GE / USA, Canada, Spain, UK
	SEL / USA
	Siemens / Germany, UK
	Toshiba / Japan, Vietnam
	Schneider Electric / France, UK
	ZIV / Spain
	INGETEAM / Spain
	NR Electric / China
	Mitsubishi / Japan
	Protecta / Hungary
	Arcteq / Finland
	Sifang / China

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Bid Document

Sep 2023

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14 ตุลาคม 2568

EGAT Accepted Multifunction Relay List

Manufacturer	Model	87L			21P			21BU			25			79			67			51			50BF			50EF			27/59			81			24			87K/87R/87C			87B (H)			87B (L)			60C (V)			60C (I)			Remark
		500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	
ABB	RED670 (*)																																																
	REL670 (*)																																																
	RET670 (*)																																																
	RET650 (**)																																					*	*	*										
	REB650 (**)																																																
	REB670 (*)																																																
	REB500																																																
	REQ650 (**)										*	*	*																																				* Only product version 2.1 is accepted.
GE	P543 (**)																																																
	L90 (*)																																																
	P443 (*)																																																
	D30																																																
	D60 (*)																																																
	ALPSDA1																																																
	P64x (*)																			**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**	*	*	*										* Only P643, P645 ** Only P643
	T35																																																
	T60 (*)																																																
	P746																			*	*	*	*	*	*	*	*	*																						* Must add 1 Relay for ground unit (More than 6 bays case)
	P740 (*)																																																
	P747																																																
	B90 (**)																																																
	B30																																																* Only for breaker and a half, double bus double breaker or main and transfer bus arrangement
	P14Nx																																																
	P14Dx (**)																																																* Only 3 Pole recloser function ** Only 3-phase breaker failure function
	P841																																															
	P141 (**)																																															
	C60																																															
	F60																																															
	F650 (**)																																															
	SR350																																															

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14 ตุลาคม 2568

Oct 2023

EGAT Accepted Multifunction Relay List

Manufacturer	Model	87L			21P			21BU			25			79			67			51			50BF			50EF			27/59			81			24			87K/87R/87C			87B (H)			87B (L)			60C (V)			60C (I)			Remark
		500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	
GE	DRS															*																																		
	P94Vx																															*	*	*																
	MIV																													*	*																			
	P94V																												*	*	*																			* None of VT input (open delta connection) for 59N.
	P143 (**)															*																																			* Only 3 Pole recloser function
SEL	SEL-311L																																																	
	SEL-411L (*)																																																	
	SEL-421 (*)																																																	
	SEL-311C																																																	
	SEL-387																																							*	*									* 4-restraint
	SEL-487E (*)																																																	
	SEL-587																																																* 2-restraint
	SEL-787 (**)																																															* 4-restraint
	SEL-587Z																																																
	SEL-487B (*)																																																
	SEL-501																																																
	SEL-351A																																																
	SEL-451 (*)																																																
	SEL-751 (**)																																																
	SEL-551																																																
	SEL-751A																																																
Siemens	7SD52 (**)																																																
	7SA522 (**)																																																
	7SA6 Series (**)																																																
	7SA87 (*)																																																
	Duobias (**)																																																
	7UT6 (**)																																							*	*	*								* 5-restraint
	7UT82 (**)																																																* 2-restraint
	7UT86 (*)																																																* 3-restraint
	7SS52 (**)																																																
	7SS60																																																	* Only for breaker and a half, double bus double breaker and main&transfer bus arrangement
	7SS85 (*)																																																
	7VK6 Series (**)																																																

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EGAT Accepted Multifunction Relay List

Manufacturer	Model	87L			21P			21BU			25			79			67			51			50BF			50EF			27/59			81			24			87K/87R/87C			87B (H)			87B (L)			60C (V)			60C (I)			Remark
		500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	
Siemens	7SJ62 (**)																																																
	7SJ85 (*)															*									**																								* Only 3 Pole recloser function ** Only 3-phase breaker failure function
	7SJ61 (**)																																																
	7SJ82 (**)																																																
	7VK61 (**)																																																
	7SL82 (**)																																																
	7SL87 (*)																																																
	7RW80 (**)																																																
	7SA82 (**)																																																
Toshiba	GRZ200 (*)																																																
	GRT200 (*)																																																
	GRD200 (*)																																																
	GRE140																																																
	GRB200 (*)																																																
	GRL200 (*)																																																
Schneider Electric	P543 (*)																																															
	P443 (*)																																															
	P645 (*)																																					*	*	*									* 5-restraint
	P746 (*)																																															
	P740 (**)																																															
	P821																							*	*																								* Only firmware version 1.F is accepted
	P141 (**)																																															
	P143 (**)																																															
	P120																																															
	P122																																															
ZIV	ZLV																																															
	IDV																																															
	IRL																																															
	IRV																																															
Ingeteam	EF-LD (*)																																			*	*	*							**	**	**				* Only 2-step overfluxing relay ** Only for open delta connection
	EF-ZT (*)																																												*	*	*				* Only for open delta connection

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Manufacturer	Model	87L			21P			21BU			25			79			67			51			50BF			50EF			27/59			81			24			87K/87R/87C			87B (H)			87B (L)			60C (V)			60C (I)			Remark
		500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	500 kV	230 kV	115 kV	
Ingeteam	EF-TD (*)																																		*	*	*							**	**	**				* 3-restraint ** Only for open delta connection
	EF-MD (*)																																											*	*	*				* Only for open delta connection
	DA-PT (**)																																											*	*	*				* Only for open delta connection
NR Electric	PCS-931 (*)																																																
	PCS-902 (*)																																																
	PCS-978 (*)																																																
	PCS-9611 (*)																																															*	* Only 1 unbalance input current.
	PCS-978S (*)																																															
	PCS-9611S (*)																																														*	* Only 1 unbalance input current.
	PCS-915SC (*)																																															
Mitsubishi	MRD-HA (**)																																							*										* 3-restraint
	MBP-H1A (**)																																											*	*					* In case of double bus single breaker arrangement, maximum 8 feeders with 1 bus coupler and 2 bus sections are allowed.
Protecta	DTIVA-E3																																															
	DTVA-E1																																															
	DTRV-E2																																															
	DGYD																																															

Remarks

(*) Applicable to IEC 61850 for both station bus and process bus with the certification issued by the third party laboratory and specifying that the said relay conforms to "IEC 61850 edition 2 parts 6, 7-1, 7-2, 7-3, 7-4, and 8-1".

(**) Applicable to IEC 61850 only for station bus with the certification issued by the third party laboratory and specifying that the said relay conforms to "IEC 61850 edition 2 parts 6, 7-1, 7-2, 7-3, 7-4, and 8-1".

Notes

1. The procedures for being listed in EGAT ACCEPTED MULTIFUNCTION RELAY LIST are specified in the EGAT's Pre-Qualification (PQ) process, of which the details can be provided by Transmission System Engineering Division on request.
2. If any types of relay in the list are planned to discontinue the manufacturing, the manufacturer or the representative is responsible for informing EGAT at least 1 year before the unavailable date.
3. The relays shall be configured to comply with all EGAT's required functions.

DRAFT
BIDDING DOCUMENT

เอกสารไม่ควบคุม
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14 ตุลาคม 2568

Oct 2023

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SECTION B

INSTRUCTIONS TO BIDDERS

INSTRUCTIONS TO BIDDERS

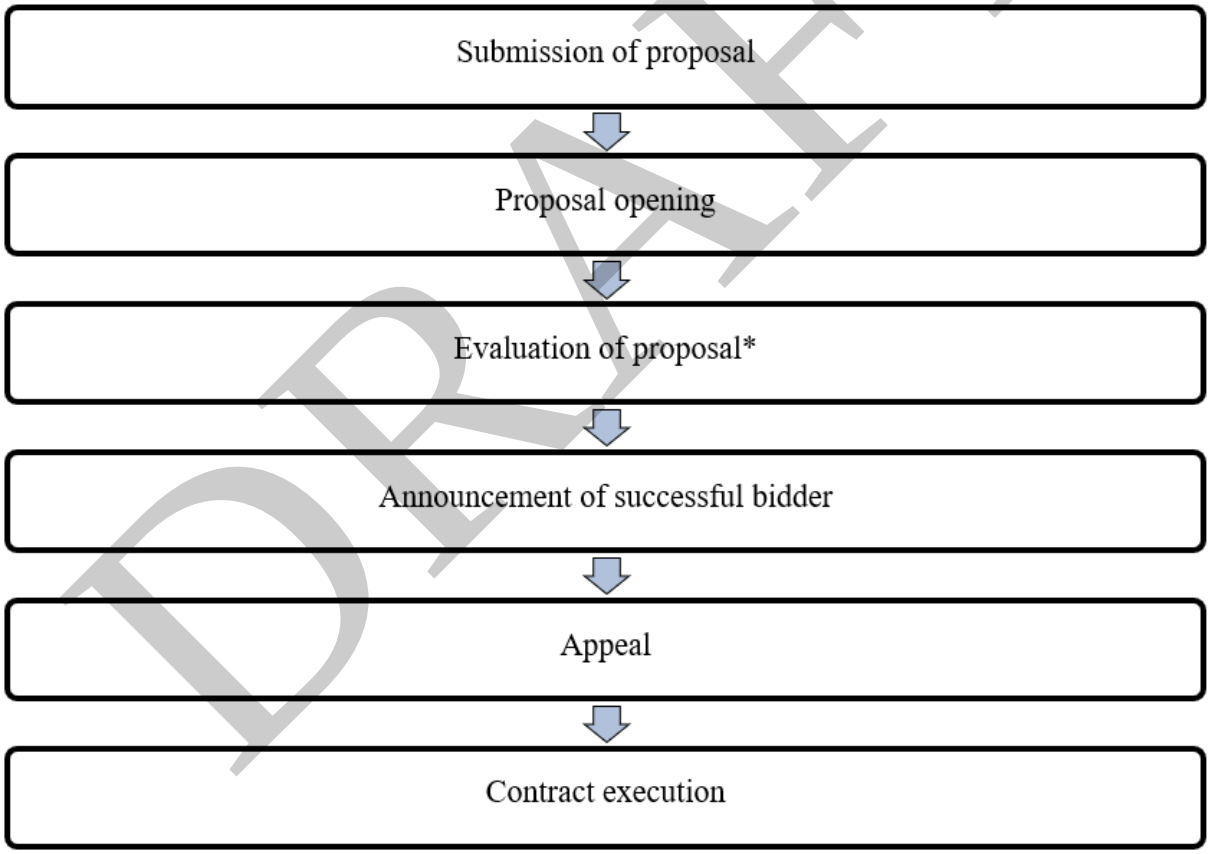
Overview of the Procurement Process

Bid prices and the Contract Price shall include value added tax (VAT) imposed under the law of Thailand. The medium cost announced by EGAT is inclusive of VAT and other relevant expenses.

The amounts of performance security, maintenance security, and liquidated damages shall also be based on the Contract Price which is inclusive of VAT (if any).

For evaluation and comparison of Bids, the bid price shall be evaluated according to the conditions specified in the bidding document.

The procurement process is summarized in the following diagram.



*Remarks

1. The Bidder shall be deemed to have carefully examined all of the terms, conditions and Specifications of the Bidding Documents.
2. EGAT will take into consideration the conformity of the bid to the requirements of the Bidding Documents as well as the suitability for the purpose intended.
3. EGAT will not be bound to accept the bid with the lowest indicated cost. EGAT reserves the right to accept the bid which in its judgement is the lowest evaluated bid.

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B-1. Preparation of Bids

a. Bids shall be prepared in English, in one (1) original ***hard copy clearly marked "Original" and one (1) electronic copy contained in USB flash drive***, submitted at the place and time specified for receipt of bids.

In the event of any discrepancy between ***the original hard copy and the electronic copy, the original hard copy*** shall govern.

For Proposal Data, Bidder shall fill in information of Proposal Data in Excel files contained in the Bidding Documents, and submit one (1) original hard copy with the PDF and Excel files in USB flash drive to EGAT at the same time of bid submission.

For price quotation, Bidder ***shall*** fill ***in*** bid prices in Excel files of Price Schedules contained in the Bidding Documents and submit one (1) original ***hard copy with the PDF and Excel files in USB flash drive*** to EGAT at the same time of bid submission.

VAT at the prevailing rate shall be filled automatically in the Summary of Bid Price of the price schedule in the Excel files subject to Article B-2. Bid Prices.

However, in case Bidder is a consortium formed of two or more companies, Bidder must also submit one (1) original hard copy ***with the PDF and Excel files*** of price schedules of the Work performed by each member of the consortium in addition to hard copies ***with the PDF and Excel files*** of the total bid price as specified above.

If any discrepancy between the bid prices of the Work performed by each member of the consortium and the bid prices of the Bidder occurs, the bid prices of the Bidder shall govern and the bid prices of the Work performed by each member of the consortium shall be adjusted accordingly.

In the event of discrepancy between the original hard copy ***and the PDF or Excel files*** submitted, the original hard copy shall govern.

b. Bidder shall not submit more than two (2) proposals and the proposal(s) to be submitted shall conform to the specifications. In case of any deviation from the specifications, Bidder shall follow the provisions under Article B-9. Deviations from Specifications.

c. The "Original" shall be prepared on the bid forms included and made a part of the Bidding Documents, which shall be submitted with all applicable blanks in the bid forms properly filled in, and shall be manually signed in ink by a person or persons duly authorized. The letter of authorization shall be indicated by written power-of-attorney accompanying the bid.

All pages of the bid, except for unamended printed literature, shall be initialled by the person or persons signing the bid.

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d. The bid shall contain no interlineations, erasures or overwriting except as necessary to correct errors made by the Bidder, in which case such corrections shall be initialled by the person or persons signing the bid.

e. Modification by letter or ***by letter submitted electronically or by electronic mail (E-mail) to*** bids already submitted will be considered if received prior to the time fixed for the receipt of bids. Confirmation by letter of any modification ***evidenced*** by post mark or by ***letter submitted electronically or by electronic mail (E-mail)*** should be sent to EGAT not later than the deadline for submission of Bids.

f. No Bidder will be permitted to alter his bid after the bids have been opened, but clarifications not changing the substance of the bid therein may be accepted.

g. Bidder may quote for any schedule or all schedules as called for, but shall quote for all items of the schedule(s) proposed. Consideration will be made as stipulated in Article B-12. Evaluation and Comparison of Bids.

h. Any price discount to be offered shall be clearly stated in the Discount Form accompanied with the Bid to be submitted on the bid opening date specified herein.

B-2. Bid Prices

Bid prices as shown in Article C-1. Price Schedule shall be firm, not subject to adjustment and payable in the currencies as follows :

Equipment

Prices for Equipment manufactured in Thailand or manufactured outside Thailand (imported Equipment) shall be firm and stated in Thai baht on DDP EGAT's store at the place of destination as specified. Any import duty and taxes (value added tax included) to be assessed by the Government of Thailand at the port of entry on importation of raw material or components for Equipment manufactured in Thailand or on importation of foreign Equipment shall be included in these prices.

Service

a. Prices for services, including installation supervisor (if any), shall be quoted in Thai baht, US dollar, euro, Japanese yen, renminbi (Chinese yuan), or in the Bidder's or Manufacturer's home currency only if his currency trading is prevailed at the time of bidding in any international market other than in Bidder's or Manufacturer's home country.

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If the currencies quoted by the Bidder do not conform to the requirement set forth herein, EGAT reserves the right to convert the bid price to US dollars by using the exchange rate on the Bloomberg screen which is announced at 10.00 a.m. (Bangkok Standard Time) on the bid opening date. Such converted bid price in US dollars shall be treated as the Bidder's proposed bid price. In such case the Contract Price for such portion under the Contract shall be made in US dollars.

Subject to paragraph a. above, in case the Bidder expects to incur a portion of its expenditures in the performance of the Contract in more than one currency and wishes to be paid accordingly, the bid price shall be expressed in different currencies and the respective amount in each currency together making up the total price.

b. Local expenditures shall be quoted in Thai baht.

c. Payments will be made in the currency or currencies in which the bid prices have been stated.

Price Schedule

The Bidder shall enter a unit price, an amount, or a lump sum price, as required, for every item listed in the price schedule. If the unit price as entered does not conform to the amount entered for the same item, the unit price shall govern. If the sum of the amount entered for individual items does not conform to the total amount entered for these amounts under total bid prices, then the sum of the amount entered for the individual items shall govern.

Where quantity and total price only are required, the unit price shall be taken as the stated total price divided by the quantity specified.

VAT at the prevailing rate shall be filled automatically in the Summary of Bid Price of the price schedule in the Excel file. However, the Contract Price shall include VAT only for the portion of Work which is subject to VAT.

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B-3. Bid Security

The original of the bid submitted shall be accompanied with a bid security in the form of a cash deposit, or a cashier cheque issued by a local bank, or a bank guarantee or a letter of guarantee issued only by a local bank or an acceptable financial institution in Thailand, or by a foreign bank counter-guaranteed by a local bank as primary obligor. In case of a cash deposit or a cashier cheque, only Thai baht can be made.

The bid security shall be in a form as per specimen attached or in any other form with essential content in accordance with the specimen, and made payable to EGAT in the amount as specified in Data Sheet. Any bid not being accompanied with bid security shall be rejected. The bid security shall remain in force up to and including ninety (90) Days after the expiry date of the bid validity.

The bid security shall be forfeited in favor of EGAT if :

a. The Bidder withdraws his bid after the bid is opened; or

b. The successful Bidder fails for any reason to execute the Contract or to furnish a performance security.

The Bidder may, upon EGAT's request to extend the bid security when it has expired, refuse to do so without forfeiting the bid security. A Bidder granting the request will be neither required nor permitted to modify his bids.

The bid security of unsuccessful Bidder(s) will be returned as decided by EGAT or within thirty (30) Days following EGAT's acceptance of the successful Bidder.

The bid security of the successful Bidder will be returned upon execution of the Contract and after the performance security furnished has been accepted by EGAT.

B-4. Validity of Bids

The validity of the bid shall be as specified in Data Sheet.

In the event EGAT requires the validity period to be extended, EGAT may in writing or by ***letter submitted electronically or by electronic mail (E-mail)*** so notify the Bidders at least fourteen (14) Days prior to the expiry date of the validity period, in which event any Bidder not agreeing to such request for extension may withdraw his bid by so advising EGAT in writing or by ***letter submitted electronically or by electronic mail (E-mail)*** prior to the expiry date of the original validity period. If the advice of withdrawal shall not have been received by EGAT prior to the said date, the extension shall be deemed to have been accepted by the Bidder, and the Bidder shall be required to extend the effective period of the bid security accordingly.

B-5. Delivery of Bids

Where bids are submitted by mail, the hour and date of receipt of the bid will be taken as that certified by EGAT. For all bids delivered directly, a receipt will be furnished to the Bidder indicating the place, hour, and date of delivery. Late bids will be returned unopened.

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B-6. Withdrawal of Bids

Bids may be withdrawn only on written requests which are received by EGAT prior to the time fixed for the receipt of the bids. Negligence on the part of the Bidder in preparing his bid confers no right for the withdrawal of the bid after it has been opened. Whenever a bid has been withdrawn, it will be returned unopened to the Bidder.

B-7. Interpretation of Bidding Documents before Bid Opening

If a prospective Bidder is in doubt about the true meaning of any part of the Bidding Documents, the Bidder may submit to EGAT a written request for a reply or an interpretation; provided that sufficient time is allowed for a reply to reach the prospective Bidder prior to the date specified for bid opening. An interpretation will be given in the form of a Supplemental Notice furnished to all prospective Bidders. Receipt of all Supplemental Notices shall be acknowledged by each prospective Bidder on the Proposal. Oral interpretation of the Bidding Documents will not be binding.

B-8. Information to be Submitted with Bid

Each Bidder shall submit with his bid the following documents, data and information in English language in addition to any other information called for elsewhere in the Bidding Documents in order to enable EGAT to fully evaluate the Proposal of the Bidder :

a. Name of manufacturer and country of origin and type or model of Equipment he proposes to furnish.

b. Data, drawings, catalogue and descriptive materials which will show equipment arrangement, general dimensions, principles of operation, extent of factory assembly, and the materials from which parts are made.

c. Sufficient references describing the technical experience of the manufacturers, including lists of the Equipment supplied and installed overseas. If possible, certificates issued by the user and/or consulting engineers supporting the said work and record of commercial operation in good condition should also be submitted.

d. Copies of Auditor's certified balance sheet of the Bidder for the past three (3) consecutive years.

e. In case the local manufactured Equipment is proposed, the sufficient documentary evidence, if any, showing that the manufacturers have been acknowledged for producing standard product by the Thai Industrial Standard Institute (TISI), Ministry of Industry, or registered with TISI, or ISO 9000 certified by the National Accreditation

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Council of Thailand (NAC) or obtained the privilege from the Board of Investment or accepted by EGAT for manufacture of such Equipment, is required to be submitted with the Bid.

f. Sufficient evidence documents clearly demonstrating that a firm/company who changes its name, merges with, or acquires other company/companies, or forms a new company by merging its business unit with those of other companies, and the experience records of the new company clearly demonstrating that it has sufficient evidence of running the business as before.

g. A statement of proposed minor deviations from the Specifications along with complete specifications and all necessary descriptive literature for any proposed alternative Equipment or procedure, as required under Article B-9. Deviations from Specifications.

h. Where Proposal Data Forms are provided, the Bidder shall enter all information as directed.

i. Where the Specifications provide for submission of a sample or samples, the Bidder shall submit same together with his bid.

j. Joint Venture/Consortium Agreement with a statement that each member of a joint venture/consortium will be jointly and severally responsible and liable for the complete execution of the work (in case the Bidder is a joint venture or consortium).

k. Confirmation Form of not being a Jointly Interested Bidder with other Bidders and not being a person who undertakes any actions as an Obstruction of Fair Price Competition, and Registration/Non-registration with the Revenue Department as a VAT registrant.

If the Bidder has registered as a VAT registrant, he shall submit EGAT an evidence of VAT registration. On the contrary, if the Bidder is not registered as a VAT registrant, he shall inform EGAT whether he will register as a VAT registrant or not.

In case the Bidder is a consortium, each member of the consortium shall fill in the Confirmation Form provided for consortium Bidders.

l. Filled-in Documentary List and documents required according to Additional Regulation.

Should the Bidder fail to submit any of the document described above and neglect to submit the same to EGAT within the time as specified by EGAT, such failure shall be sufficient reason for rejection of his bid.

Verbal statements made by the Bidder at any time regarding quality, quantity, or arrangement of Equipment will not be considered.

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If alternative Equipment is indicated in the bid, it shall be understood that EGAT will have the option of selecting any one of the alternates so indicated and such selection shall not be a cause for extra compensation or extension of time.

In case the Bidder proposes alternative Equipment, with the condition to supply any one of the alternates so indicated at his option, such bid will be considered conditional and may be considered sufficient reasons for rejection.

B-9. Deviations from Specifications

Unless otherwise provided in the Specifications, the quality of Equipment and workmanship shall comply in all respects with the Standards required under the bidding documents.

If the Bidder proposes any minor deviations from the specifications, he shall submit a statement of each proposed deviation referenced to the particular Article of these specifications, details on the design drawings or article, paragraph and section of referenced standards or specifications. Full details of all minor deviations together with

confirmation shall be submitted with the bid in a form provided in Section C. The Bidder shall submit, with his bid, copies of the standards or specifications proposed for his deviations. In case there is no statement in the form provided in Section C in the Bidder's proposal on the proposed deviations, the bid shall be regarded by EGAT as conforming in all respects to the terms and conditions and Specifications as stated in the bidding documents at no additional cost to the bid price.

Notwithstanding the foregoing, it is at EGAT's sole discretion in determining whether any of such proposed deviations is acceptable and in determining whether it is minor or major deviation.

B-10. Rejection of Bids

EGAT reserves the right not to accept the lowest evaluated bid.

Bids shall be strictly based on the Specifications and terms and conditions in the Bidding Documents. Should any bid fail to comply with the terms and conditions stipulated in these Bidding Documents, especially those under Article pertaining to payment or be incomplete, conditional or obscure, or contain additions not called for, or irregularities of any kind, it will be liable to rejection.

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EGAT also reserves the right to reject any or all bids submitted without giving reason or to reject the bid from any Bidder who fails to satisfy EGAT that the bid complies with the terms and conditions stipulated in these bidding documents without any non-compliance which is deemed substantial and advantageous over other Bidders.

B-11. Delivery Time

Delivery time required is indicated for each respective Price Schedule in the Proposal section of the Bidding Documents, and shall be carefully observed. However, no preference will be given in the bid evaluation for earlier delivery than the stipulated delivery period.

All bids specifying delivery time later than those indicated may be rejected.

B-12. Evaluation and Comparison of Bids

Bid prices pursuant to Article B-2. Bid Prices will be evaluated as follows :

1. The evaluation of bid prices shall be specified in Data Sheet.

2. Bid prices will be converted into Thai baht at the selling exchange rates, published by the Bank of Thailand, www.bot.or.th between baht and other currencies on the bid opening date.

3. The prices to be used for evaluation and comparison purpose shall be as follows:

   1) DDP EGAT's store including VAT for the final sale direct to EGAT.

   2) Cost of services (including installation supervisor) including VAT, if any.

Price for optional items, if any, will not be taken into consideration; however, Bidders shall also quote the prices thereof as required.

B-13. Acceptance of Bids

EGAT will not be bound to accept the bid with the lowest indicated cost. EGAT reserves the right to accept the bid which in its judgement is the lowest evaluated bid. In making its selection, EGAT will take into consideration the conformity of the bid to the requirements of the Bidding Documents and Specifications, guaranteed delivery time, the suitability for the purpose intended and whenever applicable, compensating factors will be applied to deviation or departures from Specifications. EGAT will also take into consideration whether the Bidder's experience, organization, facilities and financial resources will assure the successful carrying out of the Work under the Contract within the time specified.

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B-14. Appeal

Disqualified or unsuccessful Bidders who see that their disqualification or failure are due to EGAT's non-compliance with EGAT's procurement regulations may appeal to EGAT within fifteen (15) Days from the date of receipt or announcement, whichever comes first, of EGAT's final evaluation result. An appeal shall be made in writing and clearly state the cause of appeal and argument with referred facts or regulations and related documents. Appealing does not constitute a ground for suspending the ongoing procurement process unless EGAT's Governor agrees otherwise.

The Contract or Purchase Order shall not be executed until the period of appeal has ended and there is no appeal. In the event there is an appeal during such period, the Contract or Purchase Order shall not be executed unless EGAT's Governor concurs.

Decision of EGAT's Governor is final and conclusive.

B-15. Award of Contract

The Contract will be awarded as soon as practicable after opening of the bids, to the Bidder with the lowest evaluated bid. EGAT reserves the right to award the Contract on the basis of standards and specifications as proposed by the Bidder, if in the opinion of EGAT, they are considered acceptable.

At the time of execution of the Contract, the successful Bidder shall furnish the performance security in accordance with the conditions of Contract in the specimen of performance security provided in the bidding documents.

Failure to comply with the condition as expressed in the specimen of performance security will lead to withdrawal of award and cancellation of Contract, and in this respect EGAT reserves the right to award the Contract to the Bidder with the next lowest evaluated substantially responsive bid and the Bidder who defaults shall have his bid security forfeited in favor of EGAT.

After EGAT notifies the successful Bidder that his bid has been accepted, EGAT will send the Bidder the Contract Documents incorporating all agreements between the parties not later than ninety (90) Days after confirmation of Letter of Award of Contract.

Promptly but not later than fifteen (15) Days after receipt of the Contract, the successful Bidder shall sign and date the Contract and return it to EGAT.

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B-16. Bidder's Responsibility

The Bidder shall be deemed to have carefully examined all of the terms, conditions and Specifications of this Invitation to Bid, and also to have fully informed himself as to all conditions, local or otherwise, affecting the carrying out of the Work of the Contract, and to have formulated an estimate of the facilities available and needed.

The Bidder shall also be liable to any rules and regulations as well as Acts enforced in the Kingdom of Thailand. Failure to do so will be at the Bidder's risk.

B-17. Supplemental Notices

Supplemental Notices to the Bidding Documents may be issued prior to the date of opening of bids to clarify the Bidding Documents or to reflect modifications in the design or Contract terms. Each supplemental notice issued will be distributed to each person or organization to whom the Bidding Documents have been issued. The recipient shall acknowledge receipt of each supplemental notice by signing and returning in a reasonable time the receipt form distributed with the supplemental notice. All supplemental notices issued shall become a part of the Contract Documents.

B-18. Cost of Bidding

Bidders will not be reimbursed for any expenses they may incur in preparing and submitting their bids.

B-19. Cancellation of Bid

EGAT reserves the right not to accept any quantity or item or schedule or package, or to cancel the bid without purchasing any item. Bidders shall not be entitled to claim EGAT for any losses and/or damages in this connection. EGAT also reserves the right to cancel the bid should there be any reasonable grounds that bidder is not in good faith in submitting bid such as submitting false documents.

In case of bid cancellation, EGAT will not be responsible for any losses and/or damages and will not refund payment of Bidding Documents.

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SPECIMEN OF BID SECURITY

Whereas.....(hereinafter called "the Bidder") has submitted his bid dated.....for.....(hereinafter called "the Bid") under Invitation to Bid No.....KNOW ALL MEN by these presents that WE.....of.....having our registered office at.....(hereinafter called "the Guarantor") are bound unto Electricity Generating Authority of Thailand (hereinafter called "EGAT") in the sum of..... (in words : .....) for which payment well and truly to be made to EGAT, the Guarantor binds itself, its successors and assigns by these presents. Sealed with the Common Seal of the said Bank this.....(date).....day of…….(month)……., ……..(year).....

THE CONDITIONS of this obligation are :

1. If the Bidder withdraws his bid during the period of bid validity specified in the Bidding Documents; or

2. If the Bidder, having been notified of the acceptance of his bid by EGAT during the period of bid validity;

   (a) fails or refuses to execute the Contract, if required; or

   (b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders;

We, the Guarantor, unconditionally undertake to pay to EGAT as the primary obligor, up to the above amount upon receipt of its first written demand, without EGAT having to substantiate its demand.

This guarantee will remain in force up to and including ninety (90) Days after the expiry date of the bid validity.

_____

(Signature of the Bank)

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SECTION C

PROPOSAL

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INVITATION TO BID NO. BBS1-DSS-01

PROPOSAL

FOR

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

C-1. Price Schedule

The undersigned Bidder, having carefully examined the Bidding Documents, hereby offers and proposes to perform the services and to furnish the Equipment on the basis of DDP EGAT's store at EGAT Head Office in accordance with all provisions and conditions as described herein, all for the prices stated in the Schedule(s) attached :

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Note : 1. Article E-12. Performance Security

The performance security required under Article E-12. Performance Security shall be ten (10) per cent, round up to the nearest whole number, of the Contract Price. Cost for furnishing the performance security shall be spread over the items proposed.

C-2. Guaranteed Delivery Time

Delivery Time of Equipment is required as indicated in the Delivery Schedule and Distribution List attached. The undersigned Bidder guarantees to make and to complete the delivery of Equipment proposed as required by EGAT.

Whenever the Equipment in any item are sub-itemized, the Contractor shall endeavor not to make partial shipment/delivery by sub-items.

In case of failure on the part of the Contractor to comply with the provision of the above paragraph, it is hereby understood that the Equipment in such particular items shall be deemed undelivered unless and until each all sub-items have been shipped/delivered.

C-3. Drawing and Document Submission Schedule

Drawing and Document Submission Schedule is required as indicated in Article F-11. Drawings and Documents to be Furnished by Contractor. The undersigned Bidder guarantees to submit all drawings and documents as required by EGAT.

C-4. Bid Security

Bid security in the amount of _____ (in words) _____ (number) has been deposited with EGAT.

C-5. Supplemental Notices

The undersigned Bidder certifies that the following Supplemental Notices have been received for the Contract Documents :

_____

_____

_____

_____

_____

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Proposal Submission Date _____Day of _____A.D. _____

Firm's Name _____

By : _____

Title _____

Firm's Address _____

_____

_____

_____

_____

Witness

_____

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PART 1: PRICE PROPOSAL

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PART 1 : PRICE PROPOSAL

PRICE QUOTATION INSTRUCTIONS

This part of the Bidding Document comprises :

1. Summary of Bid Prices
2. Price Schedules

For cost of supply of Equipment, Bidder is allowed to quote price in only Thai baht (THB). For cost of services, including installation supervisor (if any), Bidder is allowed to quote price in Thai baht (THB) or foreign currencies. However, the number of currencies which can be quoted in the price schedule(s) are limited to only four (4) different currencies.

Bidder shall fill in the price schedules in the Excel file(s), item by item. Then, the total prices for each schedule and Summary of Bid Prices will be automatically calculated.

Filling-in the data shall be in accordance with the following instructions :

1. Bidder shall fill in all data required in blue cells of the price schedules – Currency (only for cost of services) and Unit Price.
2. The default currency for cost of supply of Equipment is THB.

Remarks: Price Schedules are created in Microsoft Office Excel 2007.

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INVITATION TO BID NO. BBS1-DSS-01

SUMMARY OF BID PRICE

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

No.	Description	Currency	**Supply of Equipment** DDP EGAT 's Store (excluding VAT) Baht Amount	**Foreign Currency** Amount	**Local Currency** (excluding VAT) Baht Amount
1	Schedule 1 : 230 kV Digital Substation Protection and Automation Equipment				
BID PRICE			**Baht**		**Baht**
VAT			**Baht**		**Baht**
SUMMARY OF BID PRICE			**Baht**		**Baht**

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INVITATION TO BID NO. BBS1-DSS-01

SUMMARY OF BID PRICE

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

No.	Description	Currency	**Supply of Equipment** DDP EGAT 's Store (excluding VAT) Baht	**Foreign Currency** (excluding VAT)	**Local Currency** (excluding VAT)
			Amount	Amount	Amount
1	Schedule 2 : 230 kV Fault Recording System				
BID PRICE			**Baht**		**Baht**
VAT			**Baht**		**Baht**
SUMMARY OF BID PRICE			**Baht**		**Baht**

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INVITATION TO BID NO. BBS1-DSS-01

Schedule 1 : 230 kV Digital Substation Protection and Automation Equipment

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Drawing No. / Reference No.	Qty.	Unit	Currency	**Supply of Equipment** DDP EGAT 's Store (excluding VAT) Baht		**Foreign Currency**		**Local Currency** (excluding VAT) Baht	
						Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
1-1	DSS : Digital Substation System	- See Bill of Materials Item 1-1 - Specification No. 1008 - Drawing Nos. BB2-E-1 S H.1/4-4/4, and TP-E-20.3 - This item shall be considered as a major equipment.	1	SET				XXXXX	XXXXX	XXXXX	XXXXX
1-2	DSS : Spare Parts	- See Bill of Materials Item 1-2 - Specification No. 1008 - This item shall be considered as a major equipment.	1	SET				XXXXX	XXXXX	XXXXX	XXXXX
1-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 1-1 (as per Section F-4.1 a)		5	Manday		XXXXX	XXXXX				
1-4	Cost of Technical Advisory online support Supervisor for item 1-1 (as per Section F-4.1 b)		1	Lot		XXXXX	XXXXX				
1-5	Cost of EGAT-Factory Acceptance Test Supervisor for item 1-1 (as per Section F-4.1 e)		45	Manday		XXXXX	XXXXX				
1-6	Cost of Installation Supervisor for item 1-1 (as per Section F-4.2)		45	Manday		XXXXX	XXXXX				
Total Price for Schedule 1						**Baht**				**Baht**	

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INVITATION TO BID NO. BBS1-DSS-01

Service of Installation Supervisor (Schedule 1)

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Qty.	Unit	Currency	**Foreign Currency**		**Local Currency** (excluding VAT) Baht	
					Unit Price	Amount	Unit Price	Amount
1-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 1-1 (as per Section F-4.1 a)	5.00	Manday					
1-4	Cost of Technical Advisory online support Supervisor for item 1-1 (as per Section F-4.1 b)	1.00	Lot					
1-5	Cost of EGAT-Factory Acceptance Test Supervisor for item 1-1 (as per Section F-4.1 e)	45.00	Manday					
1-6	Cost of Installation Supervisor for item 1-1 (as per Section F-4.2)	45.00	Manday					

Note:

1. The total man-days for supervisor shall be the number of days for all complete the activities specified in item 1-3 thru 1-6.
2. In addition to the total man-days above, EGAT will also pay the following :
   a. Travelling time from and to Supervisor's home office as well as travelling time from and to the installation site including ten (10) working days of operation, if any, which will be at the same rate as the cost quoted per man-day.
   b. Airfares round trip economy class between the Supervisor 's home office and Bangkok by the most expeditious and direct route.
3. Local transportation from and to installation site will be provided by EGAT.
4. If the working man-days are less than the total man-days, the payment shall be on the basis of actual man-days.
5. For man-days exceeding the total amount, no payment shall be made by EGAT. Any such additional man-days approved by EGAT shall be paid on the man-days rate.

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INVITATION TO BID NO. BBS1-DSS-01

Schedule 2 : 230 kV Fault Recording System

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Drawing No. / Reference No.	Qty.	Unit	Currency	**Supply of Equipment** DDP EGAT 's Store (excluding VAT) Baht		**Foreign Currency**		**Local Currency** (excluding VAT) Baht	
						Unit Price	Amount	Unit Price	Amount	Unit Price	Amount
2-1	DSS : Fault Recording System	- See Bill of Materials Item 2-1 - Specification No. 1008 - Drawing Nos. BB2-E-1 SH.1/4-4/4. - This item shall be considered as a major equipment.	1	SET				XXXXX	XXXXX	XXXXX	XXXXX
2-2	DSS : Spare Parts for Fault Recording System	-Spare DFR equipment is same ordering number as supplied in Bill of Materials Item 2-1 -Specification No. 1008 - This item shall be considered as a major equipment.	1	EA				XXXXX	XXXXX	XXXXX	XXXXX
2-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 2-1 (as per Section F-4.1 a)		5.00	Manday		XXXXX	XXXXX				
2-4	Cost of EGAT-Factory Acceptance Test Supervisor for item 2-1 (as per Section F-4.1 e)		5.00	Manday		XXXXX	XXXXX				
2-5	Cost of Installation Supervisor for item 2-1 (as per Section F-4.2)		5.00	Manday		XXXXX	XXXXX				
Total Price for Schedule 2						**Baht**				**Baht**	

DRAFT

INVITATION TO BID NO. BBS1-DSS-01

Service of Installation Supervisor (Schedule 2)

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

Item No.	Description	Qty.	Unit	Currency	**Foreign Currency**		**Local Currency** (excluding VAT) Baht	
					Unit Price	Amount	Unit Price	Amount
2-3	Cost of product and software Technical instruction and Hands-on guidance Supervisor for item 2-1 (as per Section F-4.1 a)	5.00	Manday					
2-4	Cost of EGAT-Factory Acceptance Test Supervisor for item 2-1 (as per Section F-4.1 e)	5.00	Manday					
2-5	Cost of Installation Supervisor for item 2-1 (as per Section F-4.2)	5.00	Manday					

Note:

1. The total man-days for supervisor shall be the number of days for all complete the activities specified in item 2-3 thru 2-5.
2. In addition to the total man-days above, EGAT will also pay the following :
   a. Travelling time from and to Supervisor's home office as well as travelling time from and to the installation site including ten (10) working days of operation, if any, which will be at the same rate as the cost quoted per man-day.
   b. Airfares round trip economy class between the Supervisor 's home office and Bangkok by the most expeditious and direct route.
3. Local transportation from and to installation site will be provided by EGAT.
4. If the working man-days are less than the total man-days, the payment shall be on the basis of actual man-days.
5. For man-days exceeding the total amount, no payment shall be made by EGAT. Any such additional man-days approved by EGAT shall be paid on the man-days rate.

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Breakdown Price
for Schedule 1 : Control and Protection Equipment

No.	Legend	Manufacturer	Type	DDP EGAT 's Store (excluding VAT) Baht
1	Primary Bus Protective IED consists of functions: 87B AND 50BF			
2	Secondary Bus Protective IED consists of functions: 87B AND 50BF			
3	Primary Bus Protective IED consists of functions: 87LB, 67/67N, 51OL AND 50BF			
4	Secondary Bus Protective IED consists of functions: 87LB, 67/67N, 51OL AND 50BF			
5	Primary Line Protective IED consists of functions: 87L, 21, 67N, 67/67N, 81U, 27LS, 51/51G, 51S/51SG, 50BF-1, 50BF-2, 79 AND 25 (Multi-mode)			
6	Primary Line Protective IED consists of functions: 87L, 21, 67N, 67/67N, 81U, 27LS, 51/51G, 51S/51SG, 50BF-1, 50BF-2, 79 AND 25 (Single-Mode)			
7	Primary Line Protective IED consists of functions: 21, 67N, 67/67N, 81U, 27LS, 51/51G, 51S/51SG, 50BF-1, 50BF-2, 79 AND 25			
8	Primary Line Protective IED consists of functions: 87C, 51C/51CG, 50BF-1 AND 50BF-2			
9	Secondary Line Protective IED consists of functions: 87L, 21, 67N, 67/67N, 81U, 27LS, 51/51G, 51S/51SG, 50BF-1, 50BF-2, 79 AND 25 (Multi-mode)			
10	Secondary Line Protective IED consists of functions: 87L, 21, 67N, 67/67N, 81U, 27LS, 51/51G, 51S/51SG, 50BF-1, 50BF-2, 79 AND 25 (Single-Mode)			
11	Secondary Line Protective IED consists of functions: 21, 67N, 67/67N, 81U, 27LS, 51/51G, 51S/51SG, 50BF-1, 50BF-2, 79 AND 25			
12	Secondary Line Protective IED consists of functions: 87C, 51C/51CG, 50BF-1 AND 50BF-2			
13	Primary Transformer Protective IED consists of functions: 87T, 51TH/51THG, 51TL/51TLG, 51TT/51TTG, 51GB-1, 51GB-2,51OL, 59N, 50BF-1, 50BF-2, 81U AND 27LS			
14	Secondary Transformer Protective IED consists of functions: 87T, 51TH/51THG, 51TL/51TLG, 51TT/51TTG, 51GB-1, 51GB-2,51OL, 59N, 50BF-1, 50BF-2, 81U AND 27LS			

DRAFT

Breakdown Price
for Schedule 1 : Control and Protection Equipment

No.	Legend	Manufacturer	Type	DDP EGAT 's Store (excluding VAT) Baht
15	Primary Capacitor Bank Protective IED consists of functions: 60C, 51C/51CG, 59C, 27C AND 50BF			
16	Secondary Capacitor Bank Protective IED consists of functions: 60C, 51C/51CG, 59C, 27C AND 50BF			
17	22/33kV Capacitor Bank Protective IED consists of functions: 60CH, 60CL, 59C AND BCU			
18	Bay Control Unit (BCU)			
19	Swing Rack Blank Panel And Accessories			
20	19" Rack Blank Panel And Accessories			
21	Blank Merging Unit Cubicle And Accessories			
22	Merging Unit Ordering 1			
23	Merging Unit Ordering 2			
24	Merging Unit Ordering 3			
25	Merging Unit Ordering 4			
26	Merging Unit Ordering 5			
27	Merging Unit Ordering 6			
28	Merging Unit Ordering 7			
29	Merging Unit Ordering 8			
30	Merging Unit Ordering 9			
31	Merging Unit Ordering 10			
32	Merging Unit Ordering 11			
33	Merging Unit Ordering 12			
34	DC Undervoltage Relay (27XR, 27XB, 27XM, 27XD)			
35	Switch 4 contacts (43RCC)			
36	Switch 20 contacts (43CCS)			
37	Auxiliary Tripping Relay (94) 10 Contacts			
38	Fiber Distribution Unit (FDU) 48 Ports			
39	Fiber Distribution Unit (FDU) 24 Ports			
40	Pigtails			

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Breakdown Price
for Schedule 1 : Control and Protection Equipment

No.	Legend	Manufacturer	Type	DDP EGAT 's Store (excluding VAT) Baht
41	Patch Cord Cable, Price Per Meter			
42	Transformer Tap Position Transducer (R-TDR)			
43	Temperature Transducer (TEMP-TDR)			
44	DC Voltage Transducer (DC-TDR)			
45	AC Voltage Transducer (AC-TDR)			
46	Current & Potential Test Switch (TS)			
47	Test Switch for Meter			
48	Energy Meter			
49	Computer For Engineering Workstation and Accessories			
50	Computer for HMI Server and Accessories (without Software)			
51	Console Desk And Accessories			
52	12 Core Steel Metallic Optical Fiber (Multimode)			
53	EFLEX and/or HDPE Conduit with HOT-DIP Galvanized Steel Clamp and Accessories			
54	28-Port Ethernet Switch (Without SFP)			
55	100 BaseFX (LC type) SFP			
56	1000 BaseFX (LC type) SFP			
57	GPS Antenna			
58	GPS Receiver			
59	E1(2Mbps) Converter			
60	MCB (Rating 1 A, 1 Pole) With NC Contact			
61	MCB (Rating 1 A, 2 Pole)			
62	MCB (Rating 1 A, 3 Pole) With NC Contact			
63	MCB (Rating 3 A, 2 Pole)			
64	MCB (Rating 3 A, 3 Pole) With NC Contact			
65	MCB (Rating 6 A, 1 Pole)			
66	MCB (Rating 6 A, 2 Pole, 48 VDC)			
67	MCB (Rating 6 A, 2 Pole, 125 VDC)			
68	MCB (Rating 6 A, 2 Pole, 230 VAC)			

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Breakdown Price
for Schedule 1 : Control and Protection Equipment

No.	Legend	Manufacturer	Type	DDP EGAT 's Store (excluding VAT) Baht
69	MCB (Rating 6 A, 2 Pole, 125 VDC) With NC Contact			
70	MCB (Rating 10 A, 2 Pole, 230 VAC)			
71	MCB (Rating 10 A, 2 Pole, 125 VDC) With NC Contact			
72	MCB (Rating 16 A, 2 Pole, 125 VDC) With NC Contact			
73	MCB (Rating ....A, ...Pole)			
74	MCB (Rating ....A, ...Pole) With NC Contact			
75	MCB (Rating ....A, ...Pole) With NC Contact			
76	Terminal Block For Control & VT, CT, Disconnect Knife and Accessories			
77	Inverter			
78	RedBox			
79	Software installed at Engineering Workstation (Program .....)			
80	Software installed at Engineering Workstation (Program .....)			
81	Software installed at Engineering Workstation (Program .....)			

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Breakdown Price

for Schedule 2 : Fault Recording System

No.	Legend	Type	DDP EGAT 's Store (excluding VAT) Baht
1	DFR Equipment		
2	Ethernet Switch for FRS		
3	19" Rack Blank Panel And Accessories		
4	Interfacing ……. Cable , Price Per Meter		
5	Patch Cords Cable , Price Per Meter		
6	Coaxial Cable , Price Per Meter		
7	LAN Cable , Price Per Meter		
8	Configuration Tool (Software)		
9	Auxiliary Relay		
10	Ventilation Fan		
11	MCB (Rating 0.5 A, 3 Pole)		
12	MCB (Rating 6 A, 2 Pole, 125 VDC)		
13	MCB (Rating 6 A, 2 Pole, 230 VAC)		
14	Terminal Block For CT Circuit		
15	Terminal Block For PT Circuit		
16	Terminal Block For Power Supply Circuit		
17	End Section For Terminal Block		
18	End Stop For Terminal Block		
19	Terminal Marker		
20	Marker Holder For End Stop		
21	Switchboard Wire, 1.5 Sq.mm, Gray Color, Price Per Meter		
22	Switchboard Wire, 2.5 Sq.mm, Gray Color, Price Per Meter		

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Breakdown Price
for Schedule 2 : Fault Recording System

No.	Legend	Type	DDP EGAT 's Store (excluding VAT) Baht
23	Terminal Lug		
24	Spiral Wrap		
25	Wiremark		

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PART 2: PROPOSAL DATA

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Proposal Data

Cover page

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"

* If more than one type of equipment is proposed per one proposal data, the bidder shall create additional Excel sheets. For example, if two types of auxiliary relays are used, there must be two PD-16 sheets.
**Please fill in blue cell

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Proposal Data

PD 04 (1/1)

TEMPERATURE TRANSDUCER

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Applied Standards	
c.	Type	
d.	Specify Input RTD Sensor Type	
e.	Temperature Range [°C]	
f.	Rated Output [mA]	
g.	External Load Resistance [kΩ]	
h.	Accuracy [%]	
i.	Response Time [sec]	
j.	Calibrate Adjustment [%]	
k.	Zero Adjustment [%]	

**Please fill in blue cell

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Proposal Data

PD 16 (1/1)

AUXILIARY TRIPPING RELAYS

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Applied Standards	
c.	Type	
d.	Is the Tripping Relay High Burden Type?	[ ] Yes [ ] No
e.	Time to Stable Closing [ms] Operating Time [ms] Bouncing Time [ms]	
f.	Output Contacts Rating at 125 VDC Make and carry 300V for 3 second [A] Make and carry 300V continuously [A] Break for inductive current (L/R £40 ms) [A]	
g.	DC Voltage Rating [A] Operative Voltage Range [V]	
h.	Number of Electrically Separate NO. & CO. Contacts Model -NO -CO Model -NO -CO Model -NO -CO Model -NO -CO	

**Please fill in blue cell

DRAFT

Proposal Data

PD 18.1 (1/1)

PANEL ASSEMBLY FOR CONTROL AND PROTECTION SYSTEM

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Engineering Work	
c.	Blank Panel Maker	[ ] I certify that the manufacturers specified above are in accordance with the EGAT ACCEPTED MANUFACTURER LIST FOR CONTROL AND PROTECTION PANEL (LOCAL MANUFACTURER).
d.	Applied Standards - Dielectric withstand - Insulation Resistance - Temperature Range [°C]	
e.	Type	
f.	The thickness of leveled sheet steel and formed steel members is not less than 2.5 mm. If no, specify the supporting structure method.	[ ] Yes [ ] No
g.	Degree of protection	
h.	Ambient temperature [°C]	
i.	Ambient humidity [%]	
j.	Other equipments [Type / Manufacturer]	
	j1. Test switch	
	- For Control and Protection	/
	- For Metering	/
	j2. Undervoltage Relay	/
	j3. Terminal Block	
	- For AC/DC power supply	/
	- For PT and control circuits	/
	- For CT circuits	/
	- For Alarm/Status circuits and marshalling cabinet	/
	j4. Miniature Circuit Breaker	/
	j5. Switchboard wire	/
k.	Specify type and manufacturer of spectial tool, if needed.	

**Please fill in blue cell

DRAFT

Proposal Data

PD 18.2 (1/1)

PANEL ASSEMBLY FOR FAULT RECORDING SYSTEM

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Engineering Work	
c.	Blank Panel Maker	[ ] I certify that the manufacturers specified above are in accordance with the EGAT ACCEPTED MANUFACTURER LIST FOR CONTROL AND PROTECTION PANEL (LOCAL MANUFACTURER).
d.	Applied Standards - Dielectric withstand - Insulation Resistance - Temperature Range [°C]	
e.	Type	
f.	The thickness of leveled sheet steel and formed steel members is not less than 2.5 mm. If no, specify the supporting structure method.	[ ] Yes [ ] No
g.	Degree of protection	
h.	Ambient temperature [°C]	
i.	Ambient humidity [%]	
j.	Other equipments [Type / Manufacturer]	
	j1. Test switch	
	- For Control and Protection	/
	- For Metering	/
	j2. Undervoltage Relay	/
	j3. Terminal Block	
	- For AC/DC power supply	/
	- For PT and control circuits	/
	- For CT circuits	/
	- For Alarm/Status circuits and marshalling cabinet	/
	j4. Miniature Circuit Breaker	/
	j5. Switchboard wire	/
k.	Specify type and manufacturer of spectial tool, if needed.	

**Please fill in blue cell

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Proposal Data

PD 19 (1/2)

FAULT RECORDING SYSTEM

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Type	
c.	Hardware :	
	c1. Type and capacity of hard disk	
	c2. Easy change every channels between voltage and current channels	[ ] Yes [ ] No
	If No, give detail	
	c3. Automatically short CT when remove an analog isolator module	[ ] Yes [ ] No
	If No, give detail	
	c4. Number of bits for A/D converters	
	c5. Have history log or SER log for maintenance	[ ] Yes [ ] No
	c6. Every digital channel shall be start FRS independently	[ ] Yes [ ] No
	c7. High scan frequency range [Hz]	
	c8. Slow scan frequency range [Hz]	
	c9. Dual scan frequency	[ ] Yes [ ] No
	c10. Prefault time [ms]	
	c11. Postfault time [ms]	
	c12. Event time resolution at least 1 ms	[ ] Yes [ ] No
	c13. Total memory $\geq$ 32 MB for high scan rate	[ ] Yes [ ] No
	c14. Maximum duration per record at 30 Hz scan rate [min]	
	c15. Duration of working (initialization and reset time) inclusion hardware and software [sec]	
	c16. User calculate channel shall be save in configuration file	[ ] Yes [ ] No
	c17. Continuous self diagnostics (watch dog)	[ ] Yes [ ] No
	If No, give detail	
d.	Software :	
	d1. Number of levels to security access (For User) Detail	
	d2. Open many records simultaneously	[ ] Yes [ ] No
	d3. Each channel are displayed on separate axis	[ ] Yes [ ] No
	d4. All waveforms shall be moved to any position	[ ] Yes [ ] No
	d5. Harmonics order	
	d6. Backup & restore the record with OS command (copy & paste)	[ ] Yes [ ] No
	If No, give detail	
	d7. Standard & version of comtrade file	
	d8. Every line shall be calculate power flow	[ ] Yes [ ] No
	d9. Have roll back configuration file when is communicating (remote failure)	[ ] Yes [ ] No
	d10. Have symbolic windows to indicate a status of communication that is success or not	[ ] Yes [ ] No
	d11. Polling period	From _____ to _____
	d12. Formula for the channel calculate function	
	d13. Combining any record in a new file	[ ] Yes [ ] No
	d14. Print chart same on the monitor	[ ] Yes [ ] No

**Please fill in blue cell

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Proposal Data

PD 19 (2/2)

FAULT RECORDING SYSTEM

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
e.	Sensor : e1. Have the starting sensor	
	- Overcurrent staring sensor	[ ] Yes [ ] No
	- Undervoltage staring sensor	[ ] Yes [ ] No
	- Frequency staring sensor	[ ] Yes [ ] No
	- Negative sequence voltage starting sensor	[ ] Yes [ ] No
	- Zero sequence voltage starting sensor	[ ] Yes [ ] No
	- Power swing starting sensor	[ ] Yes [ ] No
	- External start	[ ] Yes [ ] No
	e2. Sensor limit operating time [ms]	
f.	Front Panel : Have a keyboard on front panel to set the FRS	[ ] Yes [ ] No
	If No, give detail	
g.	Panel Assembly : Manufacturer Country of Origin	
h.	Spare parts : List of all recommended spare parts :	
		1. 2. 3. 4. 5. 6.
i.	Service	
	i1. Startup with manufacturer's supervisor	[ ] Yes [ ] No
	i2. Service maintenance	
	- Response time of the after sale service [Days]	
	- Service respresentative in Thailand	[ ] Yes [ ] No
	i3. 2 years warranty period	[ ] Yes [ ] No

**Please fill in blue cell

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Proposal Data

PD 20 (1/1)

CONTROL AND INSTRUMENT SWITCHES

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Applied Standards	
c.	Rated Voltage [V]	
d.	Breaker Control Switches	
	- Type	
	- Color of Handle	
	- Contact Rating Continuous [A]	
	- Is Mechanical Target Provided to Show the Last Function of the Switch?	[ ] Yes [ ] No
e.	Motor-operated Disconnects	
	- Type	
	- Color of Handle	
	- Contact Rating Continuous [A]	
	- Is Mechanical Target Provided to Show the Last Function of the Switch?	[ ] Yes [ ] No
f.	Synchronizing Switches	
	- Type	
	- Color of Handle	
	- Specify Whether the Handle is Removable in "OFF" Position Only	[ ] Yes [ ] No
g.	Recloser Cutoff Switches	
	- Type	
	- Color of Handle	
h.	Trip transfer Switches	
	- Type	
	- Color of Handle	
i.	Voltmeter Selector Switches	
	- Type	
	- Color of Handle	
j.	Differential Cutoff Switches	
	- Type	
	- Color of Handle	
k.	Breaker Failure Cutoff Switches	
	- Type	
	- Color of Handle	
l.	Direct Transfer Trip Cutoff Switches	
	- Type	
	- Color of Handle	
m.	Permissive Transfer Trip Cutoff Switches	
	- Type	
	- Color of Handle	

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Proposal Data

PD 24 (1/1)

OPTIC FIBER CABLE

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	[ ] Single-mode optical fiber	
	1. Country of origin	
	2. OFC type	
	3. ITU-T Recommendation	
	4. Maximum tensile strength [kg]	
	5. Outside diameter [mm]	
	6. Maximum weights [kg/km]	
	7. Bending radius [mm]	
	8. Optic Fiber Attenuation @ 1310 nm [dB/km]	
	9. Optic Fiber Attenuation @ 1550 nm [dB/km]	
	10. Dispersion coefficient @ 1310 nm [ps/(nm.km)]	
	11. Dispersion coefficient @ 1550 nm [ps/(nm.km)]	
	12. Maximum splicing loss per point	
	- OFC with OPGW [dB]	
	- OFC with pigtails [dB]	
	13. Number of fibers [cores]	
	14. Mode field diameter [mm]	
	15. Cladding diameter [mm]	
	16. Mode field concentricity error [mm]	
b.	[ ] Multi-mode optical fiber	
	1 Optical fiber	
	1.1 Type	
	1.2 Standard references	
	1.3 Maximum attenuation coefficient at 850 nm [dB/km]	
	1.4 Maximum attenuation coefficient at 1,300 nm [dB/km]	
	2 Indoor-outdoor cables	
	2.1 Maximum tensile load [N]	
	2.2 Bending radius	
	2.3 Number of fibers [cores]	
	2.4 Outer sheath material	
	3.Patch cords	
	3.1 Length [m]	
	3.2 Connector type	

**Please fill in blue cell

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Proposal Data

PD 27 (1/2)

MERGING UNIT

General

Bidder name	
Bid no.	
Manufacturer	
Country of origin	
Model Type	
Bill of Materials's ordering no.	Ordering n*

A Control and Protection function

Type		Quantity
VMU	Voltage Input	
AMU	Current Input	
DMU	Binary Input	
DMU	Binary Output	
CMU	DC mA Input	

B Communication

Description		IED data
IEC 61850		[ ] Edition 1 [ ] Edition 2 [ ] Edition 2.1
Process bus port	Quantity	
	Redundancy PRP	
	Connector type	
	Wavelength	
Configuration port	Quantity	
	Connector type	
SV	IEC 61850-9-2LE	[ ] Yes _____ samples per cycle [ ] No
	IEC 61869-9	[ ] Yes [ ] No
GOOSE		[ ] Yes [ ] No
MMS		[ ] Yes [ ] No

C Time Synchronization

Topic	IED data
Precision Time Protocol (PTP)	[ ] Yes [ ] No
PTP profile	[ ] IEEE C37.238 [ ] IEC 61850-9-3
Clock type	[ ] transparent clock [ ] ordinary clock (slave only) [ ] ordinary clock (master-capable) [ ] Boundary clock

*The bidder shall create an Excel sheet (PD 27) based on the number of MU orderings proposed in the project.
**Please fill in blue cell

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Proposal Data

PD 27 (2/2)

MERGING UNIT

General

Bidder name	
Bid no.	
Manufacturer	
Country of origin	
Model Type	
Bill of Materials's ordering no.	Ordering n*

D Hardware

Rating		IED data
Current Inputs	Quantity	
	Nominal Current (A)	
	Accuracy Class	
	Processing Delay Time (ms)	
	Burden In (VA)	
Voltage Inputs	Quantity	
	Nominal Voltage (V)	
	Accuracy Class	
	Processing Delay Time (ms)	
	Burden Vn (VA)	
Output Contact	Make and carry 300V for 1 second (A)	
	Make and carry 300V continuously	
	Break for inductive current (L/R < 40 ms) (A)	
	Operating Time (ms)	
	Bouncing Time (ms)	
Current Inputs (Transducer)	Nominal Current (A)	
	Accuracy range	
Watchdog		

Power supply	IED data
125 VDC nominal	
Operating range	

Operating Environment	IED data
Operating environment Temperature	

*The bidder shall create an Excel sheet (PD 27) based on the number of MU orderings proposed in the project.
**Please fill in blue cell

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Proposal Data
PD 28 (1/1)

OUTDOOR MERGING UNIT CUBICLE ASSEMBLY

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Engineering Work	
c.	Blank Panel Maker	
d.	Panel Dimension (Width x Depth x Height) [mm x mm x mm]	
e.	Sheet Steel Thickness [mm]	
f.	Degree of Protection	
g.	Operating Environment - Temperature Range [°C] - Humidity Range [%]	
h.	Cooling/Environment Conditioner System Requirement	[ ] Yes : _(Please Give Details)_ [ ] No
j.	Other equipments [Type / Manufacturer]	
	j1. Test switch	/
	j2. Undervoltage Relay	/
	j3. Terminal Block	
	- For AC/DC power supply	/
	- For PT and control circuits	/
	- For CT circuits	/
	- For Alarm/Status circuits and marshalling cabinet	/
	j4. Miniature Circuit Breaker	/

**Please fill in blue cell

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Proposal Data

PD 29 (1/2)

COMPUTER SET

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"

No.	Specification Detail	Data
a.	Computer Set for HMI server	
	a1. Workstation	
	- Quantity	
	- Main Processor Performance	
	- Memory (RAM)	
	- Storage	
	- Number of Network Ports	
	- Computer Operating System	
	- Power Supply	
	a2. Inverter Power Supply (if any)	
	- Model Type/Manufacturer	
	- Rated Power	
	- Voltage Input	
	- Voltage Output	
	a3. Display Monitor	
	- Model Type/Manufacturer	
	- Quantity	
	- Size	
	- Resolution	
	a4. Mouse	
	- Model Type/Manufacturer	
	- Quantity	
	a5. Keyboard	
	- Model Type/Manufacturer	
	- Quantity	
	a6. Speaker	
	- Model Type/Manufacturer	
	- Quantity	
	a7. List of Supervisory Software	

No.	Software	Version	Description	Minimum Requirement			
				Operating System	CPU	RAM	Storage
1							
2							
3							
4							
5							

**Please fill in blue cell

DRAFT

Proposal Data

PD 29 (2/2)

COMPUTER SET

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"

No.	Specification Detail	Data
b.	Computer Set for Engineering Workstation b1. Device properties - Main Processor Performance - Memory (RAM) - Storage - Number of Network Ports - Computer Operating System - Power Supply b2. Display Monitor - Model Type/Manufacturer - Quantity - Size - Resolution b3. Mouse - Model Type/Manufacturer - Amount b4. Keyboard - Model Type/Manufacturer - Quantity b5. List of Supervisory Software / System Configuration Software	

No.	Software	Version	Description	Minimum Requirement			
				Operating System	CPU	RAM	Storage
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

**Please fill in blue cell

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Proposal Data

PD 32 (1/2)

CONTROL AND PROTECTION IED

General

Bidder name	
Bid no.	
Manufacturer	
Country of origin	
Model Type	
Type of protection/control unit	Type n*

A Control and Protection function

IED must be able to perform all proposed functions at the same time

Class	Function	Quantity
Protection	87B	
	87L	
	87C	
	87K	
	21	
	67N	
	67/67N	
	81U	
	27SD	
	51/51G, 51T/51TG, 51S/51SG, 51C/51CG	
	51GB1	
	51GB2	
	51OL	
	50BF	
	79	
	25	
	59N	
	60C	
	60CH,CL	
	59C	
	27C	
	87R	
	51R/51RG	
	24	
Control	Breaker	
	DS	
	Transformer	

Note Quantity: number of function block available

B Communication

Description		IED data
IEC 61850		[ ] ed.1 [ ] ed.2 [ ] ed.2.1
Process bus port	Quantity	
	Redundancy PRP	
	Connector type	
	Wavelength	
Configuration port	Quantity	
	Connector type	
SV	IEC 61850-9-2LE	[ ] Yes _____ samples per cycle [ ] No
	IEC 61869-9	[ ] Yes [ ] No
GOOSE		[ ] Yes [ ] No
MMS		[ ] Yes [ ] No

*The bidder shall create an Excel sheet (PD 32) based on the number of IED types (such as mutifunction relays and BCUs) proposed in the project.
**Please fill in blue cell

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Proposal Data

PD 32 (2/2)

CONTROL AND PROTECTION IED

General

Bidder name	
Bid no.	
Manufacturer	
Country of origin	
Model Type	
Type of protection/control unit	Type n*

C Time Synchronization

Topic	IED data
Precision Time Protocol (PTP)	[ ] Yes [ ] No
PTP profile	[ ] IEEE C37.238 [ ] IEC61850-9-3
Clock type	[ ] transparent clock [ ] ordinary clock (slave only) [ ] ordinary clock (master-capable) [ ] Boundary clock

D Hardware

I/O type	Quantity
Binary input	
Binary output	
Analog input (transducer)	
Watchdog	

Output Contact Rating at 125VDC	IED data
Make and carry 300V for 3 seconds (A)	
Binary Make and carry 300V continuously (A)	
Break for inductive current (L/R <40 ms) (A)	
Opreating Time (ms)	
Bouncing Time (ms)	

Maximum SV received	
SV stream	

*1 SV stream including 4V and 4I as described in IEC61850-9-2LE

Power supply	Yes/No
125 VDC	
Operating range	

Current Rating	
Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A

E1 Converter (If any)	
Manufacturer / Type	

*The bidder shall create an Excel sheet (PD 32) based on the number of IED types (such as mutifunction relays and BCUs) proposed in the project.
**Please fill in blue cell

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Proposal Data

PD 33 (1/1)

ETHERNET SWITCH & SFP MODULE

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	
Panel No :	

No.	Specification Detail	Data
a.	Ethernet Switch	
	a1. Country of origin	
	a2. Model Type	
	a3. Power Supply	
	- Voltage Input [VDC]	
	- Redundancy	[ ] Yes [ ] No
	a4. Operating Environment	
	- Temperature Range [°C]	
	- Humidity Range [%]	
	a5. Communication Features	
	- Layer of LAN Switch	
	- Speed Bandwidth [Mbps]	
	a6. Communication ports	
	- Number of RJ45 ports	
	- Number of GE (1000Base FX) ports	
	- Number of FE/GE (100/1000Base FX) ports	
	a7. Protocol Standards	
	- IEEE 802.3x: Flow control	[ ] Yes [ ] No
	- IEEE 802.3ad: Link aggregation	[ ] Yes [ ] No
	- IEEE 802.1p: Quality of Service (QoS)	[ ] Yes [ ] No
	- IEEE 802.1Q: VLAN (Virtual LAN)	[ ] Yes [ ] No
	- IEC 61850 GOOSE messaging and SV supported	[ ] Yes [ ] No
	a8. Switching properties	
	- Switching latency [ms @ 100Mbit/s]	
	- MAC address table size	
	a9. Time synchronization protocol	
	- Boundary Clock	[ ] Yes [ ] No
	- Transparent Clock	[ ] Yes [ ] No
	a10. RSTP (Rapid Spanning Tree Protocol)	[ ] Yes [ ] No
	a11. MRP (Media Redundancy Protocol)	[ ] Yes [ ] No
b.	SFP Module for backbone	
	b1. Model Type	
	b2. Bandwidth [Mbps]	
	b3. Connector Type	
	b4. Fiber Optic Type	
	b5. Wavelength [nm]	
c.	SFP Module for IED connections	
	c1. Model Type	
	c2. Bandwidth [Mbps]	
	c3. Connector Type	
	c4. Fiber Optic Type	
	c5. Wavelength [nm]	
d.	SFP Module for IED connections (If any)	
	d1. Model Type	
	d2. Bandwidth [Mbps]	
	d3. Connector Type	
	d4. Fiber Optic Type	
	d5. Wavelength [nm]	

**Please fill in blue cell

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Proposal Data

PD 34 (1/1)

FIBER OPTIC DISTRIBUTION UNIT

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	
Panel No :	

No.	Specification Detail	Data
a.	Country of origin	
b.	Model Type	
c.	Installation	[ ] rack type [ ] wall mounted [ ] _ _ _ _ _ _ _ _ _
d.	Dimension (Width x Depth x Height) [mm x mm x mm]	
e.	Total of Capability [cores]	
f.	Connector type (Snap plate)	

**Please fill in blue cell

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Proposal Data

PD 36 (1/1)

GPS

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Model Type	
c.	Power Supply - Voltage Input [VDC] - Redundancy	 [ ] Yes [ ] No
d.	Operating environment temperature - For instrument - For antenna	
e.	Clock Output Protocol	
f.	Number of ports - Supported PRP and SNTP/NTP Protocol [ports] - Supported PRP and PTP Protocol [ports]	
g.	Time accuracy [ns]	
h.	Maximum length of coaxial cable to remain the above time accuracy [m]	

**Please fill in blue cell

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Proposal Data

PD 37 (1/1)

REDUNDANCY BOX

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Model Type	
c.	Power Supply	
d.	Operating Environment	
	d1. Temperature Range [°C]	
	d2. Humidity Range [%]	
e.	Network connected port	
	e1.Number of ports	
	e2. Bandwidth [Mbps]	
	e3. Connector Type	
	e4. Fiber Optic Type	
	e5. Wavelength [nm]	
f.	IED/computer connected port	
	f1.Number of ports	
	f2. Bandwidth [Mbps]	
	f3. Connector Type	
	f4. Fiber Optic Type	
	f5. Wavelength [nm]	

**Please fill in blue cell

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Proposal Data

PD 38 (1/1)

ENERGY METER

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"
Manufacturer:	

No.	Specification Detail	Data
a.	Country of Origin	
b.	Model Type	
b.	Auxiliary Power Supply Input [VDC]	
c.	Support Parallel Redundancy Protocol (PRP)	[ ] Yes [ ] No
d.	Number of ports d1. Optical type [ports] d2. RS-485 type [ports] d3. Ethernet type [ports]	
e.	Accuracy class	

**Please fill in blue cell

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Proposal Data

PD 39 (1/3)

MAIN PROTECTIVE RELAY LIST

Bidder name:	"Fill in cover page"		
Bid No:	"Fill in cover page"		
No.	Specification Detail	Data for 230 kV and below	Data for 500 kV
A1.	**LOW IMPEDANCE BUS DIFFERENTIAL RELAY (PRIMARY)**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
e.	Single Phase or Three Phase Relay		
f	Specify type of configuration - Maximum feeders per 1 unit - Maximum units per 1 system	[ ] Centralized	[ ] Centralized
A2.	**LOW IMPEDANCE BUS DIFFERENTIAL RELAY (SECONDARY)**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
e.	Single Phase or Three Phase Relay		
f.	Specify type of configuration - Maximum feeders per 1 unit - Maximum units per 1 system	[ ] Centralized	[ ] Centralized
B1.	**CURRENT DIFFERENTIAL RELAY (PRIMARY)**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
e.	Single Phase or Three Phase Relay		
f.	Communication Ports - Customer's Line : Single Mode (Wavelength : 1310 nm) - EGAT's Line : Multimode (Wavelength : 850 nm)	[ ] Yes [ ] No [ ] Yes [ ] No	[ ] Yes [ ] No [ ] Yes [ ] No
B2.	**CURRENT DIFFERENTIAL RELAY (SECONDARY)**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
e.	Single Phase or Three Phase Relay		
f.	Communication Ports - Customer's Line : Single Mode (Wavelength : 1310 nm) - EGAT's Line : Multimode (Wavelength : 850 nm)	[ ] Yes [ ] No [ ] Yes [ ] No	[ ] Yes [ ] No [ ] Yes [ ] No
C1.	**DISTANCE RELAY (PRIMARY)**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
e.	Single Phase or Three Phase Relay		

**Please fill in blue cell

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Proposal Data

PD 39 (2/3)

MAIN PROTECTIVE RELAY LIST

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"

No.	Specification Detail	Data for 230 kV and below	Data for 500 kV
C2.	**DISTANCE RELAY (SECONDARY/ BACK UP)**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
e.	Single Phase or Three Phase Relay		
D.	**DIRECTIONAL OVERCURRENT RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	
E.	**OVERCURRENT RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
F.	**RECLOSING RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Single Phase or Three Phase Relay		
G.	**SYNCHRO-CHECK RELAY (FOR INTERPOSING)**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
H.	**BREAKER FAILURE RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
e.	Single Phase or Three Phase Relay		
f.	End Fault Function	[ ] Yes [ ] No	[ ] Yes [ ] No
I.	**TRANSFORMER DIFFERENTIAL RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Number of Windings Application		
e.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
f.	Single Phase or Three Phase Relay		

**Please fill in blue cell

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Proposal Data

PD 39 (3/3)

MAIN PROTECTIVE RELAY LIST

Bidder name:	"Fill in cover page"
Bid No:	"Fill in cover page"

No.	Specification Detail	Data for 230 kV and below	Data for 500 kV
J.	**REACTOR DIFFERENTIAL RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Number of Windings Application		
e.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A
f.	Single Phase or Three Phase Relay		
K.	**C-BANK FEEDER DIFFERENTIAL RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
d.	Number of Windings Application		
e.	Current Rating	[ ] 1A only [ ] 5A only [ ] settable 1 or 5A	
f.	Single Phase or Three Phase Relay		
L.	**UNDERFREQUENCY RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
M.	**UNDERVOLTAGE RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
N.	**OVERVOLTAGE RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
O.	**UNBALANCE SENSING RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		
P.	**OVERFLUXING RELAY**		
a.	Manufacturer		
b.	Country of Origin		
c.	Type		

**Please fill in blue cell

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DEVIATIONS

The undersigned Bidder confirms that the Proposal submitted by the Bidder

☐ complies with Specifications and commercial terms specified in the Bidding Documents.

☐ contains deviations from Specifications and/or commercial terms specified in the Bidding Documents as listed hereunder (Use continuation sheets, if required):

……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……
……

Confirmed :

Firm : _____

By : _____

Title : _____

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PART 3: DELIVERY SCHEDULE AND DISTRIBUTION LIST

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INVITATION TO BID NO. BBS1-DSS-01

Delivery Schedule and Distribution List

Transmission System for Hydro-Floating Solar Hybrid Project Bhumibol Dam Unit 1

Schedule 1 : 230 kV Digital Substation Protection and Automation Equipment

Item No.	Description	Qty	Job no.	Substation	Delivery Required by EGAT (within months after confirmation of Letter of Award of Contract)
					DDP EGAT's Store
1-1	DSS : Digital Substation System	1	BBS1-01-S01	BHUMIBOL 2 SUBSTATION	8
1-2	DSS : Spare Parts	1	BBS1-01-S01	BHUMIBOL 2 SUBSTATION	8

EGAT's Store = EGAT Head Office

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INVITATION TO BID NO. BBS1-DSS-01

Delivery Schedule and Distribution List

Transmission System for Hydro-Floating Solar Hybrid Project Bhumibol Dam Unit 1

Schedule 2 : 230 kV Fault Recording System

Item No.	Description	Qty	Job no.	Substation	Delivery Required by EGAT (within months after confirmation of Letter of Award of Contract)
					DDP EGAT's Store
2-1	DSS : Fault Recording System	1	BBS1-01-S01	BHUMIBOL 2 SUBSTATION	8
2-2	DSS : Spare Parts for Fault Recording System	1	BBS1-01-S01	BHUMIBOL 2 SUBSTATION	8

EGAT's Store = EGAT Head Office

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SECTION D

CONTRACT

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CONTRACT

SUPPLY OF DIGITAL SUBSTATION PROTECTION AND AUTOMATION SYSTEM

TRANSMISSION SYSTEM FOR HYDRO-FLOATING SOLAR HYBRID PROJECT BHUMIBOL DAM UNIT 1

No._____

This Contract is executed and delivered this_____day of _____, B.E._____(A.D._____), between

ELECTRICITY GENERATING AUTHORITY OF THAILAND

represented by_____ of said Authority , hereinafter called "EGAT", and

_____(Contractor)_____

represented by_____, age_____years, nationality _____, hereinafter called the "Contractor".

EGAT and the Contractor mutually agree as follows :

D-1. Contract Documents

The following documents attached to this Contract are incorporated and made a part of this Contract, as though fully written out and set forth herein :

Data Sheet

A. Invitation to Bid
B. Instructions to Bidders
C. Contract Price, Delivery Time of Equipment and Proposal Data
D. Contract
E. General Conditions
F. Special Conditions
G. Ratings and Features (None)
H. Bill of Materials
I. Specifications
J. Drawings
K. Supplemental Notices

_____

_____

_____

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L. Attachments :

_____

_____

_____

M. Changes :

_____

_____

_____

All of the foregoing documents are referred to herein as the Contract Documents. They are also incorporated into this Contract and made a part hereof all codes, designations, standards, standard specifications and similar Equipment which are referred to in the Specifications and Special Conditions.

D-2. Acceptance of Proposal

EGAT has accepted the proposal of the Contractor for furnishing the Equipment in conformity and in accordance with and subject to all the terms and conditions of these Contract Documents.

D-3. Agreement

The Contractor agrees to sell and EGAT agrees to buy the Equipment as described in these Contract Documents.

D-4. Obligation of Contractor

The Contractor agrees to perform well and faithfully all of the services and to furnish all of the Equipment described in these Contract Documents, and to supply and provide all Equipment, labor and other things requisite for or incidental to the said Work.

D-5. Obligation of EGAT

EGAT agrees, subject to the terms and conditions of these Contract Documents, to pay to the Contractor the amount shown, and at the rates and times and in the manner set forth in these Contract Documents.

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D-6. Mutual Obligations

EGAT and the Contractor mutually agree to perform, fulfill, abide by, and submit to any and all of the provisions and requirements and all matters and things contained or expressed in, or reasonably to be inferred from these Contract Documents.

D-7. Deposit of Performance Security

The Contractor agrees to deposit with EGAT an acceptable performance security in accordance with the Contract Documents.

D-8. Assignment

The Contract or any part thereof shall not be assigned or pledged without the written consent of EGAT, nor shall the Contractor assign or pledge any money due, or to become due, to him hereunder, without the prior written consent of EGAT.

D-9. Notices

All notices called for by the terms of this Contract shall be effective only at the time of receipt thereof and only when received by the parties to whom they are addressed at the following addresses :

EGAT : Governor
Electricity Generating Authority of Thailand
Bangkruai, Nonthaburi 11130
Thailand

Contractor : _____

_____

_____

_____

All notices called for by the terms of this Contract shall be in the form of registered letters or ***letters submitted electronically or electronic mails (E-mails)*** in the English language.

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D-10. Integration

EGAT and the Contractor agree that this Contract, including the Contract Documents, expresses all of the agreements, understandings, promises, and covenants of the parties, and that it integrates, combines, and supersedes all prior and contemporaneous negotiations, understandings, and agreements, whether written or oral, and that no modification or alteration of this Contract shall be valid or binding on either party, unless expressed in writing and executed with the same formality as this Contract, except as may otherwise be specifically provided in this Contract.

D-11. Counterpart

This Contract is executed in two (2) identical counterparts: one (1) for EGAT and one (1) for the Contractor.

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ELECTRICITY GENERATING AUTHORITY OF THAILAND	CONTRACTOR :
BY_____	BY _____
( )	( )
WITNESS :	WITNESS :
BY_____	BY _____
( )	( )

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SECTION E

GENERAL CONDITIONS

GENERAL CONDITIONS

E-1. Definitions

Whenever the following terms are used in the Contract Documents, they will have the following meanings :

EGAT	:	The Electricity Generating Authority of Thailand, having its Head Office at Nonthaburi, Thailand, and its authorized representative or representatives
Engineer	:	Firm or company assigned by EGAT to provide engineering, consulting or construction management services in support of EGAT
Bidder	:	Any person or firm or company or joint venture or consortium of firms submitting bid to EGAT for furnishing the services and Equipment described in the Contract Documents, in response to this Invitation to Bid
Contractor	:	Any person or firm or company or joint venture or consortium of firms including appointed representatives, successors and assignees thereof, whose bid has been accepted by EGAT for furnishing of the services and Equipment described in the Contract Documents
Subcontractor	:	Any person or firm or company (other than the Contractor) to whom any part of the Contract has been sublet, with the consent of EGAT, by the Contractor
Contract	:	The agreement between EGAT and the Contractor, and all Appendices and Schedules thereto including Invitation to Bid, Instructions to Bidders, Proposal, General Conditions, Special Conditions, Specifications, Ratings and Features, Drawings, Supplemental Notices and any other documents referred to in, or connected with the Contract, even though the said documents are issued after execution of the Contract

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Contract Price	:	The sum specified in Section C which is inclusive of VAT (if any) subject to such additions thereto or deductions therefrom as may be made under the provisions hereinafter contained
Equipment	:	Machinery, apparatus, materials, goods, including accessories and spare parts to be supplied under the Contract and specifically described in the Specifications
Work	:	All the work to be done by the Contractor for design manufacture, shop test, transportation and delivery of the Equipment to EGAT's store as agreed, including, if required, supervision for installation at site and supervision for field tests of the Equipment under the Contract
Supervisor (if required)	:	Contractor's employee assigned as installation supervisor including assistant supervisor, to supervise and be responsible for the installation, erection, adjustment, field tests, and commissioning of the Equipment supplied under the Contract
Option (if any)	:	Equipment to be quoted by the Bidder which EGAT reserves the right to accept or omit in whole or in part
Year	:	Calendar year
Month	:	Calendar month
Day	:	Calendar day

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E-2. Intent of Contract Documents

All of the Contract Documents are complementary, and what is called for by one shall be as binding as if called for by all. In the case of any discrepancy between any of the Contract Documents, or any defective description or ambiguity, the matter shall be promptly submitted to EGAT, which shall promptly make a determination in writing. Any adjustment by the Contractor without this determination shall be at the Contractor's own risk and expense. In all cases of discrepancy, defective description, or ambiguities, the interpretation given by EGAT shall be binding on the Contractor, subject to the provisions of Article E-29. Dispute Resolution included in these General Conditions.

E-3. Applicable Law and Legal Jurisdiction

The applicable law of this Contract shall be the law in force in the Kingdom of Thailand. Should there be any ambiguity or discrepancy rising out or in connection with the Contract Documents, the interpretation thereof shall be made in accordance with Thai laws. Any litigations between the parties that may arise out of or in connection with this Contract or the breach or termination thereof or the performance of work thereunder shall be submitted to the Court of Thailand for decision, except as may be otherwise specifically provided in these Contract documents.

E-4. Statutory Requirements

Throughout the continuance of the Contract, the Contractor shall conform to all laws of the Kingdom of Thailand, and to all regulations, by-laws, ordinances, or orders made thereunder, and to the lawful requirements of any public, municipal, or other authority, in any way affecting or applicable to the Contractor or its operations.

E-5. Patents and Copyrights

The Contractor shall indemnify and hold EGAT, its officers, agents, and employees harmless against and from liability of any nature or kind, including costs and expenses for or on account of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article, or appliance manufactured, delivered, or used in carrying out the Work under the Contract. All drawings and the information contained therein as well as the use of any process, material or Equipment developed in the course of carrying out the Work under the Contract shall become the property of EGAT where EGAT shall have the right to use any or all of them for any purpose either for present or future projects. For the avoidance of doubt, none of them will be used solely for any commercial benefit which is not related to EGAT work.

E-6. Subcontracts

The Contractor shall not assign or transfer the Contract or any part thereof or any benefit or interest therein or thereunder, any monies due or become due under this Contract to any other person or persons.

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The Contractor shall not be allowed to subcontract the whole of the Work under this Contract. Subcontracting of any part of the Work shall be subject to the prior written consent of EGAT. Such consent, if given**,** shall not relieve the Contractor from full and entire responsibility under this Contract.

If the Contractor desires to subcontract any part or parts of the Work called for by the Contract, he shall notify EGAT in writing to that effect and shall state in such notice the nature and extent of the part or parts of the Work called for by the Contract proposed to be subcontracted and name of the person proposed as Subcontractor. Unless and until written approval is given by EGAT, approval for which shall not be unreasonably withheld, the Contractor shall not subcontract any part of the Work. All requirements specified in these Contract Documents shall be applicable to Subcontractors also.

No contractual relation shall exist between EGAT and the Subcontractors, and the Subcontractors are not to enjoy any privileges conferred on the Contractor by this Contract.

Any Work done by any Subcontractor who has not been approved by EGAT shall be subject to rejection or stoppage of Work by EGAT. In such case the Contractor cannot claim delay or request for time extension of the Contract completion date and/or make financial claim to EGAT.

E-7. Export Charges

All tariffs, duties and other taxes or charges levied by the country of origin of the Equipment shall be paid by the Contractor, and such expenses shall be included in the cost of the Equipment.

E-8. Customs Clearance, Import Duty and Taxes

The Contractor shall be responsible for customs clearance of the Equipment at the port of entry and transporting the Equipment to EGAT's store. All expenses on customs clearance including godown rent, landing and handling charges shall be paid by the Contractor. The Contractor shall also pay all costs of procuring the necessary permits and licenses for importation into Thailand, and the Contractor shall pay import duty and any taxes (including VAT) imposed at the port of entry on the Equipment to be supplied by the Contractor and imported into Thailand for the Work under the Contract.

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E-9. Value Added Tax

Pursuant to the Revenue Code of Thailand, EGAT shall be responsible and pay when due for the value added tax imposed on the supply of Equipment, including local transportation (if any) and/or on the provision of services under this Contract. EGAT shall in no case be responsible for the value added tax collectible on any payment made by the Contractor under any subcontract or under any other circumstances and the Contractor shall comply with the rules and regulations of the Revenue Code of Thailand.

In case there is any change on the rate of value added tax imposed by the Government of Thailand, the amount of value added tax comprised in the Contract Price shall be adjusted to reflect such change, provided that the price of the Work shall remain unchanged.

E-10. Income and Other Taxes

Income and other taxes assessed or collected by the Government of Thailand, or any subdivision thereof, or any municipality therein on the Contractor and his employees shall be under the responsibility and account of the Contractor.

In accordance with the Revenue Code of Thailand, should the payment under this Contract be subject to income tax and withholding tax of any kind is required to be withheld by EGAT, such withholding tax shall be deducted by EGAT from each payment and EGAT will be responsible to remit such withholding tax to the Revenue Department of Thailand on behalf of the Contractor.

E-11. Fees and Duties

Any and all immigration fees, stamp duties, and other fees, if any, assessed or collected by the Government of Thailand, or by any subdivision thereof, or by any municipality therein, on this Contract, on the Contractor and/or his personnel shall be paid by the Contractor. Any taxes collectible under this Contract, other than those stipulated in this Contract, shall be at the responsibility and account of the Contractor.

The stamp duty for any service contract (Construction, Hire of Work, Consultancy Service, Transportation, Supervisor, etc.) with the Contract value of the service portion lower than baht 200,000.- is required to be affixed by the Contractor on the original copy and the counterpart of the Contract. In case the value of the service portion is baht 200,000.- and over, payment of such stamp duty by the Contractor shall be made in cash to the Revenue Department of Thailand or its authorized subdistrict offices. In either case, the stamp duty

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is required to be affixed or paid, as the case may be, within fifteen (15) Days after the date of Contract execution, otherwise the Contractor shall be liable to pay for any and all penalties imposed for the delay as required by law.

The Contract value of the service portion to be calculated for stamp duty under this provision shall be the price excluding value added tax.

For a foreign Contractor who has no representative in Thailand, EGAT will, upon receipt of written request from the Contractor, affix or pay for stamp duties from EGAT's own fund on behalf of the Contractor, the Contractor is therefore required to reimburse EGAT for such stamp duties plus any and all penalties imposed by law for delay, if such delay is due to Contractor's failure to make written request to EGAT as aforesaid within a reasonable period of time.

If the Contractor fails to reimburse EGAT for any and all amount as required under this Article within the period of time fixed by EGAT, such period not to be shorter than fifteen (15) Days from the date of EGAT's notice for payment, EGAT has the right to claim directly from the Contractor or claim from Performance Security or Maintenance Security, as the case may be, or deduct or setoff from any and all money due to the Contractor under this Contract for the outstanding amount together with interest at the rate of Minimum Overdraft Rate (MOR) plus two (2) per cent calculated from the due date up to the date the payment is made in full.

E-12. Performance Security

The Contractor shall, at the time of execution of the Contract, deposit with EGAT a performance security for the due and proper performance of this Contract in the amount of ten (10) per cent, round up to the nearest whole number, of the total Contract Price. The performance security shall insure payment of any obligations, penalty, damages, liquidated damages, or expenses for which the Contractor may become liable to EGAT.

The amount of the performance security shall be adjusted or the Contractor may deposit a new performance security in the amount of ten (10) per cent, round up to the nearest whole number, of the additional Contract Price to cover the Contractor's obligation in case the Contract Price is increased due to change of the Equipment and/or Work under Article E-19. Changes and Extra or Omitted Work.

The performance security shall be in the form of a cash deposit, or a cashier cheque issued by a local bank, or a bank guarantee or a letter of guarantee issued by a local bank or an acceptable financial institution in Thailand, or by a foreign bank counter-guaranteed by a local bank and made payable to EGAT in the same currency as that of the Contract. In case of a cash deposit or a cashier cheque, only Thai baht portion of the Contract Price

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can be made. EGAT may at any time, upon application by the Contractor, approve the substitution for any performance security held under this Article by other performance security on such terms and conditions as may be approved by EGAT. The Contractor shall bear the cost of the performance security.

The conditions of the guarantor's obligations in the performance security shall include, inter alia, the following:

(1) The guarantor shall unconditionally guarantee, as primary obligor and not as surety merely, payment of any obligations, penalties, damages, liquidated damages, or expenses for which the Contractor may become liable to EGAT.

(2) No extension of time, change in, addition to, or other modification of the terms of the Contract or Work to be performed thereunder, or of the specifications or other Contract Documents shall in anyway release the guarantor from any liability under the performance security, and the guarantor shall thereby waive notice of any such extension of time, change, addition or modification.

(3) The performance security shall be valid and remain in full effect from the date of execution of the Contract until the issuance of the Acceptance Certificate by EGAT or the acceptance of Equipment deemed to be made by EGAT against submission of the Maintenance Security accepted by EGAT.

Unless and until an official receipt is issued in respect to a security deposit, EGAT will not recognize or accept any such deposit as fulfilling the requirements of this Article. Failure to deposit a performance security at the time specified above in this Article or such extended time as may be approved by EGAT shall be a breach of this Contract and EGAT is entitled to terminate the Contract or suspend any payment for Work performed until the performance security has been accepted by EGAT. EGAT shall not be liable for any losses, expenses and/or damages resulting from such payment suspension.

If any performance security furnished under this Article becomes unacceptable to EGAT, or if any guarantor fails to furnish reports as to guarantor’s financial condition from time to time, as requested by EGAT, the Contractor shall promptly furnish such additional or alternative security as may be required by EGAT from time to time to protect the interests of EGAT up to an amount equal to the amount of the security.

In the event of any default or breach of this Contract by the Contractor, EGAT may convert into money any performance security which does not consist of money, and the proceeds shall be deemed to be a cash deposit under this Article. EGAT shall not be liable for any cost, expenses and/or loss incurred in connection with such conversion.

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The performance security, in case of a bank guarantee, or letter of guarantee, shall be in conformity with the specimen acceptable to EGAT as shown herein at the end of these General Conditions.

E-13. Inspection and Tests

All Equipment furnished and all Work performed under this Contract shall be subject to inspection by EGAT or EGAT's authorized representatives at its option while such Work is in progress to ascertain that the completed Work will comply in all respects with the standards and requirements set forth in the Contract Documents. Notwithstanding such inspection, the Contractor will be responsible for the acceptability of the finished Work.

EGAT or EGAT's representatives shall at all times have access to the Work whenever it is in preparation or progress and the Contractor shall provide proper facilities for such access and shall furnish promptly, without additional charge, all facilities, labor and material reasonably needed for safe and convenient inspection by EGAT or EGAT's representatives. The Contractor shall notify EGAT at least two (2) Months in advance when and where the Equipment and the Work will be available for each inspection and test. Any expense incurred by EGAT or EGAT's representatives to inspect the Equipment and the Work or to attend the test caused by false call of the Contractor for inspection and tests shall be borne by the Contractor.

If any Work should be covered up, or otherwise made inaccessible, without the approval of EGAT, it shall, if required by EGAT, be uncovered and made accessible for examination. Any such cover, which is required in the finished Work, shall be restored to EGAT's satisfaction at the Contractor's expense.

The acceptance of any Work or Equipment covered by these Contract Documents, or the making or waiving of any inspection or witnessing of any tests shall in no way relieve the Contractor of full responsibility for the quality, character and satisfactory operation and performance of the complete Work, and every part of it, as outlined in these Contract Documents, nor shall it prejudice or affect the rights of EGAT as set forth in the Contract.

Unless otherwise specifically provided in the Contract, the expenses directly required for all labor, tools, instruments, other materials and Equipment necessary for performance of the tests shall be borne by the Contractor.

The Contractor shall at his own expense conduct shop tests in accordance with the Specifications and submit the results of the tests to EGAT upon completion of tests. EGAT reserves the right to inspect all Equipment either in person or via video conference

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during its manufacture or fabrication and prior to its preparation for shipment, to inspect its packing when ready for shipment, and to witness any or all tests.

In the event the results of the tests do not satisfy the requirements of the Specifications or the guaranteed performance, the Contractor shall rectify to improve the Equipment until satisfactory results are obtained and shall conduct all necessary retests at his own expense.

Any delay in delivery due to the retest shall not constitute a release of the Contractor from his responsibility for delay. Any expenses incurred by EGAT in attending these retests shall be borne by the Contractor.

EGAT reserves the right to send one or more of EGAT's employees, not as inspectors, to the Contractor's plant to witness the fabrication, assembly and testing of any or all parts of the Equipment being furnished under this Contract. Travelling expenses and per diem of such employee or employees shall be borne by EGAT.

E-14. Preparation for Delivery

The Contractor shall submit delivery schedule for EGAT's approval at least thirty (30) Days in advance before each delivery is made. No delivery shall be made prior to EGAT's approval which will be notified to the Contractor within fifteen (15) Days after receipt of the said delivery schedule.

All imported and local Equipment to be delivered under this Contract shall be satisfactorily packaged in such a manner to protect them from damage during transportation and for outdoor storage at the site in hot, wet, humid and dusty conditions. In addition, the imported Equipment shall also be satisfactorily packaged for moist tropical ocean shipment. Where necessary, heavy parts shall be mounted on skids so that cable slings for handling can readily be attached. Where it is unsafe to apply external slings to a package, attached slings shall be provided and shall project through the package so that attachment can readily be made.

In order to keep the damage to non-water proof Equipment during the transportation at minimum level, the Contractor and/or supplier is required to put an umbrella mark on every package of the Equipment.

In order to accelerate the dispatch of the Equipment to the site, the Contractor is required to arrange packaging of the Equipment in such a manner that a complete set of one unit shall be packed in package(s) or crate(s) with indication of designated substation but each individual package or crate shall contain the Equipment for only one unit or part of a complete set of one unit or otherwise as directed in the Instructions for Packaging attached at the end of Section E. General Conditions.

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Detailed breakdown prices for spare parts shall be also indicated in the invoice.

Prior to delivery of all Equipment, packaging details shall also be submitted to EGAT for approval.

The cost incurred for repair or replacement of any damages to the Equipment due to improper packaging shall be at the Contractor's expense.

Each individual package or crate shall be clearly and plainly tagged or marked for identification as follows:

EGAT, THAILAND

PROJECT NAME :_____

CONTRACT NO. :_____

SUBSTATION :_____

CASE NO. :_____

ITEM NO. :_____

DESCRIPTION :_____

EGAT'S SERIAL NO. :_____(if any)

E-15. Shipment

Shipment of equipment from port of embarkation to the final port of discharge shall be effected by using Thai vessels.

According to the regulations of ***the Maritime Promotion Division***, Marine Department (as amended from time to time), shipments by non-Thai vessels can be made after receipt of permission granted by ***the Maritime Promotion Division***, Marine Department as requested by the Contractor.

The Contractor is, therefore, required to immediately contact ***the Maritime Promotion Division***, Marine Department for such permission with supporting documents of the case thereof for arrangement of the permission in advance.

The Contractor shall follow all other regulations stated in the Mercantile Marine Promotion Act B.E. 2521 and the regulations of ***the Maritime Promotion Division***, Marine Department (as amended from time to time).

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The Contractor shall be liable for any and all costs and expenses, losses and/or damages suffered by EGAT as a result of the Contractor's failure to comply with such regulations.

For more information, the Contractor may contact ***the Maritime Promotion Division, Marine Department at telephone No. 66 2233 1311-8 extension 387 and facsimile No. 66 2639 4778, https://maritimepromotion.md.go.th/.***

E-16. Force Majeure

The Contractor shall not be in default under this Contract because of any delay in delivery or in completion of the Work on the separable parts thereof which delays are caused by force majeure; provided that the Contractor shall notify EGAT in writing of the cause of any such delay within fifteen (15) Days after the end of the event which results in the delay. Upon receipt of any such notice of delay, EGAT will promptly ascertain the facts and the extent of the delay and will extend the time for the delivery and assembly of the Equipment or the time for completing the Work when, in the opinion of EGAT, the delay is caused by force majeure or the findings of fact to justify an extension. EGAT's decision shall be binding on the Contractor, subject to the provision of Article E-29. Dispute Resolution included in these General Conditions.

"Force Majeure" shall be defined as any event, the happening or pernicious results of which could not be prevented even though a person against whom it happened or threatened to happen were to take such appropriate care as might be expected from him in this situation. (Normal rains, inundation, dearth of water, and the overturning or sinking of barges in canals, rivers, or streams and similar events shall not be considered as force majeure).

E-17. Transportation Insurance

Transportation insurance from the Contractor's premises to EGAT's Store shall be under the responsibility of Contractor.

E-18. Transfer of Title

The title of ownership for the Equipment furnished under this Contract shall be passed to EGAT at the time the Equipment is actually delivered to EGAT's store and the Contractor's statement or delivery order confirming delivery of the Equipment has been certified by EGAT's representative.

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However, this transfer of title shall not be construed as an acceptance of the Equipment. The Contractor shall continue to be responsible for the quality and performance of the Equipment, and for their compliance with the Specifications until acceptance of the Equipment by EGAT and the fulfillment of the guarantee provision of the Contract.

E-19. Changes and Extra or Omitted Work

EGAT may at any time authorize changes in, additions to, or deductions from the Equipment to be furnished under the Contract. Changes, additions, or deductions shall be authorized only by written notice served by EGAT upon the Contractor and such notice shall be treated as an integral part of the Contract. Adjustments, if any, in the amounts to be paid to the Contractor by reason of any such change, addition, or deduction shall be determined by one or more of the following methods:

a. by unit price contained in the Price Schedules

b. by an acceptable lump sum or unit price proposal from the Contractor

c. on a cost-plus limited basis not to exceed a specific limit. A cost-plus limited basis is defined as the cost of Equipment, labor, and insurance, plus fifteen (15) per cent of the said cost to cover superintendence, general expense, and profit.

No claim for an addition to the Contract Price shall be valid unless authorized as described in this Article. If the parties are unable to agree to the method to be employed in determining adjustments in the Contract Price, the method shall be determined by EGAT.

E-20. Termination and Suspension of Contract

EGAT may, by written notice sent to the Contractor, terminate the Contract, in whole or in part, at any time for its convenience. The notice of termination shall specify that termination is for EGAT's convenience, the extent to which performance of work under the Contract is terminated, and the date upon which such termination becomes effective.

The Equipment that are completed and ready for shipment within thirty (30) Days after the Contractor's receipt of notice of termination shall be purchased by EGAT at the Contract terms and prices. For the remaining Equipment, EGAT may elect:

a. to have any portion completed and delivered at the Contract terms and prices and/or

b. to cancel the remainder and pay to the Contractor an agreed amount for partially completed Equipment and for materials and parts previously procured by the Contractor.

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E-21. Default and Termination

Should the Contractor:

a. fail to furnish the Equipment or carry out the Work in accordance with this Contract; or

b. refuse or fail to prosecute the Work or any part thereof which shall ensure its completion within the time specified in this Contract or any authorized extension of time by EGAT; or

c. fail to furnish the Equipment and/or complete the Work or any part thereof within the time specified in this Contract or any authorized extension of time by EGAT; or

d. commit any breach or fail to comply with any of the provisions of this Contract; or

e. notify EGAT in writing that the Contractor is unable or unwilling to furnish the Equipment or complete the Work or any part thereof; or

f. become insolvent or bankrupt or make an arrangement or composition with the Contractor's creditors or, being a corporation, go into liquidation whether compulsory or voluntary (except for the purpose of reorganization); or

g. by himself or by any person on his behalf, give or offer any money or benefit of forbearance to any employee of EGAT and/or any employee of the Engineer who has duties or responsibilities in connection with the acceptance of the proposal or the making of this Contract;

then, in any of such events, the Contractor shall be in default under this Contract, and EGAT may at his sole discretion take any one or more of the following actions that it considers appropriate :

(i) suspend payments under this Contract until the default has been rectified;

(ii) cancel or terminate the Contract in whole or in part;

(iii) take that part of the furnishing of Equipment or the Work, in respect of which the delay or default has occurred, out of the hands of the Contractor or any other person in whose control or possession it is;

(iv) reduce the Contract Price by an amount equal to the reduction in value to EGAT of the Equipment as actually delivered.

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The Contractor shall be liable for all losses and/or damages including but not limited to the increased installation costs and increased administrative costs, suffered by EGAT as a result of the Contractor's default. The Contractor shall have no claim for payment with respect to Work thereafter performed.

All such damages may be recovered by EGAT from the Contractor in any court of competent jurisdiction or, without prejudice to that right, by deduction from any money due or becoming due to the Contractor under this Contract, or from any security deposited, or, after use of the property and materials of the Contract for completion of the work, as provided in this Contract, such property and materials may be sold and the proceeds shall be applied to any remaining obligations of the Contractor.

E-22. Indemnification by the Contractor

The Contractor shall fully indemnify and hold harmless EGAT and its employees and officers from and against any and all suit, actions or administrative proceedings, claims (including any claim for copyright or patent infringement), demands, losses, costs, expenses (including attorney's fees and expenses) and damages of whatsoever nature except breach or default, in respect of death or injury of any person or loss of or damage to any property caused by any act or omission of the Contractor or the Contractor's own officers, directors, agents, employees, Contractors or Subcontractors arising in any manner whatsoever, except any injury, death or property damage caused by the negligence of EGAT, its contractors, employees, officers or agents.

E-23. Limitation of Liability

The liability of the Contractor to EGAT arising from default or termination under the Contract in aggregate shall not exceed the total Contract Price.

E-24. Consequential Damages

Neither party shall be liable to the other party for any indirect, incidental, consequential or punitive damages as a result of the performance or nonperformance of the obligations imposed pursuant to this Contract, unless such indirect, incidental, consequential or punitive damages are foreseen or could have been foreseen at the time of execution of the Contract.

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E-25. Vesting of Contract in Receiver

If the Contractor shall compound with his creditors, or shall become bankrupt or insolvent, or carry on business under a receiver, or become incapable from any cause whatsoever of carrying out the Work, any such receiver or any person in whom by law the Contract shall become vested, shall forthwith give notice to EGAT of the fact that the Contract has become vested in it and shall take all reasonable steps to carry on the Work at a rate fulfilling the Contract requirements. Thereupon, if EGAT so desires, such receiver or other such person as aforesaid shall have the option, during the period of one (1) Month from the date when the Contract becomes so vested in it, of carrying out the Contract. In the event of the Work being stopped, this option shall be opened only for a period of fourteen (14) Days from the stoppage date. In the event of the receiver or such other person not electing to carry out the Contract or EGAT not approving the carrying out of the Contract by the receiver, the Contractor shall then be in default and EGAT may proceed in accordance with Article E-21. Default and Termination.

E-26. Extension of Time

If, by reason of any of the following:

a. Negligence or default on the part of EGAT or its agents,

b. Alteration in or addition to the Work,

c. Suspension of the Work at the written direction of EGAT for reasons beyond the control of the Contractor,

d. War, insurrection, riot or civil commotion or delay caused thereby,

e. Strikes, not caused by the Contractor's management,

f. Lawful order of civil or military authorities,

g. Unusually natural calamities, acts of God,

h. Any other unforeseen circumstance beyond the Contractor's control.

The Contractor claims that he has been unduly delayed in the progress of the Work, he shall make written request to EGAT for an extension of time for completion of the Work or any portion of it.

Should EGAT consider such claim to be valid, it will grant such extension of time as may seem reasonable to EGAT, without thereby prejudicing or in any manner affecting the validity of the Contract. No extension of time will be granted unless the Contractor makes the written request within fifteen (15) Days after the end of the event which results in the delay.

Other than claiming an extension of time for completion of the Work or any portion of it, the Contractor shall not have any further recourse or claim against EGAT, nor shall he have any right of action against EGAT for loss or damage suffered by reason of such delay.

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E-27. Failure to Meet Requirements

EGAT shall have the right to require the Contractor to make any changes in the Equipment or Work covered by this Contract, which may be necessary in the opinion of EGAT, to make the Equipment or Work conform to the requirements of the Contract Documents, without additional cost to EGAT. Any defects in the Equipment or workmanship or other failure, to meet the requirements of the Contract, including errors and omissions on the part of the Contractor, which are disclosed prior to final payment or prior to acceptance by EGAT, or after completion of all tests, whichever occurs at the later date, shall, if so directed by EGAT, be corrected or replaced promptly by the Contractor at the expense of the Contractor.

Any latent defects not disclosed prior to the date of final payment or prior to acceptance or after completion of all tests, whichever occurs at the later date, but disclosed within the guarantee period as specified in Article F-10.a., shall be corrected or replaced promptly by the Contractor at the expense of the Contractor, except that the cost of installation for the replacement parts of the Equipment will be borne by EGAT.

The Contractor shall extend the provisions of his liability to cover all repair and replacement parts furnished under this Article as follows:

(1) All Equipment except Control and Protection Equipment and Fault Recording System

- Any malfunctioning and/or defect found within the guarantee period : For a new period of one (1) Year from the day immediately following the date of completion of such repair or replacement

(2) Control and Protection Equipment and Fault Recording System

- Any malfunctioning and/or defect found within the first Year of guarantee period : For a new period of two (2) Years from the day immediately following the date of completion of such repair or replacement

- Any malfunctioning and/or defect found within the second Year of guarantee period : For a new period of one (1) Year from the day immediately following the date of completion of such repair or replacement

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The Contractor shall, if required by EGAT in writing, search under the directions of EGAT for the cause of any defect, imperfection or fault appearing prior to the acceptance of Equipment or in the period of maintenance guarantee. Unless such defect, imperfection or fault shall be one for which the Contractor is liable under the Contract, the cost of the work carried out by the Contractor in searching as aforesaid shall be borne by EGAT. If such defect, imperfection or fault shall be one for which the Contractor is liable under the Contract, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case repair, rectify and make good such defect, imperfection or fault at his own expense.

E-28 Operation or Use of Unsatisfactory Equipment

If the operation or use of the Equipment proves to be unsatisfactory to EGAT, EGAT shall have the right to operate and use such Equipment until they can be taken out of service for correction by the Contractor of such latent defects, error, or omissions and for replacement in whole or in part, if correction is unsuccessful or infeasible. The period of such operation or use shall not exceed one (1) Year from the day immediately following the date of acceptance of Equipment by EGAT.

E-29. Dispute Resolution

Any dispute arising out of or in connection with this Contract, interpretation, breach, or termination thereof shall be settled by amicable discussion between authorized representatives of each Party. Either Party may at any time send a written notice to the other Party requesting for an appointment of authorized representative for a settlement of any dispute hereunder. The Parties agree to make diligent and good faith attempt to resolve such dispute in an equitable manner. If the authorized representatives of both Parties are unable to resolve such dispute within 30 Days after commencement of the discussion for dispute resolution or other extended period of time as mutually agreed by both Parties, either Party may file a lawsuit to the court having jurisdiction in Thailand for settlement of such dispute. Each Party agrees that the final court judgment shall be conclusive and binding upon the Parties.

Pending decision of the court, both Parties shall continue to perform their respective obligations under this Contract.

E-30. Language and Numbers

All drawings, designs, specifications, manuals, nameplates, markings, operating instructions, statements, schedules, notices, documents, and all written communications between EGAT and the Contractor, concerning this Contract, shall be in the English language and in the metric system of weights and measures unless otherwise specified.

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SPECIMEN OF GUARANTEE

To : Date

Electricity Generating Authority of Thailand
Bangkruai, Nonthaburi, 11130

Thailand

Re : Performance Security for Contract No. _____

Gentlemen :

In accordance with the provision of the Contract for_____No. _____(hereinafter referred to as the Contract) the contents of which have been noted by us that Messrs._____(hereinafter referred to as the Contractor) has to deposit with Electricity Generating Authority of Thailand (hereinafter referred to as EGAT) a Performance Security for the proper and faithful performance of the Contract in the amount of_____ (in words :_____) which is_____per cent, round up to the nearest whole number, of the total Contract Price, we, the _____as instructed by the Contractor, agree unconditionally to irrevocably guarantee as primary Obligor, the payment to EGAT on its first demand, without whatsoever right of objection on our part and without its first claim to the Contractor, in the amount not exceeding :_____(in words :_____) in the event the obligations expressed in the above mentioned Contract have not been fulfilled by the Contractor, giving EGAT the right of claim for penalty, damages, liquidated damages or any expenses for which the Contractor may become liable to EGAT under the Contract.

We further agree that no extension of time, change in, addition to or other modification of terms of the Contract or Work to be performed thereunder, or of the Specifications or other Contract Documents, which may be made between EGAT and the Contractor, shall in any way release us from any liability under this guarantee, and we shall thereby waive notice of any such change, addition or modification.

This Performance Security shall be valid and remain in full effect from the date of execution of the Contract until the issuance of the Acceptance Certificate by EGAT or the acceptance of Equipment deemed to be made by EGAT against submission by the Contractor of the Maintenance Security accepted by EGAT.

Yours very truly,

_____
Authorized Signature

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Instructions for Packaging

Name of Equipment	Packed per complete set of one unit/units	Packed per Substation
1. Power Transformer	√(1)	-
2. Distribution Transformer	√(1)	-
3. Shunt Reactor	√(1)	-
4. Surge Arrester	√(1)	-
5. Current Transformer	√(1)	-
6. CC, CCVT, VT	√(1)	-
7. GIS	-	√
8. Shunt Capacitor Bank	√(1)	-
9. Power Circuit Breaker	√(1)	-
10. Disconnecting Switch	√(1)	-
11. AC/DC Dist. Board, LCUS, LRP	√(1)	-
12. Stationary Battery	√(1)	-
13. Lighting Fixture	-	√
14. Identification and Danger Notice Plate	-	√
15. Control and Protection System	√(1)*	-
16. Computerized Control System	-	√
17. Power Line Carrier	-	√
18. Teleprotection	-	√
19. Line Trap	-	√
20. Battery Charger	√(1)	-

Note : 1. Number in parenthesis represents maximum number of complete set of one unit/units packed in an individual package or crate.

2. * In case of spare for control and protection system, such Equipment shall be packed per board, but in case of loose control and protection system, such Equipment of whichever substation shall be packed in the same package or crate of that substation.

3. Other substation Equipment not mentioned shall be packaged in such a manner that it will not cause unreasonable expenses or delay to EGAT in distribution of such Equipment to the designated substation.

4. Prior to delivery of all Equipment, packaging details shall be submitted to EGAT for approval.

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SECTION F

SPECIAL CONDITIONS

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SPECIAL CONDITIONS

F-1. Scope of Work

The Contractor shall perform, furnish and deliver the Equipment to EGAT's store as required by these Contract Documents.

F-2. Responsibility of Contractor

The Contractor shall be solely responsible for ensuring that the Work throughout is executed in the most substantial, proper and workmanlike manner, with the best quality materials and conforming to the best engineering practice for the operating conditions specified; the drawings and quality control are performed or made in accordance with the Contract; and services reasonably to be furnished though not specifically provided in the Contract are furnished; all to EGAT's entire satisfaction notwithstanding that certain portions of the work may be executed by the Subcontractor.

F-3. Cooperation with Other Contractors

The Contractor, if required, shall exchange with other Contractor furnishing associated Equipment, all necessary drawings and other information required to insure the complete and proper design and manufacture of the Equipment to be furnished under these Specifications. One (1) copy of all drawings and correspondence, relating to information interchanged between Contractors, shall be sent to EGAT in Nonthaburi, Thailand.

*F-4. Supervision of Installation

Subject to the desire and decision of EGAT, the Contractor may be required to furnish the services of qualified and experienced supervisor(s) who has at least three years experience on the particular Work required under the Contract and shall be the permanent employee of the manufacturer of the Equipment. For 230 kV (or lower) Power Circuit Breaker and 115 kV (or lower) Gas-Insulated Switchgear, the permanent employee of the representative of the manufacturer is acceptable, provided that such employee is certified by the manufacturer.

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The scope of responsibility of the supervisor on behalf of the Contractor is as follows :

a. Supervise and be responsible for the start-up, field test and commissioning of the Equipment.

b. Prepare formulation sheets for a check list, test sheet, release form and field report to be discussed with EGAT before performing the installation work.

c. Submit one copy of report summarizing the work performance, from the beginning to the completion of the supervisory period, to EGAT within fifteen (15) days after finish the installation work or final inspection. The report shall include the following:

    1. Note on pending matter i.e. faulty and omitted equipment, performance deficiency etc.

    2. Problem concerning installation performance.

    3. Photographs showing progress of the installation work periodically until the work is completed.

The Contractor shall, in each and every instance, cooperate fully with the construction personnel installing and/or operating the Equipment and the Work, the operations of the supervisor shall be coordinated with the program of construction at the site as directed by EGAT.

The supervisor shall report at EGAT in Nonthaburi, Thailand, on the date designated by EGAT after a reasonable advance notice from EGAT, and shall remain until the Equipment have been in satisfactory operation for at least ten (10) working days as determined by EGAT, unless released earlier by EGAT.

The installation supervisor must be able to understand, speak, read and write the English language fluently. Should an interpreter be necessary, the cost of such interpretation service shall be at the Contractor's expense.

*If installation supervisor is required as specified in Price Schedule, this provision shall apply to this Contract.

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F-5. Acceptance Tests

After the Equipment have been installed and placed in satisfactory operation, they may be tested by and at the expense of EGAT to determine whether or not all requirements of these Contract Documents have been met and the Contractor's guarantees have been fulfilled.

The Contractor will be permitted to have his representative present at his own expense. If the tests show that the requirements or guarantee have not been met, the Contractor shall, at his own expense, make all necessary corrections. Additional tests will then be made to demonstrate to EGAT's satisfaction the effectiveness of these corrections. These additional tests will be at the Contractor's expense. Unless the necessary corrections have been made, the conditions of the Contract shall be considered unfulfilled.

All tests will be performed in accordance with the latest applicable Test Codes, unless otherwise stated.

F-6. Failure to Meet Performance Guarantees

If EGAT elects to accept the Equipment which do not meet any performance guarantee or which do not meet other requirements of these Contract Documents, as may be determined by factory test, field test or operation under service conditions, appropriate adjustment will be made of the Contract Price for such Equipment; provided that no such adjustment will be made until after the Contractor has been given a reasonable opportunity to repair, improve, or replace defective Equipment or parts thereof wherever practicable.

F-7. Acceptance Certificate

When EGAT is satisfied with the Equipment or agrees to accept the Equipment under the provision of Article F-6. Failure to Meet Performance Guarantees and there are no major unsettled claims against the Contractor by EGAT, EGAT will issue a written Acceptance Certificate against submission by the Contractor of a maintenance security effective for a period of time as specified in Article F-10.a.

The Acceptance Certificate will list all deficiencies and reservations as a result of the inspection and tests performed, if any.

The purpose of the maintenance security is to guarantee the proper functioning of the Equipment supplied by the Contractor with a provision that the effective period of the maintenance security shall automatically be extended in case that the obligations stipulated in Article F-10. Maintenance Guarantee are not fulfilled.

A form of maintenance security acceptable to EGAT is shown in Article F-12. Maintenance Security.

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F-8. Payment

Payment for Equipment

Payment in local currency will be made directly by EGAT in the following manner:

1. Eighty (80) per cent of the Contract price will be paid on the basis of pro rata value of each delivery against presentation of the Contractor's statement or delivery order confirming the delivery of Equipment at EGAT's store duly certified by EGAT's representative*, EGAT's letters of approval for delivery, EGAT's letter of approval for test report** of the relevant Equipment including EGAT's letter(s) of approval for final drawings only for Control and Protection Equipment and Fault Recording System.

   *EGAT's representative means the authorized EGAT's Store personnel to verify the quantity of Equipment according to the packing list to be delivered to the Site.

   **Test report means the report of tests specified in Article E-13. Inspection and Tests.

2. Ten (10) per cent of the Contract Price of each Schedule will be paid against presentation of Drawing and Document Acceptance Certificate to be issued by EGAT to certify the receipt of all drawings and documents required from the Contractor under Article F-11. Drawings and Documents to be Furnished by Contractor for such schedule, provided that payment shall not be made until EGAT has received from the Contractor the statement or delivery order and appertaining documents giving evidence of delivery of the main Equipment of that Schedule.

3. Ten (10) per cent of the Contract Price of each Schedule will be paid after the Equipment have been installed, tested and operated or used for a period of 30 Days and the acceptance of the said Equipment has been made by EGAT against presentation of Acceptance Certificate to be issued by EGAT and submission of maintenance security by the Contractor. EGAT will list the minor pending claim(s), if any, and payment will be made by deducting such claimed amount.

   However, if, through no fault of the Contractor or of the Equipment, such installation, test and operation or use of the Equipment are delayed beyond a period of six (6) Months after complete delivery at EGAT's store; payment of this ten (10) per cent will be made as soon as possible but not later than the ninth (9^{th}) Month after complete delivery and it shall be deemed as if acceptance of Equipment is made by EGAT at the end of the said sixth (6^{th}) Month and the guarantee period shall start therefrom against submission of maintenance security by the Contractor.

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In case there is some minor claim(s) or minor fault of the Contractor, the payment of this ten (10) per cent shall be made by deducting such claimed amount and the guarantee period of this part will start after such minor claim(s) has been settled by the Contractor and acceptance of which has been made by EGAT.

Payment for Service

Payment in foreign currency will be made in the currency or currencies in which the price has been stated in the price schedules. The Contractor has to inform EGAT the mode of payment he requires for payment for foreign currency portion together with detail of bank account No., beneficiary's name and address etc. In case the local Contractor requires foreign currency or currencies to be paid directly to him, payment of such foreign currency or currencies will be made to the local Contractor in Thai baht by using the selling exchange rate published by the Bank of Thailand on the payment date.

In case the Contractor requires the payment of foreign currency portion to be made through letter of credit, EGAT will, if there is no fault or any delay caused by the Contractor, establish the letter of credit in the name of the Contractor or Suppliers not later than thirty (30) Days after signing the Contract. The Contractor shall be responsible for all bank charges inside and outside Thailand and including opening, amendment, reimbursing charges, payment commission, cable charges, discrepancy fee, acceptance commission and others (if any) arising from Letter of Credit.

Payment in local currency will be made directly by EGAT.

The Contractor or beneficiary has to inform EGAT by mailed letter or ***letter submitted electronically or by electronic mail (E-mail)*** immediately the date upon which he has received the original letter of credit ***to be*** opened in his favour.

Payment for the services of the installation supervisor will be made within thirty (30) Days after his release by EGAT. Payment will be made on the basis of actual working man-days at the quoted cost per man-day up to a maximum equal to the total man-days quoted. For man-days exceeding the quoted total man-days, no payment shall be made by EGAT unless the Contractor can claim for any delays in the progress of the work caused by EGAT. Any such additional man-days approved by EGAT shall be paid on the basis of the quoted man-day rate.

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The number of quoted man-days shall include Sundays and shall cover a seven (7) day workweek, if required by the construction program. The working hours shall be forty-eight (48) hours per week, eight (8) hours per day, the working hours over 8 hours per day if requested by EGAT will be counted as overtime at 1½ times the regular hourly rate.

The amount to be paid for each Day for the services of the supervisor shall include for all salary, subsistence expense, insurance, compensations and personal expense of the supervisor, and all liabilities and responsibilities thereto. EGAT will pay for round-trip economy class air transportation for the installation supervisor between the Contractor's home office and Bangkok by the most expeditious and direct route on trip basis by draft after receipt of the Contractor's invoice supported with the used air ticket of such supervisor. The remission of immigration fees and taxes collectible by the Kingdom of Thailand shall not be paid by EGAT, as described in Article E-11. Fees and Duties."

After each payment is made, the Contractor or beneficiary shall issue and submit the receipt to EGAT at e-mail : FFMS@egat.co.th within three (3) calendar days upon receipt of such payment. The details of receipt shall include but not be limited to the following:

- ***Company name and address***
- ***The receipt date of payment***
- ***Lists of Goods/Services the payment is made for***
- ***Payment amount in numbers and in words***
- ***Recipient signature***

F-9. Liquidated Damages for Late Delivery of Equipment

In the event of failure by the Contractor to make delivery of any Equipment within the time set forth in the Contract, plus any extension thereof authorized by EGAT as provided in the Contract, such failure shall be a default under the Contract for which the Contractor shall be liable for payment to EGAT as liquidated damages at the rate specified in Data Sheet.

Whenever any Equipment under any item is to be used together with other Equipment in other item as specified in Price Schedule as a complete set or unit, the Contractor shall make sure that they shall be shipped together as a complete set or unit. Failure on the part of the Contractor to comply with this requirement, the liquidated damages for late delivery of partial shipment shall be imposed on the Contractor for the whole amount of the Contract Price of such related items.

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Notwithstanding, in case the Contractor fails to make delivery of minor part of any Equipment within the time set forth in the Contract and such late delivery does not have any effect to the performance of the Equipment, the Contractor shall be liable for payment to EGAT as liquidated damages at the rate of one-tenth of one (0.10) per cent of the total price of the minor part of the Equipment not timely delivered for each Day of delay. The price of such delayed minor part of the Equipment shall be determined by EGAT. EGAT shall, at his own discretion, determine whether such late delivery Equipment is the minor part and has any effect to the performance of the Equipment or not.

The payment of such liquidated damages shall not relieve the Contractor of his obligations to complete the Work under the Contract.

In case any Equipment is defective or does not conform to the requirements or specifications of the Contract where replenishment or correction or replacement must be made by the Contractor as per Article E-27. Failure to Meet Requirements, it shall be deemed that such Equipment has not yet been delivered unless such Equipment has been replenished or corrected or replaced, as the case may be, and delivered to EGAT at the delivery point specified in the Contract.

Payment of liquidated damages is contingent exclusively upon late delivery; in no case shall EGAT be required to substantiate any claim for payment of liquidated damages with proof of loss and/or damages. The liquidated damages shall be calculated for each Day of delay until the Equipment is delivered to EGAT excluding a period of time from the actual delivery date at the delivery point set forth in the Contract until the issuance of notification of defect or short pack or out of specification made by EGAT to the Contractor. This sum is payable regardless of the actual loss and/or damages incurred.

The Contractor shall not be liable for liquidated damages in the event of delay caused by force majeure.

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F-10. Maintenance Guarantee

a. The Contractor shall guarantee the proper functioning of the Equipment for a period as specified hereunder :

(1)	All Equipment except Control and Protection Equipment and Fault Recording System	:	One (1) Year from the day immediately following the date of acceptance of Equipment by EGAT as stated in Article F-7. Acceptance Certificate

(2) Control and Protection Equipment and Fault Recording System : Two (2) Years from the day immediately following the date of acceptance of Equipment by EGAT as stated in Article F-7. Acceptance Certificate

Provided, however, that should any malfunctioning and/or latent defect in Equipment under normal use and service be found during the said period, and such malfunctioning and/or defective portion be repaired or replaced as stipulated in (c) and (d) hereinafter, then the guarantee period for such portion shall be extended as follows:-

(1) All Equipment except Control and Protection Equipment and Fault Recording System

– Any malfunctioning and/or defect found within the guarantee period : For a new period of one (1) Year from the day immediately following the date of completion of such repair or replacement

(2) Control and Protection Equipment Fault Recording System

– Any malfunctioning and/or defect found within the first Year of guarantee period : For a new period of two (2) Years from the day immediately following the date of completion of such repair or replacement

– Any malfunctioning and/or defect found within the second Year of guarantee period : For a new period of one (1) Year from the day immediately following the date of completion of such repair or replacement

The premium for the maintenance guarantee shall be paid by the Contractor.

b. On the expiration of the maintenance guarantee period and if the Equipment is functioning normally, the Contractor shall thereafter be released of all obligations and responsibilities under the Contract and the maintenance security will be released and returned to the Contractor.

c. If during the guarantee period EGAT finds any malfunctioning and/or defect in the Equipment, EGAT shall inform without delay the Contractor thereof, stating in writing the nature of the malfunctioning and/or defect, and the Contractor shall promptly commence to repair and make good or replace such malfunctioning and/or defect at the expense of the Contractor, except that the cost of installation of the replacement parts of the Equipment will be borne by EGAT.

d. If, after the repair or replacement performed in accordance with this Article, such Equipment continues to show malfunctioning and/or defect, EGAT may, at its option, demand further repair or replacement, and reserve the right to claim damages, if applicable, arising therefrom.

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e. If the Contractor fails to take action for starting up the necessary works for repair or replacement within fourteen (14) Days after receipt of EGAT's written notice of defect, the defect will be corrected by EGAT or any third party selected by EGAT at EGAT's discretion, and the cost of the corrections shall be on the responsibility and account of the Contractor.

In the event of an emergency where in the judgement of EGAT the delay resulting from giving formal notice would cause serious loss or damage which could be prevented by immediate action, defects may be corrected by EGAT or a third party chosen by EGAT without giving prior notice to the Contractor, and the cost of the corrections shall be paid by the Contractor. In the event such action is taken by EGAT, the Contractor will be notified promptly and shall assist wherever possible in making the necessary corrections.

F-11. Drawings and Documents to be Furnished by Contractor

EGAT reserves the right to require the Contractor to submit the drawings and documents listed in the tables attached at the end of this Section by the designated dates either by registered airmail for foreign mail and registered mail for local mail and/or by electronic files uploaded via document management system. However, cover letters shall be submitted in hard copy to EGAT.

After the requirement under this Article has been fulfilled by the Contractor, a Drawing and Document Acceptance Certificate will be issued by EGAT to certify the receipt of all required drawings and documents:

a. Drawings

(1) Drawing Title and Sizes. The title of Contractor's drawing shall also include the followings :

ELECTRICITY GENERATING AUTHORITY OF THAILAND

EGAT's Contract No._____

Item No._____

Subs. Name_____

The sizes of the drawings except otherwise specified in the Specification shall be as follows :

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Size Designation	Dimensions in MM	Dimensions in Inches
A0	841 x 1,189	(33.11 x 46.81)
A1	594 x 841	(23.39 x 33.11)
A2	420 x 594	(16.54 x 23.39)
A3	297 x 420	(11.69 x 16.54)
A4	210 x 297	(8.27 x 11.69)

(2) Reference Drawings and Catalogues. General drawings showing principal dimensions and weights of Equipment, including controlling dimensions which affect space and handling requirements.

(3) Drawings and Data for Approval. The Contractor shall submit for approval checked detail assembly drawings including firm dimensions, foundation details and setting diagrams, physical size and weights of all principal parts, complete operating characteristics and ratings of Equipment, connection and schematic wiring diagrams, descriptive information and any other information sufficient to demonstrate fully that the Equipment to be furnished will conform to the requirements and intent of these Contract Documents.

Schematic diagrams shall indicate the operation and function of all electrical Equipment, accompanied, where necessary, with explanatory notes. Wiring diagrams shall show the external connection required, sufficient for EGAT to complete interconnection cable diagrams.

One print each of the drawings submitted for approval will be returned to the Contractor by EGAT or its authorized representative within thirty (30) Days after receipt at EGAT's office, marked either "Approved", "Approved Except as Noted", or "Returned for Correction"/"Not Reviewed". The notations "Approved" or "Approved Except as Noted" will authorize the Contractor to proceed with the manufacture of the Equipment covered by such drawing, subject to the correction, if any, indicated thereon. When prints of drawings have been "Returned for Correction"/"Not Reviewed"., the Contractor shall make the necessary revisions on the drawings and shall within thirty (30) Days resubmit drawings for approval in the same manner as before.

Any manufacturing done before approval of the drawings will be at the Contractor's risk. EGAT shall have the right to require the Contractor to make any changes in

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the design which may be necessary, in the opinion of EGAT, to make the Equipment conform to the requirements and intent of these Contract Documents without additional cost to EGAT. Approval of the Contractor's drawings shall not be held to relieve the Contractor of any part of his obligation to meet all of the requirements of these Contract Documents or of the responsibility for the correctness of his drawings.

The Contractor shall submit final drawings when the manufacturing is completed. The letter of approval for final drawings will be issued if final drawings are accepted.

b. Report of Shop Test. The Contractor shall furnish certified copies of reports of all tests required of the manufacturer to show compliance with the applicable standards and specifications. The cost of all tests and reports shall be borne by the Contractor.

c. Instruction Manuals. The Contractor shall furnish complete set of instruction manuals and all final approved drawings (if any) for erection, operation, maintenance and repair of the Equipment, and for identification of parts. The instruction manuals shall be combined, assembled and bound in binders. Each binder cover shall be stamped with proper identification indicating name of Equipment, manufacturer's name and address, EGAT's Contract number, manufacturer's reference, etc.

Prior to the assembly and submittal of the instruction manuals, a proof of the cover lettering and the table of contents shall be submitted in sufficient time for EGAT's acceptance without delaying submittal of the finished manuals.

The CD-ROM (Compact Disc-Read Only Memory) of final drawings, final documents, test report and instruction manual, if required, shall conform to the applicable International Standard Organization 9660 (ISO 9660) and have capacity of approximately 700 Mbytes.

The data in CD-ROM shall be created by the following software :

Drawing

The Contractor shall submit all drawings created by CAD software as follows:

1. MICROSTATION software Version SE or

2. AUTOCAD software Version 2000

Any necessary information supporting the completion of reading files (such as special font etc.) shall be included in CD-ROM.

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Documents

The Contractor shall submit all documents in Adobe Portable Document Format File (PDF format) and also Program of Acrobat Reader in order to read the file completely in CD-ROM.

Drawing/Document List

The Contractor shall submit the drawings/documents listing information in work sheets file provided by EGAT in CD-ROM in Microsoft Excel file format.

Drawing list of design drawings, as built drawings, manufacturing drawings shall also be submitted together with the drawings in the CD-ROM.

F-12. Maintenance Security

The Contractor shall provide to EGAT prior to the issuance of the acceptance certificate and as a condition for the release of the payment of the last instalment as specified in Article F-8. Payment, maintenance security(ies) in the amount of ten (10) per cent, round up to the nearest whole number, of the total Contract Price or ten (10) per cent, round up to the nearest whole number, of each schedule, excluding the cost of installation supervisor and cost of services (if any), guaranteeing the Contractor's performance of the provision of Article F-10. Maintenance Guarantee. The Contractor shall oblige himself to attend to and replace, during the period of maintenance, all malfunctioning parts and for repair of all defects noted in the Work and communicated to the Contractor in writing by EGAT. In case of extended guarantee of the repaired or replaced Equipment, the Contractor may request for return of the original maintenance security and submit a new maintenance security in the amount of ten (10) per cent, round up to the nearest whole number, of the Contract Price of Equipment under the extended guarantee.

The maintenance security shall be in the form of a cash deposit, or a cashier cheque issued by a local bank, or a letter of guarantee or a bank guarantee issued by a local bank or an acceptable financial institution in Thailand, or by a foreign bank counter-guaranteed by a local bank and made payable to EGAT in the same currency as that of the Contract. In case of a cash deposit or a cashier cheque, only Thai baht portion of the Contract Price can be made. EGAT may at its absolute discretion refuse to approve any maintenance security offered or may at any time, upon application by the Contractor, approve of the substitution for any maintenance security held under this Article by other maintenance security on such terms and conditions as may be approved by EGAT.

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The conditions of guarantor's obligations in the maintenance security shall include, inter alia; the following :

1. The guarantor shall unconditionally guarantee, as primary obligor and not as surety merely, payment of any obligations, damages, liquidated damages, performance penalties, or expenses for which the Contractor may become liable to EGAT.

2. No extension of time, change in, addition to, or other modification of the terms of the Contract or Work to be performed thereunder, or of the Specifications or other Contract Documents shall in anyway release the guarantor from any liability under the maintenance security, and the guarantor shall thereby waive notice of any such extension of time, change, addition or modification.

3. The maintenance security shall be valid and remain in full effect from the date of acceptance of Work until all obligations on the part of the Contractor under the Contract have been fulfilled.

Unless and until an official receipt is issued in respect to a maintenance security deposit, EGAT will not recognize or accept any such deposit as fulfilling the requirements of this Article. Failure to deposit a maintenance security at the time specified above in this Article or such extended time as may be approved by EGAT shall be a breach of this Contract and EGAT may, at its discretion, retain the payment of the last instalment of the total Contract Price.

If any maintenance security furnished under this Article shall become unacceptable to EGAT, or if any guarantor shall fail to furnish reports as to guarantor's financial condition from time to time, as requested by EGAT, the Contractor shall promptly furnish such additional or alternative maintenance security as may be necessary to satisfy the Contract requirements for a maintenance security.

In the event of any default or breach of this Contract on the part of the Contractor, EGAT may convert into money any maintenance security which does not consist of money, and the proceeds shall be deemed to be a cash deposit under this Article. EGAT shall not be liable for any cost, expenses and/or loss resulting from the conversion of any maintenance security deposit into money as herein provided. The Contractor shall bear the cost of the maintenance security.

The maintenance security, in case of a bank guarantee, or letter of guarantee, shall be in conformity with the following specimen.

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SPECIMEN OF MAINTENANCE GUARANTEE

(For Equipment with Two-Year Guarantee Period)

To : Date :

Electricity Generating Authority of Thailand
Bangkruai, Nonthaburi 11130
Thailand

Re : Maintenance Security for Contract
No. EGAT_____

Gentlemen :

In accordance with the provision of the Contract for _____No. EGAT_____dated_____(hereinafter referred to as the Contract), the contents of which have been noted by us that Messrs._____(hereinafter referred to as the Contractor) has to deposit with Electricity Generating Authority of Thailand, (hereinafter referred to as EGAT) a Maintenance Security to guarantee the proper functioning of the_____ of the Contract as specified in Article F-10. Maintenance Guarantee in the amount of _____ (in words : _____) which is ten (10) per cent, round up to the nearest whole number, of the total Contract Price or ten (10) per cent, round up to the nearest whole number, of each schedule of the said Work, excluding the cost of installation supervisor and cost of services (if any), we, the _____ as instructed by the Contractor, agree unconditionally to irrevocably guarantee as primary Obligor, the payment to EGAT at its first demand, without whatsoever right of objection on our part and without its first claim with the Contractor giving EGAT the right of claim for penalty, damages, liquidated damages or any expenses for which the Contractor may become liable to EGAT under the Contract.

We further agree that no extension of time, change in, addition to or other modification of terms of the Contract or work to be performed thereunder, or of the Specifications or other Contract Documents, which may be made between EGAT and the Contractor, shall in any way release us from any liability under the Maintenance Security, and we shall thereby waive notice of any such extension of time, change, addition or modification.

This Maintenance Security shall be valid and remain in full effect for a period of two (2) Years from the day immediately following the date of the acceptance of Equipment. If necessary, this Maintenance Security shall be extended as specified in Article F-10. Maintenance Guarantee.

Yours very truly,

_____
Authorized Signature

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SPECIMEN OF MAINTENANCE GUARANTEE

(For Equipment with One-Year Guarantee Period)

To : Date :

Electricity Generating Authority of Thailand
Bangkruai, Nonthaburi 11130
Thailand

Re : Maintenance Security for Contract
No. EGAT_____

Gentlemen :

In accordance with the provision of the Contract for _____No. EGAT_____dated_____(hereinafter referred to as the Contract), the contents of which have been noted by us that Messrs._____(hereinafter referred to as the Contractor) has to deposit with Electricity Generating Authority of Thailand, (hereinafter referred to as EGAT) a Maintenance Security to guarantee the proper functioning of the_____ of the Contract as specified in Article F-10. Maintenance Guarantee in the amount of _____ (in words : _____) which is ten (10) per cent, round up to the nearest whole number, of the total Contract Price or ten (10) per cent, round up to the nearest whole number, of each schedule of the said Work, excluding the cost of installation supervisor and cost of services (if any), we, the _____ as instructed by the Contractor, agree unconditionally to irrevocably guarantee as primary Obligor, the payment to EGAT at its first demand, without whatsoever right of objection on our part and without its first claim with the Contractor giving EGAT the right of claim for penalty, damages, liquidated damages or any expenses for which the Contractor may become liable to EGAT under the Contract.

We further agree that no extension of time, change in, addition to or other modification of terms of the Contract or work to be performed thereunder, or of the Specifications or other Contract Documents, which may be made between EGAT and the Contractor, shall in any way release us from any liability under the Maintenance Security, and we shall thereby waive notice of any such extension of time, change, addition or modification.

This Maintenance Security shall be valid and remain in full effect for a period of one (1) Year from the day immediately following the date of the acceptance of Equipment. If necessary, this Maintenance Security shall be extended as specified in Article F-10. Maintenance Guarantee.

Yours very truly,

_____
Authorized Signature

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Drawings and Documents to be Furnished by the Contractor
(For Control and Protection Equipment)

The Contractor shall submit by registered mail and/or by electronic files uploaded via document management system with the drawings and other documents listed below by the designated deadlines.

Should EGAT require the Contractor to submit the drawings and documents in electronic files via EGAT's document management system, the Contractor is also required to submit the drawings and documents in Print and CD-ROM at the number of copies listed in the parenthesis below.

Drawings/Documents	No. of copies		Deadline and Remarks
	P	CD-ROM	
Manufacturing and Delivery Schedule	1 (-)	- (-)	Within 60 Days after confirmation of letter of Award of Contract
Quality Assurance Program (If requested by EGAT)	1 (-)	- (-)	Within 60 Days after confirmation of letter of Award of Contract
Drawings or Documents "RELAY AND EQUIPMENT INSTRUCTION MANUAL"	1 (-)	- (-)	Within 90 Days after confirmation of letter of Award of Contract
Drawings or Documents "FOR APPROVAL"	1 (1)	- (-)	Within 90 Days after confirmation of letter of Award of Contract
Drawings or Documents "FOR REAPPROVAL"	1 (1)	- (-)	Within 30 Days after receipt of returned approval drawings for correction
Drawings "DRAFT-FINAL DRAWING"	1 (1)	- (-)	Within 30 Days for P and 60 Days for CD-ROM after receipt of returned approved drawings
Drawings and Documents "FINAL DRAWING or FINAL DOCUMENT"	1 (1)	1 (1)	Within 20 Days after Equipment delivery
Test Procedure (Factory Test)	1 (-)	- (-)	Within 90 Days after confirmation of letter of Award of Contract
Test Schedule (Factory Test)	1 (-)	- (-)	Not less than 60 Days before testing for foreign supply Not less than 30 Days before testing for local supply
Test Report (Factory Test)	1 (-)	- (-)	Upon completion of tests
Instruction Manuals	- (-)	3 (3)	30 Days before first shipment/delivery

Note : P = Print Drawing or Document
CD-ROM = Compact Disc-Read Only Memory with capacity of approximate 700 Mbytes conforming to ISO 9660

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Drawings and Documents to be Furnished by the Contractor (For Fault Recording System)

The Contractor shall submit by registered mail and/or by electronic files uploaded via document management system with the drawings and other documents listed below by the designated deadlines.

Should EGAT require the Contractor to submit the drawings and documents in electronic files via EGAT's document management system, the Contractor is also required to submit the drawings and documents in Print and CD-ROM at the number of copies listed in the parenthesis below.

Drawings/Documents	No. of copies		Deadline and Remarks
	P	CD-ROM	
Manufacturing and Delivery Schedule	1 (-)	- (-)	Within 60 Days after confirmation of letter of Award of Contract
Quality Assurance Program (If requested by EGAT)	1 (-)	- (-)	Within 60 Days after confirmation of letter of Award of Contract
Drawings or Documents "FRS AND EQUIPMENT INSTRUCTION MANUAL"	1 (-)	- (-)	Within 90 Days after confirmation of letter of Award of Contract
Drawings or Documents "FOR APPROVAL"	1 (1)	- (-)	Within 90 Days after confirmation of letter of Award of Contract
Drawings or Documents "FOR REAPPROVAL"	1 (1)	- (-)	Within 30 Days after receipt of returned approval drawings for correction
Drawings "DRAFT-FINAL DRAWING"	1 (1)	- (-)	Within 30 Days for P and 60 Days for CD-ROM after receipt of returned approved drawings
Drawings and Documents "FINAL DRAWING or FINAL DOCUMENT"	1 (1)	1 (1)	Within 20 Days after Equipment delivery
Test Procedure (Factory Test)	1 (-)	- (-)	Within 90 Days after confirmation of letter of Award of Contract
Test Schedule (Factory Test)	1 (-)	- (-)	Not less than 60 Days before testing for foreign supply Not less than 30 Days before testing for local supply
Test Report (Factory Test)	1 (-)	- (-)	Upon completion of tests
Instruction Manuals	- (-)	3 (3)	30 Days before first shipment / delivery

Note : P = Print Drawing or Document
CD-ROM = Compact Disc-Read Only Memory with capacity of approximate 700 Mbytes conforming to ISO 9660

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Drawings and Documents to be Furnished by the Contractor
(For All Equipment except Control and Protection Equipment and Fault Recording System)

The Contractor shall submit by registered mail and/or by electronic files uploaded via document management system with the drawings and other documents listed below by the designated deadlines.

Should EGAT require the Contractor to submit the drawings and documents in electronic files via EGAT's document management system, the Contractor is also required to submit the drawings and documents in Print and CD-ROM at the number of copies listed in the parenthesis below.

Drawings/Documents	No. of copies		Deadline and Remarks
	P	CD-ROM	
Manufacturing and Delivery Schedule	1 (-)	- (-)	Within 60 Days after confirmation of letter of Award of Contract
Quality Assurance Program (If requested by EGAT)	1 (-)	- (-)	Within 60 Days after confirmation of letter of Award of Contract
Drawings or Documents "FOR REFERENCE")	4 (2)	- (-)	Within 90 Days after confirmation of letter of Award of Contract
Drawings or Documents "FOR APPROVAL"	4 (-)	- (-)	Within 60 Days for foundation, steel supporting structure (if any) and within 90 Days for others after confirmation of letter of Award of Contract
Drawings or Documents "FOR REAPPROVAL"	4 (-)	- (-)	Within 30 Days after receipt of returned approval drawings for correction
Drawings and Documents "FINAL DRAWING or FINAL DOCUMENT"	4 (2) *4 (-)	- (-)	Within 30 Days after receipt of approved drawings
Final Design Data	4 (-)	- (-)	Within 150 Days after confirmation of letter of Award of Contract
Test Procedure (Factory Test)	1 (-)	- (-)	Within 150 Days after confirmation of letter of Award of Contract
Test Schedule (Factory Test)	1 (-)	- (-)	Not less than 60 Days before testing for foreign supply Not less than 30 Days before testing for local supply
Test Report (Factory Test)	1 (-)	- (-)	Upon completion of tests
Installation Instruction	9 (7)	5 (5)	60 Days before first Shipment / Delivery
Instruction Manuals	9 (7)	5 (5)	Before Shipment / Delivery

Note : P = Print Drawing or Document
CD-ROM = Compact Disc-Read Only Memory with capacity of approximate 700 Mbytes conforming to ISO 9660
*For Transmission Line Insulator, Hardware Assemblies and Line Accessories, Transmission Line Steel Tower, HTLS Transmission Line Conductor and Invar Transmission Line Conductor.

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SECTION H

BILL OF MATERIALS

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H. BILL OF MATERIALS

H -1. Bill of Materials

The following Bill of Materials sheets are attached hereto and made a part of the Contract Documents :

BM No.	Description	Page
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2	BILL OF MATERIALS FOR ITEM 1-2	H5
3	BILL OF MATERIALS FOR ITEM 2-1	H6
4	BILL OF MATERIALS PATCH CORD CABLE	H7

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BID.NO.BBS1-DSS-01

BILL OF MATERIALS ITEM 1-1

BILL OF MATERIALS FOR PROTECTION AND METERING EQUIPMENT						QTY					
Item No.	Description	PD ref. no.	Typical ref.	Unit	PANEL 1R	PANEL 2R	PANEL 3R	PANEL METER	PANEL BCU-1	PANEL BCU-2
1	PRIMARY BUS PROTECTIVE IED (87B, 95B AND 50BF) (See NOTE 12)	32 Type 1	-	Ea	1					
2	SECONDARY BUS PROTECTIVE IED (87B, 95B AND 50BF) (See NOTE 12)	32 Type 1	-	Ea	1					
3	PRIMARY LINE PROTECTIVE IED (87L, 95L, 21, 67N, 67/67N, 81, 27, 51/51G, 51S/51SG, 50BF1, 50BF2, 79 AND 25) MULTI-MODE	32 Type 2	-	Ea		Suppy By EGAT 4 EA				
4	PRIMARY LINE PROTECTIVE IED (87L, 95L, 21, 67N, 67/67N, 81, 27, 51/51G, 51S/51SG, 50BF1, 50BF2, 79 AND 25) SINGLE-MODE	32 Type 3	-	Ea						
5	PRIMARY LINE PROTECTIVE IED (87C, 95C, 51C/51CG, 50BF1 AND 50BF2)	32 Type 4	-	Ea						
6	SECONDARY LINE PROTECTIVE IED (87L, 95L, 21, 67N, 67/67N, 81, 27, 51/51G, 51S/51SG, 50BF1, 50BF2, 79 AND 25) MULTI-MODE	32 Type 2	-	Ea						
7	SECONDARY LINE PROTECTIVE IED (87L, 95L, 21, 67N, 67/67N, 81, 27, 51/51G, 51S/51SG, 50BF1, 50BF2, 79 AND 25) SINGLE-MODE	32 Type 3	-	Ea						
8	SECONDARY LINE PROTECTIVE IED (87C, 95C, 51C/51CG, 50BF1 AND 50BF2)	32 Type 4	-	Ea						
9	PRIMARY TRANSFORMER PROTECTIVE IED (87K-5 RES, 95K, 51T/51TG, 51/51G1, 51/51G2, 51GB1, 51GB2, 51OL, 59N, 50BF1, 50BF2, 81 AND 27)	32 Type 5	-	Ea	2	1	2			
10	SECONDARY TRANSFORMER PROTECTIVE IED (87K-5 RES, 95K, 51T/51TG, 51/51G1, 51/51G2, 51GB1, 51GB2, 51OL, 59N, 50BF1, 50BF2, 81 AND 27)	32 Type 5	-	Ea	2	1	2			
11	PRIMARY CAPACITOR BANK PROTECTIVE IED (60C, 51C/51CG, 59C, 27C AND 50BF)	32 Type 6	-	Ea						
12	SECONDARY CAPACITOR BANK PROTECTIVE IED (60C, 51C/51CG, 59C, 27C AND 50BF)	32 Type 6	-	Ea						
13	BAY CONTROL UNIT (BCU)	32 Type 8	-	Ea					5	6
14	TEMPERATURE TRANSDUCER (TEMP-TDR)	04	-	Ea					1	
15	DC VOLTAGE TRANSDUCER (DC-TDR)	-	-	Ea					1	
16	AC VOLTAGE TRANSDUCER (AC-TDR)	-	-	Ea						
17	43RCC	20	TP-E-9.1	Ea					1	
18	43CCS	20	TP-E-9.1	Ea					1	
19	TEST SWITCH FOR METER	-	-	Ea				4		
20	ENERGY METER	-	TP-E-10.21 TP-E-20.11	Ea				4		
21	DC UNDERVOLTAGE RELAY (27XR, 27XD)	-	-	Ea				2	1	1
22	MINIATURE BREAKER (C Curve for PT CCT,K Curve for AC/DC Supply)	20	-	Ea	lot	lot	lot	lot	lot	lot
23	TERMINAL BLOCK FOR CONTROL & VT, CT, DISCONNECT KNIFE AND ACCESSORIES	18	TP-E-20.14	Set	lot	lot	lot	lot	lot	lot
24	SWING RACK BLANK PANEL AND ACCESSORIES	18	TP-E-20.14	Ea	1	1	1	1	1	1

BILL OF MATERIALS FOR COMMUNICATION EQUIPMENT					QTY				
Item No.	Description	PD ref. no.	TYPICAL ref.	Unit	PANEL GPS AND GATEWAY	PANEL ESW-P(A)	PANEL ESW-P(B)	PANEL ESW-S	PANEL E1 CONV
25	ETHERNET SWITCH	33	TP-E-20.6	Ea		5	5	6	
26	FIBER DISTRIBUTION UNIT (FDU) WITH ACCESSORIES	34	TP-E-20.6	Set		4	4		
27	E1(2Mbps) CONVERTER (See NOTE 11)	-	TP-E-10.20	Ea					Suppy By EGAT 4 EA
28	FIBER OPTIC TO E1(2Mbps) CONVERTER	-	TP-E-10.20	Set				lot	lot
29	COAXIAL CABLE	-	TP-E-10.20	Set					lot
30	GPS DEVICES AND ACCESSORIES	36	TP-E-20.10	Set	2				
31	GATEWAY	35	TP-E-20.10	Set					
32	PATCH CORD CABLE (See NOTE 8 and Bill of material for Patch Cord Cable)	24	-	Set		lot	lot	lot	
33	MINIATURE BREAKER (C Curve for PT CCT,K Curve for AC/DC Supply)	20	-	Ea	lot	lot	lot	lot	lot
34	TERMINAL BLOCK FOR CONTROL & VT, CT, DISCONNECT KNIFE AND ACCESSORIES	18	TP-E-10.19	Set	lot	lot	lot	lot	lot
35	19"RACK BLANK PANEL AND ACCESSORIES	18	TP-E-10.19	Ea	1	1	1	1	1

BILL OF MATERIALS FOR STATION EQUIPMENT					QTY
Item No.	Description	PD ref. no.	TYPICAL ref.	Unit	
36	COMPUTER FOR HMI SERVER, ACCESSORIES AND SUPERVISORY SOFTWARE	29	TP-E-20.8	Set	
37	COMPUTER FOR ENGINEERING WORKSTATION AND ACCESSORIES	29	TP-E-20.8	Set	1
38	CONSOLE DESK AND ACCESSORIES	29	TP-E-20.8	Set	1

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BILL OF MATERIALS FOR MERGING UNIT CUBICLE							QTY																					
Item No.	Description	Card	Point QTY.		PD ref. no.	Typical ref.	Unit	MUC 800		MUC 801-1		MUC 801-2		MUC 802-1		MUC 802-2		MUC 803-1		MUC 803-2		MUC 804		MUC 805		MUC 806-1		MUC 806-2		MUC 807-1		MUC 807-2	
								PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC	PRI	SEC
39	MERGING UNIT ORDERING 1	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
40	MERGING UNIT ORDERING 2	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
41	MERGING UNIT ORDERING 3	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
42	MERGING UNIT ORDERING 4	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
43	MERGING UNIT ORDERING 5	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
44	MERGING UNIT ORDERING 6	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
45	MERGING UNIT ORDERING 7	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
46	MERGING UNIT ORDERING 8	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
47	MERGING UNIT ORDERING 9	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
48	MERGING UNIT ORDERING 10	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
49	MERGING UNIT ORDERING 11	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
50	MERGING UNIT ORDERING 12	VMU	AI		27	TP-E-20.9	Ea																								
		AMU	AI																												
		DMU	BI																												
		DMU	BO																												
		CMU	AI																												
51	TIME SYNC MERGING UNIT (IF ANY)				27	-	Ea																								
52	MINIATURE BREAKER 6A, 1 POLE FOR DC				-	TP-E-20.4 TP-E-20.12	Ea			lot		lot		lot		lot		lot		lot										
53	AUXILIARY TRIPPING RELAY				-	TP-E-20.4 TP-E-20.12	Ea			lot		lot		lot		lot		lot		lot										
54	KNIFE SWITCH				-	TP-E-20.4 TP-E-20.12	Ea			lot		lot		lot		lot		lot		lot										
55	TRANSFORMER TAP POSITION TRANSDUCER (R-TDR)				04	-	Ea					lot				lot				lot										
56	TEMPERATURE TRANSDUCER (TEMP-TDR) WITH TEMPERATURE DETECTOR				04	-	Ea					lot				lot				lot										
57	FIBER DISTRIBUTION UNIT (FDU) WITH ACCESSORIES				34		Ea	lot		lot		lot		lot		lot		lot		lot		lot		lot							
58	NORMAL/MAINTENANCE SWITCH (4 NO CONTACTS)				20	TP-E-9.1	Ea	lot		lot		lot		lot		lot		lot		lot		lot		lot							
59	CURRENT & POTENTIAL TEST SWITCH (TS)				-	-	Ea	lot		lot		lot		lot		lot		lot		lot		lot		lot							
60	PATCH CORD CABLE				24	-	Set	lot		lot		lot		lot		lot		lot		lot		lot		lot							
61	DC UNDERVOLTAGE RELAY (27XR,27XD)				-	TP-E-20.4 TP-E-20.12	Ea	lot		lot		lot		lot		lot		lot		lot		lot		lot							
62	MINIATURE BREAKER (C Curve for PT CCT,K Curve for AC/DC Supply)				20	-	Ea	lot		lot		lot		lot		lot		lot		lot		lot		lot							
63	TERMINAL BLOCK FOR CONTROL & VT, CT, DISCONNECT KNIFE AND ACCESSORIES				28	-	Set	lot		lot		lot		lot		lot		lot		lot		lot		lot							
64	BLANK MERGING UNIT CUBICLE, ACCESSORIES AND COOLING SYSTEM				28	-	Ea	1		1		1		1		1		1		1		1									

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BID.NO.BBS1-DSS-01
BILL OF MATERIALS ITEM 1-1

NOTE
1. SEE SPECIFICATION NO.1008 FOR DETAIL OF PANELS AND EQUIPMENT.
2. MERGING UNIT CUBICLE SHALL BE DESIGNED BY CONTRACTOR AND SUBMITTED TO EGAT FOR APPROVAL.
3. FIBER DISTRIBUTION (FDU) IN MERGING UNIT CUBICLE SHALL BE PROVIDED SUFFICIENTLY TO THE QUANTITY OF OPTICAL FIBER CABLE FROM EQUIPMENT.
4. ALL BOLTS, NUT AND OTHER ACCESSORIES SHALL BE MADE OF CORROSION RESISTANCE METERIAL OR PROTECTED BY GALVANIZING.
5. TERMINAL BLOCKS WITH DESIGNATION LABEL SUITABLE FOR TERMINAL LUG FOR COPPER CABLE SIZE UP TO 2x6 sq.mm THESE TERMINAL STRIPS SHALL BE 600 V. MOLDED NONFLAMMABLE THERMOSETTING MATERIAL TYPE OR 6.6 POLYMIDE THERMOPLASTICS WITH INSULATING BARRIER BETWEEN ADJACENT TERMINALS.
6. SPARE PATCH CORD CABLES WHICH ARE USED TO CONNECT BETWEEN IED AND ETHERNET SWITCH FOR EACH PANEL SHALL BE PROVIDED AS PER THE NUMBER OF DESTINATION ETHERNET SWITCH PANELS. FURTHERMORE, THE SPARE CABLES SHALL BE COMPLETELY INSTALLED TO BE READY TO USE.
7. ALL SPARE EQUIPMENT SHALL BE THE SAME ORDERING NUMBER AS SUPPLIED FOR ITEM NO. 1-1. IN CASE OF SPARE MERGING UNIT (MU), TWO (2) MUs OF EACH PROPOSED ORDERING NUMBER SHALL BE PROVIDED.
8. THE PATCH CORD IS USED TO CONNECT BETWEEN THE ETHERNET SWITCH AND ALL CONNECTED IED DEVICES.
9. THE PROPOSED MULTIFUNCTION PROTECTIVE IEDs SHALL BE OF ANY TYPE/MODEL SPECIFIED IN "EGAT ACCEPTED MULTIFUNCTION RELAY LIST".HOWEVER, IN CASE OF THE UNCERTIFIED FUNCTIONS, DO AS FOLLOWS:
   -AT BIDDING STAGE, INDIVIDUAL TEST REPORTS OF THE ADDITIONAL FUNCTIONS SHALL BE SUBMITTED FOR APPROVAL BY EGAT.
   -AFTER LOA, THOSE IEDs SHALL BE MULTIFUNCTION TESTED IN EGAT'S LABORATORY. FAILURE TO COMPLY WITH EGAT'S REQUIREMENTS, THE CONTRACTOR SHALL REPLACE THE SAID IEDs WITH NO ADDITIONAL COST AND TIME EXTENSION.
10. MERGING UNIT SHALL BE INSTALLED IN EACH CUBICLE AS SPECIFIED ON TYPICAL DRAWING NO. TP-E-20.9
11. DURING BIDDING STAGE, THE TEST REPORT OR CERTIFIED DOCUMENT WHICH PROVES THE SUCCESSFUL INTEROPERATION BETWEEN THE PROPOSED IED AND E1 CONVERTER SHALL BE SUBMITTED FOR APPROVAL BY EGAT. IN ADDITION, AFTER BIDDING STAGE, THE INTERFACE BETWEEN IED AND E1 CONVERTER SHALL BE TESTED AS REQUIRED BY EGAT. IN CASE THE PROPOSED EQUIPMENT IS INCOMMUNICABLE, THE CHANGE SHALL BE UNDER CONTRACTOR'S RESPONSIBILITY WITHOUT ADDITIONAL CHARGES.
12. THE NUMBER OF 50BF FUNCTION BLOCKS IN BUS PROTECTION SHALL BE EQUAL TO 12 BLOCKS.
13. EGAT RESERVES THE RIGHT TO SELECT ORDERING NUMBER/OPTIONS OF EQUIPMENT.

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BID.NO.BBS1-DSS-01
BILL OF MATERIALS ITEM 1-2

BILL OF MATERIALS FOR SPARE EQUIPMENT CONTROL AND PROTECTION								
Item No.	Description						Unit	QTY.
1	BUS PROTECTIVE IED (87B, 95B AND 50BF)						Ea	1
2	LINE PROTECTIVE IED (87L, 95L, 21, 67N, 67/67N, 81, 27, 51/51G, 51S/51SG, 50BF1, 50BF2, 79 AND 25) MULTI-MODE						Ea	
3	LINE PROTECTIVE IED (87L, 95L, 21, 67N, 67/67N, 81, 27, 51/51G, 51S/51SG, 50BF1, 50BF2, 79 AND 25) SINGLE-MODE						Ea	
4	LINE PROTECTIVE IED (87C, 95C, 51C/51CG, 50BF1 AND 50BF2)						Ea	
5	TRANSFORMER PROTECTIVE IED (87K-5 RES, 95K, 51T/51TG, 51/51G1, 51/51G2, 51GB1, 51GB2, 51OL, 59N, 50BF1, 50BF2, 81 AND 27)						Ea	1
6	CAPACITOR BANK PROTECTIVE IED (60C, 51C/51CG, 59C, 27C AND 50BF)						Ea	
7	BAY CONTROL UNIT (BCU)						Ea	1
8	E1(2Mbps) CONVERTER						Ea	1
9	ETHERNET SWITCH						Ea	2
10	GPS RECEIVER AND ANTENNA						Set	1
11	TIME SYNC MERGING UNIT (IF ANY)						Ea	
12	MERGING UNIT ORDERING 1	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
13	MERGING UNIT ORDERING 2	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
14	MERGING UNIT ORDERING 3	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
15	MERGING UNIT ORDERING 4	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
16	MERGING UNIT ORDERING 5	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
17	MERGING UNIT ORDERING 6	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
18	MERGING UNIT ORDERING 7	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
19	MERGING UNIT ORDERING 8	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
20	MERGING UNIT ORDERING 9	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
21	MERGING UNIT ORDERING 10	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
22	MERGING UNIT ORDERING 11	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					
23	MERGING UNIT ORDERING 12	VMU	AI				Ea	
		AMU	AI					
		DMU	BI					
		DMU	BO					
		CMU	AI					

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BID.NO.BBS1-DSS-01
BILL OF MATERIALS ITEM 2-1

BILL OF MATERIALS FOR FAULT RECORDING SYSTEM					
No.	Description	PD ref. no.	TYPICAL ref.	Unit	**QTY**
1	DSS -- FRS, 48 ANALOG INPUT, 144 BINARY INPUT	19	TP-E-10.22 TP-E-20.3	Set	
2	DSS -- FRS, 64 ANALOG INPUT, 192 BINARY INPUT	19	TP-E-10.22 TP-E-20.3	Set	
3	DSS -- FRS, 80 ANALOG INPUT, 240 BINARY INPUT	19	TP-E-10.22 TP-E-20.3	Set	1
4	DSS -- FRS, 96 ANALOG INPUT, 288 BINARY INPUT	19	TP-E-10.22 TP-E-20.3	Set	
5	DSS -- FRS, 128 ANALOG INPUT, 384 BINARY INPUT	19	TP-E-10.22 TP-E-20.3	Set	

NOTE 1. The following are channel requirements of Fault Recording System.
- 3 analog voltage channels for each bus.
- 3 analog voltage channels for each line to PEA.
- 1 analog voltage channels for each line to EGAT.
- 3 analog current channels for each line bay.
- 3 analog voltage channels for transformer's bushing.
- 3 analog current channels for each feeder on transformer's low side.
- 3 analog current channels for each capacitor bank.
- 4 analog current channels for each tie transformer. The remaining analog input channels shall be current channels.

2. The Fault Recording System shall include the following additional functions for every line.
- Calculation of Fault Locator and Power Flow.

3. In case of breaker and a half bus arrangement, the summation of feeder current(2 CTs from different 2 MUs) shall be effectively provided for both FRS trigger data and PMU stream data.

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BID.NO.BBS1-DSS-01

BILL OF MATERIALS PATCH CORD CABLE

BILL OF MATERIALS PATCH CORD CABLE			
No.	Description	Unit	QTY
1	PATCH CORD CABLE LENGTH 5 Meter	Ea	
2	PATCH CORD CABLE LENGTH 10 Meter	Ea	10
3	PATCH CORD CABLE LENGTH 15 Meter	Ea	55
4	PATCH ORD CABLE LENGTH 20 Meter	Ea	80
5	PATCH CORD CABLE LENGTH 25 Meter	Ea	15

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SECTION I

SPECIFICATIONS

I. SPECIFICATIONS

I-1. Specifications

The following specifications are attached hereto and made a part of the Contract Documents :

Specification No.	Description	Page
1008 (Sept. 2024)	IEC 61850 Based Substation Protection and Automation System	1008-1 - 1008-91

DRAFT

SPECIFICATION NO. 1008

IEC 61850 BASED SUBSTATION PROTECTION AND AUTOMATION SYSTEM

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BIDNRBA1-DS-01

เอกสารไม่ควบคุม
รับรองสำเนาโดย หหอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

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BIOPBA-DS-01 DRAFT

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รับรองสำเนาโดย หผอ-ร. กสส-ร. อวส.
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1008-1 General Conditions. This functional specification covers the minimum requirements for engineering design, manufacture, inspection and testing, and installation of IEC 61850 based Substation Protection and Automation System (SA) to be used for substations of EGAT transmission system.

The scope of the standard IEC 61850 is to support the communication for all functions being performed in a substation. The goal of the standard is interoperability, i.e. the ability for Intelligent Electronic Devices (IEDs) from one or several manufacturers to exchange information and use the information for their own functions. The standard IEC 61850 supports the free allocation of functions to IEDs and, therefore, supports any kind of system philosophy covering different approaches in function integration, function distribution, and SA architecture.

The scope of supply shall be a complete integrated SA package, which shall be executed on a turnkey basis that involves all activities from "start to finish" covering site data collection, technical discussions with Contractor's design and O&M team, basic & detailed engineering, system configuring, software and hardware assessment, development and testing, procurement, manufacturing, factory acceptance and integration test, delivery, storage, installation, construction, site acceptance test, and commissioning.

The Contractor shall enclose a SA implementation plan from start to handover phase of the turnkey package including identification of Supplier's team and location, project definition, project scope understanding, compliance and non-compliance statement, data gathering, system input/output signal development based on data given in this functional specification, project responsibility identification, implementation plan during design, design review/testing, functional description, design integration tests acceptance and integrity tests, and site acceptance and integrity tests.

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1008-1.1 Information Required from the Bidder. The Bidder shall submit with his bid the name of the manufacturer, and the type or model of the equipment offered. Technical data, descriptive information, drawings and catalogs showing all significant characteristics and details, principles of operation, general arrangement and dimensions shall also be included to enable EGAT to determine the suitability of the equipment for its purposes. Whereas Proposal Data Forms are provided, the Bidders shall enter all information as directed. These requirements from the Bidders are very essential and failure of any Bidder to comply with these requirements may constitute reasonable cause for EGAT to cancel a part or all the Proposal from that Bidder.

1008-1.2 Codes and Standards. All equipment, materials, fabrication and testing under this Specification shall conform to the latest applicable standard specifications and codes contained in the following list, or to equivalent applicable standard specifications and codes established and approved in the manufacturer's country of the equipment. Whereas standards are mentioned by name, the following equivalent applicable standards may be used:

- IEEE Institute of Electrical and Electronic Engineers
- ANSI American National Standards Institute
- NEMA National Electrical Manufacturers Association
- NEC National Electrical Code
- ASTM American Society for Testing and Materials
- IEC International Electrotechnical Commission
- TIA Telecommunications Industry Association
- ITU International Telecommunication Union

Any details not specifically covered by these standards shall be subject to the approval of EGAT. In the event of contradictory requirements between such standards and this Specification, the terms of the Specification shall govern. The design/manufacture of the system shall conform to the latest edition of the Codes and Standards.

Noting that IEC 61850 standard mentioned in this specification is referred to IEC 61850edition 2.

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1008-2 General Requirements. SA shall be used for controlling, protecting and monitoring substations. At least from a logical point of view, SA comprises three (3) levels, the station level with the substation host, the substation HMI and the Gateway to the remote control center, i.e. National Control Center (NCC), Regional Control Center (RCC) and Group Control Center (GCC), the bay level with all the control and protection units and the process level with more or less intelligent process interfaces to the switchgear. Extended implementations show all three (3) levels equipped with IEDs. All implemented levels are interconnected by serial communication links. There is not only vertical communication between the levels (e.g. between bay and station level), but also horizontal communication within the level (e.g. between bay units for functions like interlocking in the bay level).

The substation shall continue to be operable even if any SA communications component fails. There shall be no single point of failure that will cause the substation to be inoperable. Adequate local monitoring and control shall be maintained. A failure of any component should not result in an undetected loss of functions or multiple and cascading component failures.

For some applications, particular provisions are necessary in the SA implementation and the communications system must take these into account. An example is that the substation master may be redundant with automatic failover. If communication elements of the SA are redundant, there shall be no single failure mode that would disable both redundant elements. Redundant communication elements of the SA shall be powered by separate independent power sources (for example, separate battery or station service circuit) whereas such power sources exist. Redundancy is not mandatory and depends upon the importance of the substation, in other words, the consequences of an outage of that substation and the operator's philosophy.

A fail-safe design shall be provided. There shall be no single failure mode that causes the SA to initiate an undesired control action, such as tripping or closing a circuit breaker. In addition, SA failures shall not disable any available local metering and local control functions at the substation.

A single point of failure shall not disable critical functions (protection, primary control function, metering, etc.). To accomplish this requirement, the SA shall include the following characteristics:

- Protective functions shall operate autonomously.
- The SA may be used to execute control logic actions, such as automatic failover following a transformer fault, which are not considered time-critical. If such logic actions are used, then the Contractor shall clearly state the time (in milliseconds) to accomplish the failover.
- The SA HMI shall be capable of independent operation of the telecontrol interface to the control center.

System and data backup may be provided for the SA. Whereas backup is provided, a single unit failure in the SA shall not cause loss of data or prevent normal activity

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of the system. Being repaired and switched back to the normal configuration may require manual intervention. Critical communication links for SA functionality may be redundant or allow alternate routing to prevent a system outage due to a cut in the information transport infrastructure.

Increasing error rates shall not cause a sudden system outage but result in graceful degradation. There shall be facilities for error recovery to restore reliable operation of the SA.

The SA communication system shall deliver reliable data in the presence of transmission and procedural errors, varying delivery delays, and equipment failures in the communication facilities. It, thus, must provide the following:

- Detection of transmission errors in the noisy substation environment
- Recovery from link congestion
- Optional support for link, media and equipment redundancy

The integrity and consistency of the data delivered by the SA shall be as defined for integrity classes I1, I2 and I3 (in Item 3.5 of IEC 60870-4). The use of a specific integrity class shall be determined by the application that uses the delivered data.

1008-2.1 Environmental Conditions. The Contractor shall confirm that his proposed system shall be able to withstand and operate under the conditions specified in this section. The SA shall be located inside the switchgear room. The room is deemed to be unclassified, non-hazardous, air-conditioned safe area. All materials shall be selected and specially treated so that they will be satisfactory for use under the following climatic conditions:

Ambient Temperature Range	:	0°C to 55°C
Relative Humidity	:	95%

The equipment, however, shall meet the ANSI/IEEE C37.90 ambient temperature requirement of 55°C.

The design of all SA equipment shall ensure satisfactory operation in an electrically hostile environment of high voltage electrical installations. In order to prevent incorrect function or damage to the equipment when subjected to interference arising from power system switching, fault currents and lightning, all SA I/O circuits, and power supply circuits shall be provided with isolation and/or immunity to electrical interference. Whereas the inherent withstand capability of Remote I/O modules, Protective Relays, disturbance recorders, etc. does not meet the test requirements specified in IEC 870.3 class III, the interposing equipment with the required withstand characteristics shall be provided.

All control and protection equipment shall meet the requirements of IEC 1000-4-3 test level 3 with regard to immunity to radiated electromagnetic emissions from external sources. The SA shall meet the normal standards of electromagnetic compatibility applicable to the industrial environment as

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per IEC 61000. The performance of the system shall not be affected or in any way degraded by the use of portable radio transmitters/receivers.

Any electromagnetic disturbance generated by the SA shall not exceed a level which would affect the correct operation of both radio and telecommunications equipment. In addition, the SA shall have an adequate level of intrinsic immunity to external electromagnetic disturbance to enable it to operate as intended. The SA shall be immune to RFI (Radio Frequency Interference) and EMI (Electro Magnetic Interference).

The Contractor shall provide at least two (2) records of a third party's international standard type test, each of which is certified and issued by a representative of an internationally recognized testing laboratory or inspection firm, or an institute or a client inspector who is clearly not aligned with the manufacturer to verify that the complete SA is effectively screened against EMC.

Communications equipment shall be designed and tested to withstand the various types of induced conducted and radiated electromagnetic disturbances that occur in substations. Sources of disturbances are, for example:

- Lightning and switching surges
- Discharges and strokes in gaseous isolation media, like the commonly used SF6, producing fast transients
- Travelling waves in GIS, producing fast transients

The general immunity requirements for the industrial environment are considered not sufficient for substations. Therefore, dedicated requirements are defined in IEC 61000-6-5; details of these requirements and testing procedures are given in the parts of the IEC 61000 series.

Communications equipment may be subjected to various kinds of electromagnetic disturbances conducted by power supply lines, signal lines or directly radiated by the environment. The types and levels of disturbance depend on the particular conditions in which the communications equipment has to operate. Reference shall be made to IEC 61000-4-16, for magnetic fields as well as to IEC 61000-4-8 and IEC 61000-4-10.

1008-2.2 Power Supply Requirements. The SA shall be powered by 125V DC power supply used for the controller/server and communication devices. In case the Contractor has the requirement for an alternate or additional power supply which is specific to his offered equipment, it shall be a scope of the Contractor to transform the power to meet his equipment requirement.

The SA internal power supply distribution shall be distributed with dual redundancy to all components within the system. The marshalling cabinets (If required by EGAT) shall be sized so that they will not carry more than 75% of capacity under normal loads.

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The power supply system shall be adequately equipped to protect the SA from external electrical disturbances, surge suppression and isolation circuits. The SA shall include the capability of automatic start-up and initialization following restoration of power after an outage without need of intervention.

Power input fuses and LEDs for monitoring shall be provided on the front of the unit. All power supply failures shall be logged and reported to the master station. Overvoltage and undervoltage protection shall be provided within the power supply system to prevent the system internal circuit from being damaged as a result of a component failure in the power supply system and to prevent the system internal logic from becoming unstable and causing malfunction as a result of voltage fluctuations.

The performance of the communications equipment shall not be affected in the case of an interruption to the DC supply of duration. No damage shall be caused to the equipment by supply interruptions of any duration, nor shall the equipment respond to an interruption in a manner that could cause danger to other equipment or personnel.

1008-2.3 Basic Scope of Work. The scope includes design engineering, software development, system configuration, manufacturing, testing at works/factory, site acceptance tests, supply, delivery, erection, site configuration, testing, and commissioning of a modern state-of-the art distributed SA along with the existing EGAT's SCADA. The SA shall provide controls and acquire real time data from the various circuits within the new substation and, in addition, present readily understood information to the control room and the remote control centers.

The SA shall be designed to carry out the principal tasks of control of the transmission systems, data acquisition, display of parameters, data storage, reporting, fault recording and interfacing with switchgears, and relay panels. The SA shall include the features for controlling, monitoring, and supervision of the equipment and components concerning EGAT's HV substation, event recording, parameter setting, trending and display of alarms. The main purpose of the SA is to be an aid to control operators. Furthermore, failure of the SA must not stop operation of any part of the transmission systems.

Multi-level authorization such as monitoring (view), control, engineering and system manager level with respective password organization and key lock for access control shall be provided. In case of SA failure, all outputs shall take fail-safe state automatically. The failure shall not lead to plant tripping or system operating without control and shall enable safe take over by operator for manual control.

All elements of the SA system shall be based on a real time multi-tasking operating system. The system shall be user friendly and allow easy access for maintenance, testing and repair. The SA shall be based on a distributed

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architecture and all components shall be of approved and reliable design with highest attainable attributes for uniformity, interoperability and interchangeability. The design shall be modular to facilitate easy maintenance, fault diagnosis and repair of components as well as to support

installation and incremental expansion. It shall be possible to alter, extend or upgrade any element of the substation by simple addition of hardware with necessary software augmentation and configuration.

All furnished materials and equipment shall meet the design and environmental conditions as stated in this Specification and shall be new, sound, free of defects and of the rating and quantity specified. The SA shall comprise full station control, monitoring and communication functions. It shall enable station control via PC by means of a Human Machine Interface (HMI) and a control software package which performs the necessary system control and data acquisition functions.

The system shall be capable of having its computing power increased in the future by addition of computing systems. The scope shall include all equipment and services which may not be specifically stated herein but are needed for functional completeness of the system for meeting the intents, purposes, and requirements of the Specification. The offered SA shall be complete in all respects necessary for their effective and trouble-free operation with full coordination and integration of the electrical power distribution substation control, monitoring, and protection.

Final detailed Input/Output (I/O) list shall be prepared by the Contractor. It is responsibility of the Contractor to include all required I/Os in the tentative list from EGAT to meet all functional requirements as specified in this Specification. The Contractor shall size, design and engineer the SA based on functional requirements as shown in this Specification. Moreover, the Contractor shall provide system availability for controllers/servers, and reserve space for required modules in the future.

The system is required to be capable of expansion to the ultimate system size which includes all identified future equipment without any degradation of performance. The system software shall be designed to meet the requirements of ultimate capacity without further program development. Future units shall be added by defining their parameters interactively with the system generation software. The equipment as initially supplied and installed shall be capable of 25% extension of all functions simply by addition of plug-in modules for which all necessary wiring shall be provided. The design shall allow expansion, modification and testing with the minimum of disruption. Each controller/server supplied shall only utilize 60% of its memory and computing capacity with 40% spare capacity available at all times and for all computing requirements.

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1008-2.4 Drawings and Data Requirements. The Contractor shall submit for approval the following drawings and data, sufficient to fully demonstrate that the equipment to be furnished shall conform to the requirements and intent of this Specification. In addition, EGAT may request the additional document in case of more information is required.

1008-2.4.1 Metering and Relaying Diagrams. The metering and relaying diagrams of each substation are included in the Bidding Documents. The Contractor shall furnish metering and relaying diagrams in conformity with the specified requirements.

1008-2.4.2 AC Schematic Diagrams. Each AC schematic diagram shall show AC connections such as AC current and AC voltage which supplies to all metering and relaying equipment. Each diagram shall show wire designations, terminal numbers and appropriate cross-referenced symbols for interfacing between equipment.

1008-2.4.3 DC Schematic Diagrams. Each DC schematic diagram shall show the DC wiring for control, protection, indication, remote annunciation, etc., arranged in a schematic form. It shall also include the schematic diagram of the power circuit breaker which receives a trip signal from the protective relays specified in the Drawing of "Protective Device Functions" for each substation. The diagram shall show wire designations, terminal numbers and appropriate cross-referenced symbols for interfacing between equipment.

1008-2.4.4 Programmable Logic Schemes. Logic Schemes shall show details of the logic circuits for each individual IED. These schemes shall be required for each individual IED.

1008-2.4.5 HMI Graphic Display. System configuration drawings and documentation includes standard display assignments customs graphics, customized faceplates, reports, logs, etc. Instruction, application, and operator's manual for installation, commissioning and maintenance must be specific to the equipment as purchased and not of a general nature.

1008-2.4.6 Signal List. All GOOSE, SV, and MMS lists include their details and functions.

1008-2.4.7 Communication Network Connection Diagram. The diagram shall include architectural schemes of system and the supported protocols at various levels.

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1008-2.4.8 IP Address Design in Substation. The contractor shall supply the document that describe the criteria for assigning the IP address for all devices that required IP addresses in IEC 61850 substation and submit for approval by EGAT. The topology which is conforming to the assigned IP addressed shall be proposed by the contractor.

1008-2.4.9 Wiring Diagrams. Wiring diagrams shall show connections from point to point for all control and protection system equipment. All the wiring connections to the equipment on any one panel shall be shown on the same drawing. Inter-panel connections shall be properly identified on both the incoming and outgoing panel drawings.

1008-2.4.10 Nameplate Schedule Diagrams. A nameplate schedule diagram for each substation shall show designations on all nameplates. The wording of each nameplate designation shall be revised to satisfy physical limitations subject to the approval of EGAT.

1008-2.4.11 Equipment Layout Diagrams. Each equipment layout diagram shall show dimensions, location, and general layout of all panels and all equipment to be located on the panels.

1008-2.4.12 Panel Assembly. The Contractor shall provide for approval the general assembly drawings including dimensions, details of an arrangement plan and a section and floor plan complete with an anchor bolt setting plan.

1008-2.4.13 Technical Data Sheet. Technical specification of the system and its components, which shall include a description of the design, operation, construction, performance and maintenance aspects of the equipment. The Contractor shall supply the documents of equipment and software which are loadable in CD-ROMs.

1008-2.4.14 Bill of Materials. Enlisting major equipment to be mounted on the protective relay panel and marshalling cabinets, if not otherwise indicated elsewhere in this Specification, the bill of materials shall cover only the major equipment, or such equipment as will require particular information from the Bidder.

It is to be understood that all other associated auxiliary equipment and accessories, which are not listed in the bill of materials but necessary for the complete and sound functions of the panels and cabinets as described in this Specification and as generally accepted as the applicable standards, shall be furnished by the Contractor.

The proposed panels and cabinets shall give the best optimum result as called for in this Specification, and as basically required by standard electrical engineering practice. The Contractor, after having finished the design of the panels and cabinets, shall submit to EGAT for approval of all the design details including individual equipment of the panels and cabinets.

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all associated equipment in the substation, and overall functions of the schematic diagrams. EGAT shall review the schemes, and choose any proper functions required in this Specification or required for sound engineering practice of the panels and cabinets. If there are any necessary modifications to the scheme or additional equipment other than those originally proposed by the Bidder at the time of bidding, EGAT will return the scheme to the Contractor to carry out the required modification without any extra charge to EGAT.

1008-2.4.15 Test Form and Test Procedure. Test form and test procedure of each equipment shall be prepared by the contractor and submitted for approval by EGAT. The items included in documents are as specified in clause “0

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Testing and Commissioning."

1008-2.4.16 Training Courses for Installation. Requirement of the training courses are as specified in clause "1008-14.1 On Site Training."

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1008-3 Design and Operating Requirements. SA shall be divided into three (3) distinct levels:

- Station Level
- Bay Level
- Process Level

For the services of the data model, Interoperability requires the standardization of not only the data objects but also the access to them. Therefore, standardized abstract services also belong to IEC 61850. The most common ones include:

- Read: reading data such as the value of an attribute
- Write: for example, writing the value of a configuration attribute
- Control: controlling switching devices and other controllable objects using standardized methods such as “select before operate” or “direct operate”
- Reporting: for example, event driven reporting after value changes
- Logging: the local storage of timestamp events or other historical data
- Get Directory: in other words, to read out the data model (important part of self-description)
- File Transfer: for configuration, disturbance recording or historical data, (File Transfer Protocol (FTP) shall also be acceptable when MMS file service is not available).
- GOOSE: GOOSE is the acronym for generic object-oriented system event and is a service used for the speedy transmission of time critical information like status changes, blockings, releases or trips between IEDs.
- Sampled Value (SV): the SV service quickly transmits a synchronized stream of current and voltage sampled values.

The allowed propagation delay to achieve fast tripping shall be less than 5 ms. With a failure of the communication channel, alternative actions must be considered. This may result in degraded selectivity or slower tripping.

There is a substation LAN with the performance requirement of being able to deliver a trip signal from the sending IED application layer to the receiving IED application layer in 3 ms. In case that there is no process bus, VTs and CTs are directly hard wired to the protective relays. For the purpose of this case, the output of protective relays shall be hard wired to each circuit breaker. Command signals to a circuit breaker were used to trip and close its breaker.

A switchgear controller contains electronics for handling binary input and output signals (signal and power contacts). The device will communicate status information and commands through the process bus. The location of the electronics depends on a number of criteria. Primary apparatus with electronics integrated in the drive cubicles is one possibility. On the other hand, it must be possible to handle cases whereas the primary equipment does not yet contain communication interfaces. Here, system integrators need to mount the process electronics as near as possible to the primary equipment, e.g., to locate them within the marshalling kiosks.

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The operation of SA shall be independent from other systems. This is to avoid shutting down of the SA due to failures in other systems that can put the power system at risk from cascade shutdown. The SA shall use the Contractor's software and shall also incorporate the remote communication. It shall collect the data and information from the EGAT's substation and the relevant system (if required by EGAT).

The controller/server shall be arranged in a bus topology whereas all controllers and servers will be connected with interlinking long-distance bus data link as shown in the substation configuration drawing enclosed with the bidding document. The operator stations shall incorporate a Human Machine Interface (HMI) to enable visual monitoring of the transmission system, configuration, alarms, pre/post faults, fault trend, etc., and also the adjustment of the protective relay parameters. The HMI shall also allow the operator to fully control of all main switchgears in the transmission systems.

The system shall be so designed that personnel without any background of this technology can operate the system easily after they have been provided with some basic training. The offered products shall be suitable for efficient and reliable operation and maintenance support. The SA shall be of a state-of-the-art design suitable for operating in high voltage substation environmental, following the latest engineering practice, and ensuring long term compatibility requirements, continuity of equipment supply, and the safety of the operating staff. Failure behavior of the hardware, software and communication functions shall be addressed. Related diagnostic and rectification working instructions shall be provided.

System control shall be operated on a Windows based PC, with the industrial computer (PC) operated by a keyboard and an optical mouse. The following HMI functions shall be provided:

- Acquisition and plausibility check of switchgears status (single line diagram display)
- Control of switchgears (disable and lock by password)
- Remote checking of device parameters, setting change and activation of alternative parameters sets in the connected protective relays
- Display of actual measured values (voltage, current, frequency, active power, reactive power, transformer's tap position, winding temperature, oil temperature). The accuracy of the channels for analog values shall not be worse than 0.2% from the unit input to display.
- Display of sequence of events
- Display of alarms
- Display of trend
- Sequence control functions and interlock programming
- Disturbance records and fault location (local and remote analysis)
- System self-supervision
- Hard copy printing
- System monitoring function

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For display of alarm annunciation, lists of events, etc., a separate HMI view node shall be provided. All operations shall be performed with mouse and/or a minimum number of function keys and cursor keys. The function keys shall imply different meanings depending on the operation. The operator shall see the relevant meanings as function tests displayed in the command field (i.e. operator prompting).

Automatic program load shall be included in all computers, providing for simple and rapid startup of the system by the user. The processor shall provide an orderly shutdown without program or data corruption when power failure or power supply out of tolerance occurs. When power is restored within tolerance, the processor shall restore to normal operation automatically and shall initiate routines to scan and update the database/announce any changes or alarms, which have been stored during the power failure.

Security of control selections is paramount and every precaution in the software and hardware design and implementation shall be taken to ensure that false selection of a control is minimized. Failure of a data channel, which interrupts the transmission of data either permanently or intermittently, shall not lead to a false control selection. Injunction or noise into the receiver in this interrupted condition shall not lead to a false control selection.

It shall not be possible to make two (2) controls selections at different workstation at the same time or make a fresh selection until the previous selection has been completed or cancelled. Clear indication shall be given to the operator of the action required before a further selection can be made.

The operator stations shall be separately powered to ensure the avoidance of common mode of failure. It shall be possible to allow the duplicate equipment to be set up and tested independently of the other to ensure that equipment is in working order. Common equipment shall be minimized and shall be powered jointly from both main and standby sources. It shall not be possible for failure of any operator workstation, communication channel or peripheral equipment to jeopardize the continued working of the rest of the system.

1008-3.1 SA Architecture and Function Hierarchy. The SA (Substation Automation) shall be integrated with IEDs such as electronic microprocessor-based numerical type protective relays/devices used on the switchgear assemblies in the relay panels.

Remote I/Os of each feeder (incomer, bus-tie and outgoing feeder) shall be controlled by the Bay Control Unit which serves to perform its functions of measurement, control, protection and constitutes a complete and self-sufficient protection system with a non-volatile memory of all specific pre-programmed parameters. The units shall automatically be able to maintain operation capability after power interruption.

The SA shall provide integrated control, protection, measurement, historical trending with back-up and monitoring functions for all the feeders

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(incomers, bus-ties and outgoing feeders) by dedicated Engineering Workstation (EWS).

A dual redundant bus shall connect the workstations and printers to the controller. In case the communication link is broken at a single point, all devices are still accessible from the controller. The monitoring shall include analog indications of all system parameters (voltage, frequency, current, power, power factor, temperature, etc.) and digital indications of electrical equipment and switchgear status, alarms and trips. In addition, hardwired connections through volt-free contacts shall be provided to close/trip the feeders.

The EWS shall provide operator access for real-time monitoring of the power system status checking and/or updating protective relay settings and analysis after a fault. In order to ensure single party responsibility and trouble-free implementation of the SA and its interface with the EWS, the completed SA hardware/software and panels shall be provided by the Contractor.

The Contractor shall provide a simulation demonstration during Factory Acceptance Test of the communication links between the SA (including EWS) and other equipment using all the required hardware and software. The SA shall comprise:

- Central control unit i.e. controller and server
- User interface i.e. engineering workstations and printers
- Dual redundant bus
- Communication facilities via OFC enabling connection for the controller to Remote I/Os
- Remote I/Os with ring bus communication network
- Time reference (synchronized with GPS)

The interface between the SA and the EGAT SCADA shall be via dual redundant serial links utilizing IEC60870-5-104 protocol. The dual redundant links shall operate in a floating (master/slave) hot standby arrangement such that in the event of failure or one link, the second shall take over control in a smooth fashion and shall also provide local and remote alarm to indicate the failed unit. The Contractor shall provide for a minimum of 100 electrical devices per controller link and at least six (6) digital and control points per electrical device (e.g. close/ open/ reset/ available/ common alarm/ selected/ deselect) and for at least three (3) analog monitoring points per electrical device (e.g. voltage/ current/ power/ power factor).

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1008-3.2 Network Redundancy. The protection and control system performs critical application in electrical substations and in IEC 61850 based systems the communications network shall always be available, fast and secure. Network redundancy is required for substation automation system in order to guarantee that the network is resilient to communication failures.

The automatic network fault recovery shall be fast in order to minimize data losses and ensure proper functioning of the system. EGAT shall accept the redundancy protocols which permit achieving “zero-time” recovery or “bumpless redundancy”.

To achieve network redundancy, more than one path is required from source to destination which implies physical loops in the network. However, if a true loop occurs in an Ethernet network, the first broadcast frame will circulate endlessly, consuming all available bandwidth resulting in a ‘broadcast storm.’ layer 2 redundancy protocols like Rapid Spanning Tree Protocol (RSTP) prevent this problem by quickly forming a logical tree network that spans all switches on the network hence the name of the protocol at the base of the tree is found the ‘root bridge’ which is elected by all the switches. Spanning tree protocols ensure that certain links in the network are put into a backup state so that no traffic may flow across the link thus breaking any physical loops in the network. The backup links are re-enabled as needed when network problems occur to restore connectivity of all devices.

1008-3.3 Quality of Service. Network designing shall be in the concept of high availability networks according to international standard IEC 62439. Perfect solutions when no data loss during the network failures shall be determined. Examples of applications when “zero-time” recovery or “bumpless redundancy” may be required tripping via GOOSE messages or IEC 61850 process bus in high voltage substations. The ultimate goal of deploying redundant networks is to guarantee packet delivery for high priority traffic classes. PRP and HSR protocols duplicate all the data frames but are not lossless networks by definition. By duplicating a frame, those protocols only increase the delivery probability of a packet.

Even short-term congestion caused by certain data source consuming all the available bandwidth can create packet drop and affect higher level applications. Therefore, other network protocols and special techniques shall be required in order to provide guaranteed packet delivery for high priority traffic classes.

1008-3.4 VLANs and Traffic Prioritization with Class of Service. Virtual LAN (VLAN) defined in IEEE 802.1Q and Class of Service (CoS) defined in IEEE 802.1p share a common tag header in Ethernet frame. These two mechanisms provide two (2) basic features for IEC 61850 based communications network:

- Traffic segregation

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- Traffic prioritization

Traffic segregation permits restriction of certain types of traffic or data streams to determined segments of the network or to defined group of receivers. Traffic prioritization allows increasing performance of the critical applications such as GOOSE or sampled measured values. A VLAN allows the advantages of a logically separate network while sharing cabling and equipment infrastructure with other VLANs to reduce cost. Each VLAN has its own broadcast domain, meaning that Ethernet frames from one VLAN will not be transmitted onto another VLAN. This segregation provides a powerful security mechanism; users and IEDs on one VLAN cannot communicate with other VLANs unless a router is deployed to route between the VLANs.

1008-3.5 Event Logging, Reporting and Recording. The SCL file with the substation configuration data is also used to configure the 61850 client databases of the SCADA and the communication Gateways. This ensures that the data is consistent throughout the system. The engineering of the SCADA functionality in the HMI shall be not dependent on the communication standard.

Alarms and abnormal system conditions in the process shall be recorded by the hard copy device. Software shall generate the following reports in the required formats and shall be approved by EGAT. The system shall save the values of specified parameters at every user-defined interval in different groups (exact groups will be identified later). Logs shall be printed out periodically. The system shall print out any faults detected in the system e.g. card failures, any processor failure, peripheral failures, etc., immediately on occurrence.

Some events such as main circuit breakers switching, switching over from normal to stand by unit etc. shall be logged in the system with discrimination time between the events as 10 ms or less. Automatic log printing of events through the printer shall be possible. Sequence of Event (SOE) recording will show minimum resolution of 1 ms. It shall be possible to assign priority on selective basis for each event. Sampling shall be achieved with time discrimination of 10 ms. This resolution shall be guaranteed for the complete network.

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1008-4 Substation Automation and Communication Network. EGAT has a SCADA system that gathers data from substations and provides control over their operation. The primary objective is to provide operational reliability for the power system.

The SCADA system shall communicate with substations covered by this Specification using IEC 60870-5-104 protocol. These data communications shall be carried by EGAT's communication system (SDH, Fiber optic WAN). The Contractor shall provide a Fiber Optic Modem (FO Modem) or a device that has the following function at each station. The modem shall support bidirectional communications and provide an interface circuit between the EGAT's communication system and a serial RS-232 data circuit. The RS-232 circuit shall be used to interface the FO Modem to a Communications Gateway module (CGW), which shall provide and support an Ethernet connection in compliance with the IEC 61850 Ethernet profile. The CGW module shall physically connect to both Substation LANs through a fiber optic interface, using either two Ethernet connectors (preferred) or a single connector equipped with a bifurcated adapter. Operation with the two connectors is explained elsewhere in this technical Specification.

1008-4.1 Substation Gateway. The substation Gateway shall be a single point of access to substation data, helping utilities to streamline the automation process and to provide complete control of their environment. As the entry-level solution, it shall support redundancy, IEC 61850 Goose messaging and delivers strong security features. In this section, the term "gateway" is not about a device (L3 routing) that allow communication between different subnets or between local SA and WAN router.

Substation Gateway shall be the main station processor which has several roles, as described below:

- Principal Station Client: The Gateway shall be the principal station client, meaning it is responsible for collecting and maintaining the various data and files that comprise the station information base. Bay Control Units, Protective Relays, and other devices which shall be expected to report their data.
- Local Repository: The Gateway shall provide a local repository for the storage of station data. This is directly related to its role as principal station client. The information stored in the repository shall include real-time data and closely related support data (e.g. operational parameters, configuration parameters, text-based descriptions), as provided by the IEC 61850 information models.
- Proxy Server: The Gateway shall act as a proxy server. The intent is (1) to prevent access contention and congestion that may potentially disrupt the operation of field IEDs, (2) to simplify access mechanisms, and (3) to provide accountability (i.e. an audit trail) for past operations. The supported system logs shall be the StatusLog, CommandLog, ChangeLog, SubLog, and FileLog.

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- Supporting SCADA/EMS Operations: Dispatchers shall be able to control station equipment and gather system data command and polling messages transmitted from the SCADA/EMS control center. All application functions that must be implemented in the Gateway shall be listed below. They are described in more detail under the Specification heading titled Functional Requirements, Application Functions Support.
    - Heartbeat function
    - Trip Counters for circuit breakers
    - 'Rate-of-change' calculations for selected measurements
    - 'Breaker Operating Time' checks
- File Agent: The Gateway shall include a File Agent utility that provides file management, performs file transfers and deletions, and maintains the FileLog. The File Agent shall process all file transfers, which shall occur between the Gateway and other IEDs
- Communications Gateway: The Gateway shall supply and receive all application data. Lower-level communications functions are the responsibilities of the TCP/IP, Ethernet, and/or other communications software (if required by EGAT).

Communication Gateway Feature:

- A true IEC 61850 communication gateway
    - IEC 61850-6 for Substation Configuration Language (SCL)
    - IEC 61850-7 for communication structure for substation and feeder equipment and cross reference between protocols
    - IEC 61850-8-1 for mappings to MMS using TCP/IP over Ethernet
    - IEC 61850-8-1 for GOOSE service communication profile as an option
- Protocol conversion gateway for station automation
    - Process communication with the IEC 60870-5-104 and IEC 61850-8-1 protocols
    - Remote communication with the IEC 61850-8-1 and IEC 60870-5-104 protocols
- Connectivity to EGAT systems and devices
    - EGAT's SA
    - Intelligent Electronic Devices (Protective Relay, Bay Controller, FRS, Remote I/O)
- For communication redundancy the IEC 62439/PRP (parallel redundancy protocol) based communication is supported.
- Logic processor for implementing substation-level automation tasks. The framework includes HMI functions for controlling and monitoring sequence execution and a logic processor library for creating the sequence logic.

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- The Gateway data historian shall be a real-time database designed and optimized for process information management and extensive history recording.
- Fault detection, fault isolation and load restoration function shall gather data from protection and control IEDs installed in the radial distribution networks and substations and automatically runs fault detection.
- Remote communication with IEC 61850-8-1 and GOOSE services. Gateway shall support GOOSE messaging between several devices in the SA.
- GOOSE analyzer tool shall be used for monitoring and analyzing GOOSE signals in an IEC 61850 station bus. The Gateway shall support commissioning, operation, maintenance, and upgrade phases of the system.

1008-4.2 Industrial Firewall with routing feature. That is an industrially hardened cyber security appliance with integrated router, firewall, and Virtual Private Networking (VPN) functionality. The Router can be used to establish an electronic security perimeter around critical cyber assets found in control and automation systems, in order to prevent the disruption of operations by accidental or malicious acts. Ideally suited for electric power utilities, the industrial plant floor, and traffic control systems, the firewall is designed to protect and secure SCADA system networks connected directly to the Internet, or within the EGAT's Wide Area Network (WAN) or Local Area Network (LAN).

The firewall shall include the following features:

- Security: Firewall rules (incoming/outgoing, management), Layer 3 and Layer 2 Access Control Lists (ACL), IPSec VPN
- Management: SNMPv3, SSH, HTTP/HTTPS, CLI, RADIUS
- Redundancy: VRRP (Virtual Router Redundancy Protocol)
- LAN & Routing function: VLAN (IEEE 802.1Q), CoS (IEEE802.1P), static routing
- Monitoring: SCADA protocol, IEC61850 protocol, IEC60870-5-104 and other relevant protocol.
- Logging: log shall be sent via syslog to log collector.

The firewall shall provide at least 4 Fast Ethernet interfaces to connect LAN and WAN. Integrated modem and GPS time synchronization options are also available. Router shall provide routing local LAN (using private SA's IP address) and WAN gateway (using private EGAT's IP address).The firewall shall be hardened to the specification which provides a high level of immunity to electromagnetic interference (EMI) and heavy electrical surges typical of the harsh environments found in many industrial applications. An operating temperature range of -40 to +55°C shall be required as well as the Ingress Protection (IP) rating of at least IP20. With high availability, the Router shall be provided the option for integrated dual

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redundant power supplies each capable of accommodating a wide range of input voltages for worldwide operability. DC power supply shall be able to receive power from EGAT's DC power supply with the workable range of 43.2-57 VDC with no harm. The ability to have each power supply fed from different voltage sources thereby providing great flexibility in creating high availability systems.

1008-4.3 Computer set. At station level, sets of computers are installed in order to carry out various applications, e.g., control and monitoring of substation, system configuration, commission and maintenance test, asset management. Each set of computers is assigned for specific tasks. The list and number of accessories included in the set may be different regarding the assigned tasks, as shown further in subclauses. Minimum requirements of each item are described as follows.

Workstation

Part	Minimum requirements
Installation	Rack-mounted type
Operating System (OS)	Microsoft Windows Pro 64 bit
Central Processing Unit (CPU)	latest generation of intel Core i7 processor, 6 cores, 12 threads or equivalent
Memory (RAM)	ECC RAM, DDR4, 64 GB
Storage	1 TB, internal Solid-State Drive (SSD) M.2 PCIe type or equivalent
Build-in port	4 GE RJ45 ports 1 USB type-C port 1 USB type-A port 2 HDMI ports
Wireless connection	Wi-Fi according to IEEE 80.11ax Bluetooth 5.0
Power supply	125 VDC nominal, 80% to 125% range (preferable) or 220 VAC ± 10% with inverter power supply

Monitor

Part	Minimum requirements
Screen	24-inch LED color anti-glare
Resolution	1,920x1,080 pixels, 60 Hz vertical frequency
Response time	5 ms
Contrast ratio	1000:1
Build-in port	1 HDMI interface port
HDMI interface cable	1.5 meters long

Mouse
Bluetooth optical mouse with compatible mouse pad

Keyboard
Bluetooth English-Thai keyboard

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Speaker
Built-in speaker or sound bar speaker

Printer
Laser printer

Inverter power supply
As required, the power supply of the server is expected to be 125 VDC nominal. In the case that server does not support, the inverter power supply with the following specification shall be included.

DC input	
Range	125 VDC nominal, 80% to 125% range
Interface	Terminal block or equal to TB30-3P 3 poles 30 A 600 V
Protective	Overload protected by circuit breaker, cut off by control circuit when DC input low or high self-reconnect when DC input return to normal
AC input	
Range	220 VAC nominal ± 10%
Frequency	50 Hz
Interface	Terminal block or equal to TB30-3P 3 poles 30 A 600 V
Protective	Overload protected by circuit breaker, AC line is disconnected by a contactor if abnormal voltage and/or frequency is encountered
AC output	
Range	220 VAC (pure sine wave) ± 1%
Frequency	Auto sync with AC input (AC input is present) 50Hz ± 1% (AC input is not present)
VA	To cover power consumption of HMI set connected
Efficiency	Not less than 80%
Overload	Tolerate 120% overload, at least 10 minutes
Interface	Terminal block or equal to TB30-3P 3 poles 30 A 600 V

Network Attached Storage (NAS)

Part	Minimum requirements
Installation	Rack-mounted type
Central Processing Unit (CPU)	latest generation of intel Core i7 processor, 6 cores, 12 threads or equivalent
Memory (RAM)	64 GB DDR4 ECC
Storage	Hot swap, Nearline SAT, 512e format, 7200 rpm, raw storage capacity of 2 TB at RAID 5
Build-in port	2 GE RJ45 ports, 1 USB type-C port, 1 USB type-A port, 1 HDMI ports
Power supply	125 VDC nominal, 80% to 125% range, Out-of-band management capability

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Software	File sharing using Window SMB, Block storage sharing using NFS/iSCSI

1008-4.3.1 Human Machine Interface (HMI). The whole substation can be controlled and monitored via several dedicated operator interfaces situated in the control building or GIS building, called HMI. It shall enable substation control by means of control software package that shall perform the necessary system control and data acquisition functions. The descriptive language SCL is used as the formal representation of information.

To fulfill the SCADA function with redundancy capability, one (1) set of HMI shall be comprised of the following items.

- 2 workstations (with inverter, if any)
- 4 monitors
- 2 mouses
- 2 Keyboards
- 2 Speakers
- 1 Printer
- RedBox (in the case that HMI is not PRP supported)

Software
- Antivirus
- Microsoft Office
- SCADA

System security
- System hardening
- Patch management
- Authentication &user administration
- Detection of attacks
- Security routine check

User-authority Levels.
It shall be possible to restrict activation of the process pictures of each object within a certain user authorization group. Each user shall then be given access rights to each group of objects, e.g.

- Display only
- Normal operation (e.g. open/close of switchgear)
- Restricted operation (e.g. by-passed interlocking)
- System administrator

For maintenance and engineering purposes of the station HMI, the following authorization levels shall be available:

- No engineering allowed
- Engineering/configuration allowed
- Entire system management allowed

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The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights.

1008-4.3.2 Engineering Workstation (EWS). Engineering workstation is meant for maintenance and engineering purposes e.g. IED configuration, SCADA configuration, system monitoring.

To perform the application mentioned above, one (1) set of EWS shall be comprised of items as following.

- 1 workstation
- 1 monitor
- 1 mouse
- 1 keyboard
- RedBox
- 1 NAS

Software
The number of provided software licenses shall be match to the number of users regarding server virtualization, i.e., same set of software is expected to be available for every user.

- Server virtualization for 4 users
- Windows OS
- Remote desktop
- Storage back-up
- Antivirus
- Microsoft Office
- PDF editor
- IED and SCD configurator (as required for the complete system configuration of the proposed IEDs)
- AutoCAD
- Network work management tool

In the case of additional IED supplied to a substation with existing EWS, all related software required for IED configuration and integration to the system shall be provided and installed in the existing EWS for every user.

1008-4.4 Network Management Tool. shall be supplied. The main functions of the tool shall be:

- Fault Management—Detect, isolate, notify, and correct faults encountered in the network.
- Configuration Management—Configuration file management, and software management.

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- Performance Management—Monitor and measure various aspects of performance so that overall performance can be maintained at an acceptable level. The following items shall be monitored.
    - Bandwidth usage (real-time and historical data)
    - SCADA protocol, IEC61850 protocol, IEC60870-5-104 and other relevant protocol (real-time and historical data).
- Security Management—Provide access to network devices and corporate resources to authorized individuals.
- Accounting Management—Usage information of network resources. Provide historical information about the communication network and network device performance.
- Display: Display network topology and drill down to each equipment including IP address, communication, make, type, etc.

The purpose of fault management shall be to detect, isolate, notify, and correct faults encountered in the network. Simple Network Management Protocol (SNMP) shall be accepted for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behavior. All network devices shall be supported the network management tools, include routers, switches, servers, workstations. Network devices shall be capable of alerting management stations when a fault occurs on the systems.

All types of license and enough quantity of license shall be provided in order to enable Network Management Tool to do main functions.

The access rights shall be defined by passwords assigned during the login procedure. Only the system administrator shall be able to add/remove users and change access rights. The user access level (permissions, user groups) shall be assigned to accounts.

1008-4.5 Station Bus. The IEC 61850 station bus shall be use for communication between the bay level and the station level or between equipment like protective relays, bay controllers, SCADA gateways and local HMIs.

The term station-level, used in the context of this Specification, includes all station responsibilities and capabilities above bay-level. These include the following:

- Substation LANs, providing the means by which devices and applications exchange data within the station
- Station-level data management, data storage, and data retrieval mechanisms includes support for IEC 61850 information models, historical data, configuration data, diagnostic and maintenance data, and files (e.g. non-operational, configuration, application programs, software updates)
- System functions required to implement and support the general secondary system environment (e.g. time and date synchronization services)

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- Application functions which are necessary to meet specified business and/or functional objectives. These may include functions that would normally be implemented at the bay level, if the bay level is not equipped to provide them.
- Station-wide, centralized, functional interlocking
- Station-wide collection of maintenance data, diagnostic data, and statistical data for (1) primary system components, (2) secondary system components, and (3) application functions
- Local control of the station for O&M purposes
- Security
- Gateways for legacy subsystems

At station level, the entire station is controlled and supervised from the station HMI. But, it is possible to control and monitor the bay from the bay level IEDs using the local HMI, whenever required. Clear control priorities prevent the initiation of simultaneous operation of a single switch from more than one of the various control levels. The control operation also depends on the status of other functions like interlocking, synchrocheck, etc., as applicable.

1008-4.6 Process Bus. The IEC 61850 process bus shall be use for communication between the bay level and the process level. With a process bus, the connections between the Control and Protection IEDs and the process equipment (e.g. switchgear, current and voltage transformers) are as well implemented using communication services. In that case, the process equipment includes intelligent devices. The functionality of these intelligent devices depends on the technology of the primary equipment.

As a minimum, it includes a communication interface according to IEC 61850. One possibility to connect switchgear like circuit breakers or disconnectors to the process bus is, to use Remote I/O devices which shall be called “Digital Merging Unit”.

The information captured by Merging Units shall be distributed over the communication network; therefore, multiple IEDs can share the signals from the switchgear without the need of a marshalling box. In some cases, with new switchgear technology electronics may be integrated to the switchgear. An example is a circuit breaker using servo motors for the movement of the contacts. In these cases, it is straight forward to add a communication interface to the electronics in the switchgear for a direct connection to the process bus.

A merging unit provides a set of samples of the analog signal to the communication network. Typically, a merging unit will provide synchronized samples from the three phase currents and the three phase voltages. If conventional CTs and VTs are used, the merging unit will do the analog to digital conversion of the conventional output of the CTs and VTs. If non-conventional sensors like optical sensors are used, the Merging

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Unit will be integrated in the electronics required to process the optical signal.

1008-4.7 Ethernet Switches. IEC 61850 SA shall coordinate between various control devices, such as protective relays, controllers, switchgears, and Remote I/Os, which shall use the same protocol. KEMA certificate or equivalent certificate for all IEDs and Ethernet switches conforming to IEC 61850 is to be furnished as qualification requirement. The connections between Ethernet Switch and other equipment shall be joined at the FDU. The loss power measurement shall be performed to verify that the total loss in communication path between each 2 equipment are not greater than total attenuation regarding clause 1008-4.11 and 1008-4.12.1.

Ethernet Switch Communication Features:

- Layer 2 or 3 LAN Switch
- Highly integrated port 10/100/1000-Mbps Ethernet switch device
- High number of optical ports required, mainly fiber optical ports
- FE/GbE backbone for SCADA systems providing data channels
- Fast redundancy protocol needed for fast network recovery time
- IP Multicast Routing
- QoS (Quality of Service) and VLANs used to provide performance
- Levels needed for substation automation
- GOOSE messaging and SV supported

Protocol Standards:

- IEEE 802.3x: Flow control
- IEEE 802.3ad: Link aggregation
- IEEE 802.1p: Quality of Service (QoS)
- IEEE 802.1Q: VLAN (Virtual LAN)
- IEC 61850 GOOSE messaging and SV supported

Switching properties:

- Switching: store and forward
- Switching latency < 3us @ 100Mbit/s
- MAC address table size > 2000
- Traffic prioritization > 3 queues
- Port rate limiting (ingress & egress) in steps of kbps
- Configuration Recovery Adapter (CRA) or equivalent feature.
- Watchdog & rollback feature or equivalent feature

Time Synchronization:

- IEEE 1588 according to IEC 61850-9-3 (PTP)
- Management of the network via SNMP, Telnet, Web interface
- Class of Service (CoS) queues per port assures the lowest latency to high-priority traffic
- RMON (Remote Monitoring)

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- IGMPv3 snooping for multicast filtering
- SFP (Small Form-Factor Pluggable) diagnostic management
- Remote Monitoring, diagnostics with logging and alarms
- Port Mirroring (at least 1 port for each switch)

Protection:

- RSTP (Rapid Spanning Tree Protocol) according to IEEE 802.1D
- MRP (Media Redundancy Protocol) according to IEC 62439

Security:

- Multi-level user passwords
- SSH encryption
- Local log file and Syslog reporting
- RADIUS (Remote Authentication Dial In User Service) centralized password management
- SNMPv3 (Simple Network Management Protocol with encrypted authentication)
- Management of the network via SNMPv3
- Watchdog & rollback feature or equivalent feature
- Enable/disable ports, MAC based port security

Power Supply:

- Dual power inputs for redundant 125 VDC power supply with hot-swap capability.
- 125VDC power supply shall be able to receive power from EGAT's DC power supply with the workable range of 80-115% of nominal voltage with no harm.
- Fast reboot after power failure
- Switch shall remain operate even if one power supply fails or is disconnected.

Communication Ports

Ethernet Switch shall be a modular-design type with capability of supporting at least 28 GE ports. The ports required to fulfill functions are as follows

- Configuration: 1 GE/FE RJ45 port
- Backbone: 2 GE SFP slot with 1000BASE, 1310 nm, LC type SFP for OFC specified in clause 1008-4.11
- IED connected: FE/GE SFP slot with 100BASE, 1310 nm, LC type SFP for OFC specified in clause 1008-4.11
- EWS connected: 1 GE SFP slot with 1000BASE, 1310nm, LC type SFP for OFC specified in clause 1008-4.11

Alarm indication:

- Diagnostic LEDs
- 1 alarm contacts

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Ambient conditions:

- Utility grade switches supporting IEC61850
- EMC hardened; IEEE1613 compliant
- Extended temperature rating -10° to +85°C
- Fan-less design

1008-4.8 Redundancy Box (RedBox). The IEC 62439-3 standard provides zero recovery time in case of failure thus fulfilling the most demanding real-time requirements of substation automation. Using IEC 62439-3 all end nodes have two Ethernet ports each sending the same data over two independent links. Because the data is always available to the receiver via at least one of the two ports, no topology reconfiguration is required to recover from communication failure on any one port/link. Each end node has only one IP address and one MAC address shared by the two ports, which makes the configuration identical to that of a non-duplicated node. The link redundancy entity in each node is responsible of duplicating the frames at the source and discarding of duplicate frames at the destination.

The redundancy box or RedBox shall implements the PRP protocol for all the attached non-redundant-port devices and thus operates as a kind of redundancy proxy for all types of standard equipment. With RedBox, a singly attached node device can be communicated to the other IEDs within the parallel redundant LANs. Duplicates shall be introduced into each frame by a PRP connection or RedBox. A RedBox shall recognize duplicates, and if necessary discard them, on the basis of the clearly identifiable features contained in each frame (physical MAC source address and sequence number). The RedBox's power supply shall be able to receive power from EGAT's DC power supply which is 125VDC with the workable range of 80-115% of nominal voltage with no harm.

Communication Ports

The ports required to fulfill functions are as follows

- Network connected: 2 GE SFP slot with 1000BASE LC type SFP for OFC specified in clause 1008-4.11
- Computer set connected: GE RJ45 port

1008-4.9 E1 converter. IEEE C37.94 – ITU-T G.703 E1 converter is meant to be an interface between IED and EGAT's communication network for remote communication application, e.g., line differential function.

IEEE C37.94 Interface

	value
Port	1 port
Protocol	IEEE C37.94
Data rate	N x 64 kbps (N=1, 2, 3, …, 12)
Mode	Multi-mode
Connector type	ST or LC

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Wavelength	820 or 850 nm
Optical power budget	8 dB
Operating range	Up to 2 km

Table 4-1 IEEE C37.94 Interface of E1 converter

ITU-T G.703 Interface

	value
Port	1 port
Protocol	ITU-T G.703
Data rate	2048 kbps
Connector type	BNC
Impedance	Unbalance 75 Ohm
Frame structure	As per ITU-T G.704
Jitter performance	As per ITU-T G.823

Table 4-2 ITU-T G.703 Interface of E1 converter

Clock Timing

The converter shall comply with PDH compliant clock standard and shall be able to set clock timing mode as follows:

- Master mode: Clock generated internally
- Slave mode: Clock received from master clock (remote E1 converter) via E1 interface

Management

The converter shall be manageable via Command Line Interface (CLI) or web interface or software application or DIP switch with the following features.

- Configuration
  - C37.94 data rate (auto-configuration is acceptable)
  - Clock mode
  - Loopback control (C37.94 and E1 interface)
- Fault and performance monitoring
  - Alarm status (LOS, LOF, AIS)
  - Alarm log status
  - ITU-T G.821 error performance status

Fault report

Fault status shall be able to report externally via Simple Network Management Protocol (SNMP) at least version V2C and dry contact.

Power supply

	value
Rated voltage (V_r)	48 Vdc
Operational voltage range	0.8 to 1.2x V_r

Installation

The converter shall be designed for 19” rack panel. Mounting ears shall be supplied in additional for installation.

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1008-4.10 Time Synchronization and Grandmaster Clock. Precise time synchronization is required to ensure that devices have accurate clocks for system control and data acquisition. In substation automation, time synchronization is important especially for time stamping of sampled values (IEC61850-9-2LE) of current, and voltage values require accurate clocks inside the merging units. Precision timing is always in demand in automation technology when procedures require precise synchronization.

Grandmaster Clock shall be provided from GPS devices, a highly accurate source of synchronization, with a quick and easy solution to time synchronize intelligent electronic devices, computers, and measurement equipment.

GPS (Global Positioning System), a satellite-based technology, shall determine positions at points in time by utilizing navigational signals broadcast by multiple satellites, known as a satellite constellation.

The GPS devices and accessories shall include the following items:

- GPS antenna
- antenna cable
- surge voltage protector
- cable for surge voltage protector
- GPS receiver (converter, processor, and I/O ports)

Both antenna cable and cable for surge voltage protector shall be a low-loss coaxial type with 50 Ohm impedance.

GPS receiver shall be a high precision, time and frequency synchronization solution which provides 1PPS, IEEE 1588 (PTP), NTP (Network Time Protocol), and IRIG-B. It shall be used to synchronize the time-of-day and frequency across all nodes of the network from a GPS referenced source. The Multiple 1PPS and IRIG-B output ports shall be provided to synchronize local clock for all devices in the SA.

The GPS receiver shall automatically determine its position when it is turned on. During a weak or poor signal is encountered, the GPS receiver shall still determine its position. If the signal is interrupted and then restored, GPS receiver shall recover and resume calculating its position within 20 second.

For the consistency of the GPS receiver operation, supporting 2 sources of power supply is required. In the case of one power supply failure, GPS receiver shall be able to continue operating by utilizing another power supply. Furthermore, GPS receiver shall support the input voltage (from power supply) by built-in 125 VDC.

Time synchronizations for IEDs at bay and process level may be implemented separately. Because process bus inputs shall be sampled at high rates with independent digitizers distributed throughout the substation, time synchronization becomes critical for all applications. In general case, time synchronization of the process bus shall be required higher accuracy

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than of the station bus. However, a common precise time source may be applied for all network equipment. Precision Time Protocol (PTP) implemented in the substation shall be compliant to IEC/IEEE 61850-9-3 standard.

A redundant time source from another time satellite shall be applied to enhance system reliability. A fully redundant GPS-synchronized time reference shall be provided for demanding applications like Merging Unit. In case of an interrupted GPS signal (or events of inaccurate GPS signal), other clock may be used as a master clock. The selection is performed by the best master clock algorithm (BMCA) based on IEC/IEEE 61850-9-3 standard.

Time synchronization is used to precisely synchronize internal clocks in IEDs, MUs, protection/control units, Ethernet switches and wherever processes need to be synchronized in substation automation. Time synchronization helps to achieve accurate control and precise global analysis of network response, when, where and why any faults have occurred. In substation automation, the following applications require time synchronization:

- Files and Log contents
- Operator Command, Automatic interaction
- Trip, Interlocking, Event, and Alarm Information
- Transmission of Ethernet protocols like GOOSE and MMS
- Real-time process control of equipment like protective relays
- Real-time data acquisition from IEDs, and Remote I/Os
- Real-Time Measuring of equipment like MUs
- Fault recording for fault and performance analysis

1008-4.11 Optical Fiber Cable (OFC). The optical fibers shall be multimode graded index optical fiber with at least OM3 type. The bare fiber shall be high grade pure or doped silica. The required characteristic is shown in Table 4-3, in accordance with IEC 60793-2-10 standard.

Attribute	Unit	Value
Cladding diameter	µm	125±1
Cladding non-circularity	%	≤ 1
Core diameter	µm	50±2.5
Core-cladding concentricity error	µm	≤ 2
Core non-circularity	%	≤ 6
Primary coating diameter - uncolored	µm	245±10
Primary coating diameter - colored	µm	250±15
Proof Test Stress	GPa	≥ 0.69
Maximum attenuation coefficient at 850 nm	dB/km	≤ 2.50
Maximum attenuation coefficient at 1,300 nm	dB/km	≤ 0.80
Minimum modal bandwidth-length product for overfilled launch at 850 nm	MHz/km	1500

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Minimum modal bandwidth-length product for overfilled launch at 1300 nm	MHz/km	500

Table 4-3 OFC Characteristic

Each fiber and loose tube shall be color coded as specified in Table 4-4, according to TIA/EIA-598-D standard.

Position #	Color
1	Blue
2	Orange
3	Green
4	Brown
5	Slate
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua

Table 4-4 Color Code for Fiber identification

1008-4.11.1 Indoor-outdoor cable. Indoor-outdoor optical fiber cables shall support a bend radius of 10 times the cable outside diameter or less when not subject to tensile load, and 20 times the cable outside diameter or less when subject to tensile loading up to the cable's rated limit.

Cable structure of the OFC shall have high strength to protect the fibers from external forces, be easily installed without requiring any special care or equipment and shall be suitable for installation in cable trench.

1008-4.11.1.1 OFC with up to 12 cores. The cable shall be rated for the minimum tensile load of 2000 N and consist of at least:

- Multiple fiber cores, as required
- Loose tube filled with jelly compound for water repellant
- Additional Strength Member made of water blocking E-glass yarn material
- Ripcord
- Corrugated steel armored or steel wire armored
- Polyethylene with FR-LSZH outer sheath

1008-4.11.1.2 OFC with more than 12 cores. The cable shall be rated for the minimum tensile load of 2000 N and consist of at least:

- Multiple fiber cores, as required
- Multi-Loose tube filled with jelly compound for water repellant
- Central strength member
- Filler Rod, if needed

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- Additional Strength Member made of water blocking E glass yarn
- Ripcord
- Corrugated steel armored or steel wire armored
- Polyethylene with FR-LSZH outer sheath

1008-4.11.2 Indoor type. Cable structure of the OFC shall consist of at least:

- Multiple fiber cores, as required
- Tight buffer
- Additional Strength Member made of aramid yarn
- Polyethylene with LSZH outer jacket

1008-4.11.3 Patch cords. The thickness of jacket shall be at least 2 mm. Type of connector shall be matched with other proposed equipment. The length of patch cords shall be suitable for connecting between panels.

1008-4.12 OFC Cabling System. For the complete installation of communication infrastructure in substation, cabling system is required as depicted in typical drawing no. TP-E-20.13. The associated hardware is described as follows.

1008-4.12.1 EFLEX Conduit. The EFLEX conduit shall be made of high-density polyethylene with spiral corrugated pipe shape which is highly resistance to weather and corrosion, flexible, mechanically strong and suitable for installation in cable trench, above ground or direct burial. Hot-dip galvanized steel clamp shall also be provided, 1 set per each 1 meter of EFLEX conduit.

1008-4.12.2 Fiber Distribution Unit (FDU). The Fiber Distribution Units (FDUs) are installed to provide interconnects between incoming OFC and equipment. The following items shall be included in FDU:

- Snap-in plate with LC-type connectors for multimode OFC
- Splice tray
- Pigtail fiber optic cable (as many as FDU's ports)

Optical fiber splices, fusion or mechanical shall not exceed a maximum optical insertion loss of 0.3 dB. Connection attenuation allowance is up to 0.75 dB/connection.

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1008-5 Control and Protection IEDs.

The Intelligent Electronic Device (IED) is a microprocessor-based device that is used to monitor, control, and protect the primary equipment in the substation. The IED is expected to obtain the system measurement and communicate between each other to perform the monitoring, control and protection function and other complicate tasks.

Certification.

The conformance test of the IEDs shall be performed in accordance with IEC 61850-10 standard, by the third party who is a representative of an internationally recognized testing laboratory or inspection firm, or an institute or a client inspector who is clearly not aligned with the manufacturer.

Type test report.

Type tests shall be used to verify manufacturer's hardware/software specification regarding the testing standard. According to IEC 61850-3, the type tests shall cover the following items.

Test items	Referring standard
Dimensions of structure and visual inspection	IEC 60297-3-101
Functional requirements	Relevant IEC 61850 series
Product safety requirements - Clearance and creepage - IP rating - Impulse voltage - AC or DC dielectric voltage - Protective bonding resistance - Flammability - Single fault conditions	IEC 60255-27
EMC requirements - Emission - Immunity	 IEC 61000 series IEC 61000 series
Energizing quantities - Burden	 N/A
Climatic environmental requirements - Cold storage - Cold operation - Dry heat storage - Dry heat operation - Change of temperature - Damp heat cyclic - Damp heat steady state	 IEC 60068-2-1 IEC 60068-2-1 IEC 60068-2-2 IEC 60068-2-2 IEC 60068-2-14 IEC 60068-2-30 IEC 60068-2-78
Mechanical requirements - Vibration - Shock - Bump - Seismic	 IEC 60255-21-1 IEC 60255-21-2 IEC 60255-21-2 IEC 60255-21-3
Enclosure protection	IEC 60529

Table 5-1 Standard reference for type test

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1008-5.1 Hardware.

1008-5.1.1 Environmental

All control and protection IEDs shall be fully tropicalized, with operating temperature range of 0°C to +55°C and adequately protected against damage from incoming surges.

1008-5.1.2 Analog Input (AI)

AC Current Inputs

	value
System frequency	50 Hz
Current	1 A or 5 A (as specified in TOR)
Measuring rage	0 to 20x I_r

AC Voltage Inputs

	value
System frequency	50 Hz
Voltage transformer (rated voltage, V_r)	115 V
Measuring range	0 to 1.2x V_r

DC mA Input

	value
Measuring range	4 to 20 mA

1008-5.1.3 Binary Input (BI)

	value
Rated voltage (V_r)	125 Vdc
Operational voltage range (pick up)	0.85 to 1.15x V_r

1008-5.1.4 Binary Output (BO)

	value
Rated voltage (V_r)	125 Vdc
Operational voltage range	0.85 to 1.15x V_r
Current carrying capacity	5 A
Making capacity	8 A
Breaking capacity (L/R=40 ms)	0.2 A
Operating time	6 ms

1008-5.1.5 Remote Communication

Remote communication application is to transmit analog value or to transmit binary signal between IEDs at each end of the line. Data exchange between IEDs at each terminal takes place either via direct fiber-optic connections or via communication network connections which is specified in TOR.

Direct fiber-optic connection type

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Communication module shall be optical port via single-mode optical fiber covering the distance between each terminal with IEEE C37.94 standard implementation.

Communication network connection type

Communication module shall be optical port via multi-mode optical fiber with IEEE C37.94 standard implementation. IEEE C37.94 – ITU-T G.703 E1 converter, described in clause 1008-4.9, shall be provided as a communication interface.

1008-5.1.6 Power Supply

Each IED shall utilize a DC-to-DC converter-type regulated power supply to provide transient surge isolation between the station battery and the electronic components.

	value
Rated voltage (V_r)	125 Vdc
Operational voltage range	0.85 to 1.15x V_r
Watchdog	1 contact

1008-5.1.7 Local Communication

Station Bus Interface

	value
Ports	2 ports
Redundancy protocol	Parallel Redundancy Protocol (PRP) IEC 62439-3
Type	100BASE-FX
Connector type	LC
Mode	Multi-mode
Applications	Send/receive GOOSE and Client/server (IEC 61850-8-1) Read/write configuration

Client/server communication shall support at least 5 clients.

Process Bus Interface

	value
Ports	2 ports
Redundancy protocol	Parallel Redundancy Protocol (PRP) IEC 62439-3
Type	100BASE-FX or 1000BASE-SX
Connector type	LC
Mode	Multi-mode
Applications	Send/receive GOOSE and Client/server (IEC 61850-8-1) Receive SV (IEC61850-9-2LE)

Configuration port

	value

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Port	1 port
Application	Read/write configuration

1008-5.1.8 Local HMI

Display

The display is capable of showing whole protected unit, e.g. feeder, with related measured values, and capable of commanding switchgear e.g. close/open circuit breaker and raise/low transformer tap. The largest screen size option of the proposed model shall be selected.

Keypad

Keypad is utilized for navigating throughout the display including switchgear command, alarm monitoring, and parameter setting. Programmable push-buttons are required with individually settable mode.

- Toggle mode: the output toggles each time push-button has been pressed for a certain time.
- Pulsed mode: the output sets high when the push-button has been pressed for a certain time.

Annunciator LED

Programmable annunciator LED is required with individually settable mode.

- Unlatched mode: LED is illuminated in correspondence with the activation of an input signal.
- Latched mode: LED is illuminated at the activation of input signal. Once the signal is acknowledged and no longer present, the LED is turned off.

The color of LED shall be adjustable to red, yellow, or green.

1008-5.2 Generic

1008-5.2.1 Time Synchronization

The bay level IEDs shall support IEEE1588 time synchronization according to IEC/IEEE 61850-9-3. They shall be able to participate in Best Master Clock Algorithm (BMCA).

There are 2 clock types for control and protection IEDs.

- Master-capable: In the normal condition, i.e., the grandmaster clock in the system is active, an IED with master-capable type are expected to be a slave clock, at least in one port connected to PTP time source. During the failure of grandmaster clock, the IED may serve as a source of time, i.e., be a master clock, for other IEDs in the system. The IED shall support at least time synchronization class T1 (1 µs) according to IEC 61850-5.

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- Slave-only: an IED with a slave-only type is expected to be a slave clock in any scenario

1008-5.2.2 GOOSE supervision

GOOSE signal subscription shall be supervised by specified logical node, LGOS. There shall be one instance of LGOS per GOOSE control block.

1008-5.2.3 SV supervision

SV signal subscription shall be supervised by specified logical node, LSVS. There shall be one instance of LSVS per SV control block.

1008-5.2.4 Setting Group Control Block (SGCB)

The IEDs shall be provided with SGCB (Setting Group Control Block) services to allow switching between parameter setting groups. Setting group switching can be executed either from local HMI or external inputs.

1008-5.2.5 Testing

Testing function according to IEC 61850-7-1 shall be supported to perform functional, commissioning or maintenance tests. Hence, the following options are required to be available.

- Receiving multicast simulation signals instead of actual signals
- Receiving test input signals instead of actual signals
- Setting a function or a group of functions of the system in test mode

1008-5.2.6 Local/remote position

The function of Local/remote position is to determine a commanding interface for an IEDs. The IED shall be in either local or remote position. When IED is in remote position, all commands can only be done via SCADA. However, in local position, the local HMI shall be the sole source of commands. The Local/remote position can be selected via local HMI or IEC 61850.

1008-5.2.7 Binary Control Switch

An IED shall provide a software control switch for commands received via the local HMI or IEC 61850. The outputs of control switch are expected to be used for binary control, e.g., on/off function, raise/low transformer's tap.

1008-5.3 Primary Equipment Control & Monitoring

1008-5.3.1 Circuit Breaker

The required control and monitoring features of circuit breaker are as follows.

- Providing circuit breakers status of
  - Position

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- Local/remote switch position
- Close/open command (Select-before-operated with enhance security)
- Block close/open of circuit breaker
  - For lockout operation
  - For time-delay closing (to prevent reconnection of charged capacitor to an energized network)
- Interlocking
- Synchronism-check bypass
- Operation counter

1008-5.3.2 Switch

The required control and monitoring features of switch, i.e., disconnecting switch and earth switch, are as follows:

- Providing switch status of
  - Position
  - Local/remote switch position
- Close/open command (Select-before-operated with enhance security)
- Block close/open of switch
- Interlocking
- Operation counter

1008-5.3.3 Power Transformer

The required control and monitoring features of transformer, i.e., loading transformer and tie transformer, are as follows:

- Providing status of
  - Tap position
  - Temperature
- Master-slave for parallel operation of transformer
- Raise/low command (Select-before-operated with enhance security)

1008-5.4 Power System Monitoring

This function is for monitoring of power system parameters in nominal operating condition and recording those parameters with event log during fault situation.

1008-5.4.1 Power System Parameters

- Phase-to-earth and phase-to-phase voltage (amplitude and angle)
- Phase current (amplitude and angle)
- Power system frequency
- Three-phase active, reactive and apparent power
- Power factor
- Symmetrical components (zero-, positive-, negative-sequence components) of voltage and current (amplitude and angle)

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- RMS values of voltage and current

1008-5.4.2 Disturbance Recorder

For later engineering analysis, information regarding the primary system, e.g., AC current/voltage, switchgear position, and the secondary system status, especially internal activities of an IED, shall be recorded chronologically. The accuracy of time tagging shall be at least 1 ms. Binary input signal, e.g., trip command, of the disturbance recorder are utilized as trigger signals. The disturbance recording files shall be saved in the COMTRADE format according to IEEE C37.111.

1008-5.4.3 Fault Locator

Fault locator shall determine a location where fault occurs on the transmission line based on local measurement

1008-5.5 Protection.

1008-5.5.1 Busbar Differential (87B). Busbar differential are numerical and low-impedance type, expected to detect all types of internal phase-to-phase and phase-to-earth faults on difference of incoming and outgoing currents with a three-phase operation. It shall be capable of supporting up to at least 4 busbar sections.

Performance

For instantaneous operation in each voltage level application, operating time is expected to be as follows:

- 500 kV, less than or equal to 35 ms
- 230 kV, less than or equal to 35 ms
- 115 kV, less than or equal to 35 ms

Operating characteristic.

Busbar differential shall operate based on bias current differential with a settable minimum pick-up value.

Zone selection.

Busbar differential shall be capable of automatically including or excluding measure current to each differential zone according to changing topology of substation for multiple busbar section application by obtaining circuit breaker's position and disconnecting switch's position, both normally closed and normally open contacts.

Isolator supervision.

As described, switchgear's position is required to ensure correct zone selection. Hence, a signal shall be published as a discrepancy of related switchgear's position is detected.

Check zone

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An integrated overall differential zone is required for multiple busbar sections, in case of problem with disconnector switch's auxiliary contacts.

End-fault protection in feeder
End-fault protection shall be available to prevent the undesired tripping due to the section between the current transformer and the open circuit breaker in feeder by acquiring circuit breaker's position and disconnecting switch's position. As EGAT's design with current transformers installed on the line side, end-fault protection shall prevent overfunction of the busbar protection.

End-fault protection in bus coupler
End-fault protection for dead zone. In bus coupler, the section between the current transformer and circuit breaker is called dead zone. By applying end-fault protection, the protection range is extended by the dead zone when the circuit breaker is opened. In additional, end-fault protection for dead zone shall utilize command close of busbar circuit breaker as one of an input to improve the behavior of protection.

Current circuit supervision
Current circuits shall be monitored, phase segregated, if they are connected incorrectly or the measure values are defective. The output signal shall be provided for blocking and alarming purposes.

1008-5.5.2 Transformer Differential (87T). Transformer differential is expected to determine if a fault is within the protected zone, i.e. the position of current transformer, or outside of the protected zone. The transformer differential relay shall detect and identify all types of internal phase-to-phase and phase-to-earth faults. The number of restraints shall be indicated on the drawing entitled "Metering and Relaying Diagram" for each substation.

Performance
For instantaneous operation in each voltage level application, operating time is expected to be as follows:

- 500 kV, less than or equal to 35 ms
- 230 kV, less than or equal to 35 ms
- 115 kV, less than or equal to 35 ms

Operating Characteristic.
Operating characteristic of 87T comprised of Restrained (biased) and unrestrained (unbiased) part.

The restrained part includes 3 sections: first, the constant minimum pick-up value. Second and third section are an incline plane with separately adjustable slope.

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The unrestrained part is the maximum pick-up value used for very high differential current.

Magnetization current detection.
The magnetizing inrush currents at switching operations and the magnetizing currents at overexcitation cause differential currents which can lead to unwanted trip. These events shall be detected and utilized for blocking of transformer differential operation.

Cross-blocking.
One of the three phases shall be capable of blocking transformer differential operation of the other two phases due to the magnetization current detection in that phase.

Current circuit supervision
Current circuits shall be monitored, phase segregated, if they are connected incorrectly or the measure values are defective. The output signal shall be provided for blocking and alarming purposes.

1008-5.5.3 Line Differential (87L). Line differential compares the currents entering and leaving the protected multi-terminal circuit. The function shall be phase segregated with single-pole tripping.

87L shall be capable of supporting up to 3 terminals. All restraint CT inputs shall be measured separately from each other, i.e., summing up the CT's secondary currents at the terminal is not accepted. The current samples are exchanged between all IEDs included in the same line differential protection zone to be processed by each IED. The measured value synchronization between IEDs is expected to be done without using an external time source.

Performance
For instantaneous operation in each voltage level application, operating time is expected to be as follows:

- 500 kV, less than or equal to 35 ms
- 230 kV, less than or equal to 35 ms
- 115 kV, less than or equal to 35 ms

Operating characteristics.
Restrained (biased) and unrestrained (unbiased) operate characteristic. The restrained part includes 3 sections: first, the constant minimum pick-up value. Second and third section are an incline plane with separately adjustable slope. The unrestrained part is the maximum pick-up value used for very high differential current.

However, the algorithm for 87L to determine the faults is not limited to the restrained and unrestrained operating characteristic. Another algorithm with equivalent or better performance can be proposed, e.g. the Alpha plane method.

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Charging current compensation

Due to capacitive reactance of the conductors, transmission lines and cables generate charging currents which cause differential currents in 87L zone. This can lead to incorrect operation of 87L. Hence, charging current shall be compensated. The compensation is expected to utilize only the currents as already be the inputs for 87L.

Current circuit supervision

Current circuits shall be monitored, phase segregated, if they are connected incorrectly or the measure values are defective. The output signal shall be provided for blocking and alarming purposes.

1008-5.5.4 Shunt Capacitor Bank Feeder Differential (87C). Shunt capacitor bank feeder differential compares the currents entering and leaving the protected zone. The function shall be phase segregated with single-pole tripping.

All restraint CT inputs shall be measured separately from each other, i.e., summing up the CT's secondary currents at the terminal is not accepted.

Performance

For instantaneous operation in each voltage level application, operating time is expected to be as follows:

- 500 kV, less than or equal to 35 ms
- 230 kV, less than or equal to 35 ms
- 115 kV, less than or equal to 35 ms

Operating characteristics.

Restrained (biased) and unrestrained (unbiased) operate characteristic. The restrained part includes 3 sections: first, the constant minimum pick-up value. Second and third section are an incline plane with separately adjustable slope. The unrestrained part is the maximum pick-up value used for very high differential current.

However, the algorithm for 87L to determine the faults is not limited to the restrained and unrestrained operating characteristic. Another algorithm with equivalent or better performance can be proposed, e.g. the Alpha plane method.

Current circuit supervision

Current circuits shall be monitored, phase segregated, if they are connected incorrectly or the measure values are defective. The output signal shall be provided for blocking and alarming purposes.

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1008-5.5.5 Distance (21). Distance determines fault impedance by comparing measured voltage and current. Suffix letters are added to indicate those applications as shown in Table 5-2.

	description
21P	Distance with pilot scheme enabled
21BU	Distance with pilot scheme disabled

Table 5-2 description of distance protection's code

All 6 fault loops, including 3 phase-to-earth faults and 3 phase-to-phase faults, shall be calculated simultaneously. At least, 5 impedance-measuring zones are required including 3 forward zones, 1 reverse zone, and 1 additional forward zone for setting group.

Performance

For instantaneous operation in each voltage level application, operating time is expected to be as follows:

- 500 kV, less than or equal to 25 ms
- 230 kV, less than or equal to 30 ms
- 115 kV, less than or equal to 40 ms

Operating Characteristic

The implementation of quadrilateral and mho characteristic shall be available in all 5 zones separately.

Residual compensation factor

The residual compensation factor helps reducing an error of 21's impedance calculation caused by zero-sequence current in the case of an earth fault. Due to the impact of mutual coupling of parallel circuits, the zone 1 distance protection is required to have a dedicated residual compensation factor, i.e., the parameter setting of zone 1 is separate from other zones.

Load encroachment

Having a heavy load on transmission line can cause an apparent impedance perceived by distance protection to fall in an operating zone which leads to unwanted trip. To prevent that, load encroachment function is required. The function is expected to activate during normal operation and can be neglected in fault conditions to allow tripping.

Power swing blocking

Disturbances in power system such as disconnection of heavy loads or a trip of big generation plants cause power swing. During power-swing phenomena, the IED perceived high current and low voltage which lead to incorrect operation of 21. In this case, power swing blocking is expected to block instantaneous functions from operation, i.e., each distance or pilot zone can be blocked separately.

Switch onto Fault (SOTF)

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The function is for instantaneous tripping when closing onto a fault. Closing command, either from control unit or auto recloser, combining with distance protection zone 2 is used as an input to enable SOTF.

Voltage Failure Function

voltage failure function is to block distance protection at failure in secondary circuits between the voltage transformer and the IED. The blocking conditions are either one of the following

- sufficient change in voltage without a sufficient change in current is detected.
- Miniature Circuit Breaker (MCB) of voltage transformer's secondary circuit trips.

time delay setting is required. Up to 5 seconds after the conditions met, the distance protection is permanently blocked.

Pilot scheme

Permissive Underreach Transfer Trip (PUTT)

PUTT logic uses carrier received from distance zone 1 of remote IED with the operation of the distance zone 2 to allow an instantaneous trip.

Permissive Overreach Transfer Trip (POTT)

POTT logic uses carrier received from distance zone 2 of remote IED with the operation of the distance zone 2 to allow an instantaneous trip. To prevent operation under current reversal conditions in a parallel feeder circuit, current reversal logic shall be applied together with POTT

Current reversal

The current reversal logic uses distance zone 4 (reverse zone) to prevent tripping of pilot scheme. The blocking signal is required to hold for a settable time after

Weak infeed

Weak infeed logic uses carrier received from distance zone 2 of remote IED and measured undervoltage under the condition that distance zone 4 (reverse zone) does not operate to allow an instantaneous trip.

Echo

The echo function sends the permissive trip signal back to the sending IED.

- Echo on weak infeed uses weak infeed to operate.
- Echo on opened breaker uses carrier received from distance zone 2 of remote IED and open-breaker status to operate.

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1008-5.5.6 Directional Overcurrent (67). The measurement used for directional overcurrent protection shall be phase segregated fundamental frequency component.

Characteristic
The direction to the earth fault is determined by utilizing voltage polarizing. The voltage polarizing is capable of using zero sequence component and negative sequence component.

The directional overcurrent protection shall be able to operate in a definite time delay mode or in an inverse time mode. For time characteristic in both modes, ANSI/IEEE and IEC based standard curves are supposed to be available.

Reset time. The timer shall be reset directly when the current falls below the drop-out.

1008-5.5.7 Directional Earth Fault (67N). Ground current shall be taken from the neutral CT measuring, not by three-phase current calculation. Fundamental frequency component of the current is applied for 67N operation. 3 steps of time overcurrent with individual time characteristic setting are required.

Characteristics
The direction to the earth fault is determined by utilizing voltage polarizing. The voltage polarizing is capable of using zero sequence component and negative sequence component.

The directional overcurrent protection shall be able to operate in a definite time delay mode or in an inverse time mode. For time characteristic in both modes, ANSI/IEEE and IEC based standard curves are supposed to be available.

Reset time. The timer shall be reset directly when the current falls below the drop-out.

Pilot scheme

Permissive Overreaching Trip Transfer (POTT)
POTT logic uses carrier received from 67N forward direction of remote IED with the forward direction of its own 67N to allow an instantaneous trip. To prevent operation under current reversal conditions in a parallel feeder circuit, current reversal logic shall be applied together with POTT

Current reversal
The current reversal logic uses reverse direction of 67N to prevent tripping of pilot scheme. The blocking signal is required to hold for a settable time after

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1008-5.5.8 Overcurrent (51). Overcurrent protection in this clause is used for various applications. Suffix letters are added to indicate those applications as shown in Table 5-3.

	description
51TH	Transformer high voltage side overcurrent
51TL	Transformer low voltage side overcurrent
51TT	Transformer tertiary voltage side overcurrent
51C	Shunt capacitor bank phase overcurrent
51OL	Overload
51S	Stub overcurrent

Table 5-3 description of overcurrent protection's code

The measurement used for overcurrent protection shall be phase segregated and selectable either from only fundamental frequency component of each phase current or including the DC component and higher harmonics as well.

Operating Characteristic.
The overcurrent protection shall be able to operate in a definite time delay mode or in an inverse time mode. For time characteristic in both modes, ANSI/IEEE and IEC based standard curves are supposed to be available.

Reset time.
The timer shall be reset directly when the current falls below the drop-out.

1008-5.5.9 Ground Overcurrent (51G). Ground overcurrent in this clause is used for various applications. Additional suffix letters are added to indicate those applications as shown in Table 5-4.

	description
51THG	Transformer high voltage side ground overcurrent
51TLG	Transformer low voltage side ground overcurrent
51TTG	Transformer tertiary voltage side ground overcurrent
51CG	Shunt capacitor bank ground overcurrent
51SG	Stub ground overcurrent

Table 5-4 description of ground overcurrent protection's code

Ground current shall be taken from the neutral CT measuring, not by three-phase current calculation. Fundamental frequency component of the current is applied for 51G operation.

Operating characteristic
The overcurrent protection shall be able to operate in a definite time delay mode or in an inverse time mode. For time characteristic in both modes, ANSI/IEEE and IEC based standard curves are supposed to be available. According to reset time, the timer shall be reset directly when the current falls below the drop-out.

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1008-5.5.10 Backup Ground Overcurrent (51GB). Backup ground overcurrent function is utilized to protect tertiary winding from carrying heavy current due to external ground faults on the primary or secondary side of the transformer. Backup Ground Overcurrent shall have 2 current measuring steps with separate time characteristic setting in each step.

Characteristic
51GB shall be able to operate in an inverse time delay mode according to ANSI/IEEE or IEC based standard curves.

Reset time. The timer shall be reset directly when the current falls below the drop-out.

1008-5.5.11 Residual Overvoltage Relay (59N). The residual voltage is measured directly from a three-phase voltage transformer, where the secondary windings are connected in an open delta.

Characteristic
59N shall be able to operate in a definite time delay mode according to ANSI/IEEE or IEC based standard curves. According to reset time, the timer shall be reset directly when the current falls below the drop-out.

1008-5.5.12 Overexcitation (24). Overexcitation protection utilize 3-phase voltage as the measuring inputs.

Characteristic
The number of measuring step and time delay characteristic of overexcitation protection is expected to be either one of the following:

Firstly, overexcitation protection shall be a single measuring step with inverse time characteristic.
Secondly, overexcitation protection shall have 3 measuring steps with definite time delay characteristic.

Anyway, both of the time delay characteristic mentioned above shall be according to ANSI/IEEE or IEC based standard curves.

1008-5.5.13 Shunt Capacitor Bank Unbalance (60C).An internal fault in capacitor bank, i.e. failed element, can cause cascading failure and lead to extensive damage of entire unit. Unbalance function detects unbalance current/voltage arises from the failed elements to protect shunt capacitor bank from further damage.

Generally, there are 3 types of capacitor bank connection utilized in EGAT's substations. 60C shall be applicable to all these types with the following measuring value required:

Ungrounded wye-connected banks
Unbalance function measures neutral-point voltage and 3-phase voltages. Neutral-point voltage is utilized for voltage unbalance

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detection while 3-phase voltage is for system unbalance compensation. 1 operating step of function is required for trip signal.

Ungrounded double wye-connected banks
Unbalance function measures neutral current for current unbalance detection. 2 operating steps are required for alarm and trip signals.

H configuration
Unbalance function measures 3-phase current for current unbalance detection. 2 operating steps are required for alarm and trip signals.

Characteristic
60C shall be able to operate in a definite time delay mode according to ANSI/IEEE or IEC based standard curves. Pickup level and time delay are settable independently in each step.

Reset time
The timer shall be reset directly when the measured value falls below the drop-out.

1008-5.5.14 Shunt Capacitor Bank Phase Overvoltage (59C). The measurement used for shunt capacitor bank phase overvoltage shall be phase segregated fundamental frequency component.

Characteristic
The 59C shall be able to operate in a definite time delay mode according to ANSI/IEEE or IEC based standard curves.

Reset time
The timer shall be reset directly when the current falls below the drop-out.

1008-5.5.15 Shunt Capacitor Bank Phase Undervoltage (27C). The measurement used for shunt capacitor bank phase undervoltage shall be phase segregated fundamental frequency component.

Characteristic
The 27C shall be able to operate in a definite time delay mode according to ANSI/IEEE or IEC based standard curves.

Reset time
The timer shall be reset directly when the current falls below the drop-out.

1008-5.5.16 Auto Reclosing (79). Auto reclosing function is used to automatically close the circuit breaker after predetermined time since the tripping of circuit breaker.

Characteristic

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For three-phase tripping application, auto reclosing function shall be initiated by the following signal: circuit breaker ready, circuit breaker status, trip signal, and synchronism-check.

For single-phase tripping application, auto reclosing function shall be initiated by the following signal: circuit breaker ready, circuit breaker status, and trip signal. Synchronism-check is not required in this case.

Deadtime setting range shall be adjustable between 0.1 to 10 seconds.

Reclaim time setting range shall be adjustable between 1 to 30 seconds.

For monitoring, auto reclosing function shall indicate the following status:

- In progress- the auto reclosing sequence is start
- Command closed- the auto reclosing operate
- Unsuccessful- the circuit breaker does not remain close after the closing command has been made.

1008-5.5.17 Synchronism-Check (25). Synchronism-check function assures that 2 parts of electrical power system are synchronized by measuring and comparing single-phase voltages from both sides of circuit breaker, i.e., bus and line voltages

Characteristic
The measured voltage magnitudes are compared to 2 different set values to verify if they are live or dead. The live or dead status is automatically determined without any activation required.

When the status of both sides is live-live, live-dead, dead-live, then synchronism-check function evaluates magnitude difference, phase difference, and frequency difference of voltages if they are in the acceptable ranges to confirm the synchronization.

To support double busbar application, Voltage selection chooses which measured voltage is utilized for the synchronism-check by acquiring disconnecting switch statuses.

1008-5.5.18 Under-Frequency (81U). Under frequency shall have 2 voltage-measuring steps with separate time delays.

Characteristic.
Definite time delay mode is required.

Blocking.
If the measured voltage level decreases below the blocking level (roughly at 80% of nominal voltage) the trip and start outputs shall be blocked.

Under Voltage Protection for Load Shedding (27LS). Under voltage load shedding shall have 2 voltage-measuring steps with separate time

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delays and can be set to measure phase-to-earth RMS value, i.e. DC component and higher harmonics are included.

Characteristic.
Definite time delay mode is required. Each phase shall be able to operate separately. When the voltage reaches the drop-out the time is expected to reset instantaneously.

Blocking.
If the measured voltage level decreases below the blocking level (roughly at 30% of nominal voltage) the trip and start outputs shall be blocked.

1008-5.5.19 Breaker Failure (50BF). Breaker failure protection is expected to send tripping command to all adjacent breakers in case of failed attempt to open its own breaker.

Characteristic.
For three-phase tripping application, initiating signal and current, including phase and residual, are required as the starting conditions to run a timer until it reaches the pre-set delay time. In the case that breaker failed to open in at least one pole or there is still high residual current, then 50BF shall operate. If the conditions are not fulfilled, timer will be stopped and reset.

For single phase tripping application, initiating signal and phase current are required as the starting conditions to run a timer, separately for each different starting condition, until it reaches the pre-set delay time. In the case that breaker failed to open in at least one pole, then 50BF shall operate. If the conditions are not fulfilled, timer will be stopped and reset.

Pilot Scheme

Direct transfer trip (DTT)
DTT logic uses carrier received from breaker failure operate of remote IED to trip and lockout circuit breaker.

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1008-6 Non-Intelligent Electronic Devices.

1008-6.1 Loss of DC Alarm Relays (27X). All DC control circuits for protective relaying systems and power circuit breakers shall be monitored by a loss of DC alarm relay.

The operating voltage shall be continuously adjustable. The output contact shall be set to delay with timing range of 0.05 to 1.0 second and shall be continuously adjustable.

Each shall be auxiliary relay, standard speed with slow dropout characteristics. Each relay shall be furnished with two (2) electrically separate normally closed contacts. These contacts shall be: one contact shall be wired to send alarm signal and the other shall be wired to terminal blocks for future use.

1008-6.2 Auxiliary Tripping and Lockout Relays (86). Auxiliary tripping and lockout relays shall be provided with transformer protection, bus protection, direct transfer tripping and breaker failure protection. Each relay shall be of the high speed, draw out and DC voltage operated type.

Each relay contact shall be rated properly for each its applied circuit (for making and/or breaking) without damage for all conditions in protection functions.

In general case, 'Make and Carry continuously' contacts for tripping circuit shall be rated at least 5A, 125V DC, and 30A, 125V DC for 1 second. Each contact output shall be electrically separate contact.

The operating time including bouncing time of each relay shall not exceed 10 milliseconds. There shall be coil transient suppression device in order to protect the relay coil from electromotive force. Both electrical reset and manual reset shall be performed. A cut-off switch shall be provided to interrupt the operating coil. The minimum number of contacts shall be sufficient and correct as specified in the protective device function or bill of materials.

1008-6.3 Auxiliary Tripping Relays (94). Each auxiliary tripping relay to be furnished shall be high speed, high burden, draw out, self-reset, DC voltage operated type.

Each relay contact shall be rated properly for each its applied circuit (for making and/or breaking) without damage for all conditions in protection functions.

In general case, 'Make and Carry continuously' contacts for tripping circuit shall be rated at least 5A, 125V DC, and 30A, 125V DC for 1 second. Interrupting or Breaking capability of relay contacts, for any inductive load circuit (L/R < 40 ms), shall be 5A, 125V DC. Each contact output shall be electrically separate contact.

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They shall have an operating time including bouncing time not exceeding 10 milliseconds at 250-Watt load. There shall be coil transient suppression device in order to protect the relay coil from electromotive force. The minimum number of contacts shall be sufficient and correct as specified in the protective device function or bill of materials.

1008-6.4 Auxiliary and Control Relays (CCX, CTX, MCX, and MOX). Auxiliary and control relays shall be of the semi-flush mounted type if feasible, otherwise of the surface mounted, with a removable cover and transparent window, where applicable, and shall be finished dull black.

There shall be coil transient suppression device in order to protect the relay coil from electromotive force. The coils of relays shall be suitable for continuous duty at their normal operating voltage. All relay contacts shall be rated to carry each rated circuit current (for making and/or breaking) without damage for all conditions in control functions. Generally, all relay contacts shall be of the renewable type with ample current-carrying and interrupting capacity for the application, and shall withstand at least 20 A, 125 V at 1 second and 4 A, 125 V at continuous duty.

Auxiliary relays of the mechanically latched-in type shall have manual reset devices operable from the front of the panel and shall have an operating time not to exceed 30 milliseconds. Auxiliary relays of the self-reset, standard-speed type shall have an operating time not to exceed 40 milliseconds. Auxiliary relays of the self-reset, medium speed type shall have an operating time not exceeding 30 milliseconds. Auxiliary relays of the self-reset, high speed type shall have an operating time including bouncing time not exceeding 20 milliseconds.

1008-6.5 Control and Pushbutton Switches. The control switches shall be of the multistage, rotary type, rated 600 V, 10 A, continuous duty, protected against dust and water, for both AC and DC services. The pushbutton switches shall be of flush type with the base, single pole single throw, that make or break the connection of a single conductor in a single branch circuit. The pushbutton switch shall be open or closed only during actuation. After actuation force is removed, the switch reverts to its normal position.

The control and pushbutton switches shall comply with International Quality Standards and their quality and durability are fully guaranteed.

Each contact of the switch shall be of the readily renewable, self-cleaning type and shall be of the wipe-type. The terminal of each switch shall be screw type.

A rectangular front-of-panel escutcheon plate shall be furnished and engraved showing the switch position of control switch. The switch identification shall be engraved on the escutcheon plate, or if necessary, on a separate adjacent nameplate furnished by the Contractor.

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The shapes of control switch handle and pushbutton switch and their colors preferred shall be provided as follows:

- Closing pushbutton switch: circular shape (red)
- Opening pushbutton switch: circular shape (green)
- Raise pushbutton switch: circular shape (yellow with black arrow-up image)
- Lower pushbutton switch: circular shape (white with black arrow-down image)
- Synchronizing switch: oval removable (yellow or white)
- Control selector switch: oval (black)

Details of individual control and instrument switches shall be as described below. The total number of contacts and the total number of contact arrangements shall be adequate for their required functions but minimum number of contacts and contact arrangements shall be at least as shown on the EGAT's typical drawing.

If the schemes for control, protection and other equipment as proposed by the Contractor and approved by EGAT, require additional contacts than those listed in this Specification and shown in the above drawing, the Contractor shall furnish these extra contacts and contact arrangements without additional cost to EGAT.

1008-6.6 Miniature Circuit Breaker (MCB). The MCB shall be conformed to IEC 60898 and IEC 60947-2 standard with the following requirements.

Applications	Pole	Auxiliary contact	Rated Current [A]	Curve
1-phase voltage transformer circuit	1	1	1	C
3-phase voltage transformer circuit for Merging Unit	3	1	1	C
3-phase voltage transformer circuit for Meter	3	1	3	C
Circuit breaker control circuit	1	-	6	K
DC power supply circuit	2	-	≥1.25x load current	C
AC power supply circuit for lighting and outlet	2	-	≥1.25x load current	C
AC power supply circuit for cooling system	2	1	≥1.25x load current	C

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1008-6.7 Knife Switch (KS). The KS shall be conformed to IEC 60947-3 standard with the following requirements.

Applications	Pole	Rated current [A]
Breaker control circuit	1	32

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1008-7 Transducers and Remote I/O units.

1008-7.1 Transducers. Each transducer shall be of the surface-mounted, dustproof, fully tropicalized type. The entire transducer shall be removable from the enclosure to provide complete accessibility to components and circuitry. Each transducer shall generate a DC voltage or current output proportional to the quantity being measured. Input stage coupling shall use an ultra-linear transformer, if required. Output stage shall be a solid-state output amplifier and shall be short circuit proof.

Each shall be independent of external load resistance over a range as required. Each transducer shall be suitable for use with instrument transformers. Means shall be provided with each transducer to adjust zero shift and span or gain. Each shall withstand the voltage of 1,500 V for one minute between independent circuits, input and output circuits to case.

General Requirements.
Each transducer shall have the following characteristics and requirements:

Accuracy	±0.5% when output from 5% to 125% of full rated output
Output ripple	<2% peak to peak
Response time	<1 second, to 99% of final value
Adjustment	
Zero control range	±2%
Calibrate control range	±10%
Operating temperature range	+0ºC to +75ºC range
Operating humidity	0 to 95%

Detailed Requirements.
Each temperature transducer shall be for use in conjunction with 10 ohms (at 25ºC) copper resistance temperature detector for both indicating and recording of the transformer winding temperature. Each transducer shall be suitable for use with the Remote I/O furnished under separate Specification. Each shall have the following requirement:

Temperature range	0ºC to 100ºC
Rated output	4 to 20 mA, unidirectional
External load resistance	0 to 10 kΩ

Each transformer tap position transducer shall be of the surface-mounted, dustproof, fully tropicalized type. The entire transducer shall be removable from the enclosure to permit complete accessibility to components and circuitry. Each transducer shall be designed to operate in conjunction with a multi-tap resistor which is used as transformer tap position input signal. The multi-tap resistor will be provided and located in the transformer LTC driving mechanism cabinet.

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Each transducer shall generate a DC voltage or current output corresponding to the tap position being transmitted to telemetering equipment. Output stage shall be a solid-state output amplifier and shall be short circuit proof. The current output shall be independent of external load resistance over a range as specified in the bill of materials. Means shall be provided with each transducer to adjust zero shift and span or gain.

1008-7.2 Remote Input/Output Unit.

The Substation Automation System shall be installed to control and monitor all the sub-station equipment from remote control center (SCADA) as well as from local control center. Dedicated remote input and output units shall be provided for control and protection functionality on IEC 61850 standard. The Control and Protection IEDs shall communicate on the IEC 61850 standard for communication networks.

Remote Input and Output Unit (Remote I/O) shall be designed based on the international standards IEC 61850 and IEC 61131-3, promoting a revolutionary innovation in control systems. The Remote I/O shall convert copper signals to and from digital optical signals. Copper signals shall include transducers, contact inputs, and contact outputs. The Remote I/O architecture provides a wide variety of input and output modules, which combined with a powerful CPU and a bus based in high-speed deterministic Ethernet, comprises requirements of various applications. Additionally, the new series offers a complete tool for programming, configuration, simulation and debugging of user application.

Remote I/O shall be designed to expand the digital and analog I/O protective relays, BCU and HMI, in order to provide input and output for the station automation device using IEC 61850 communication. The Remote I/O unit allows maximum I/O flexibility and provides a seamless IEC 61850 connectivity between the substation binary and analog signals. The Remote I/O unit shall be provided the inputs and outputs signal distributed within the switchgear itself.

Remote I/O unit shall use the Ethernet-based IEC 61850-8-1 for horizontal GOOSE communication. The signals can be transmitted within the switchgear and to the higher-level automation systems. Signals from the upper-level automation systems shall be executed directly to Remote I/O, or through connected bay control units. For teleprotection application, a Remote I/O unit shall receive command signals from teleprotection equipment and communicate to the protective relay with GOOSE message. In the manner of remote terminal unit, Remote I/O unit shall receive alarm signal from some conventional devices and communicate to the substation control system over TCP/IP.

The functionality of the Remote I/O not only data from direct inputs and outputs can be provided but also data from IEDs which don't support the IEC 61850 station bus. All data can be described in an IEC 61850 data

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model with the Remote I/O. Hereby the selection of components for different tasks in the station, e.g., HMI, is independent of the manufacturer.

The Remote I/O shall have sufficient both digital input and output modules for EGAT's required functions. The Remote I/O used in this application shall calculate electrical values from the signal via external transducers, such as transformer tap position, winding temperature, and oil temperature. Analog module shall be used for metering and monitoring desired input signals (0 to 20 mA) from various transducers. RTD-to-mA module may be used for metering and monitoring desired temperatures (°C) via RTDs. Input current (mA) can be linearly scaled for various applications, for example, transformer tap changer position indication.

Remote I/O shall be provided with communication module with dedicate RJ-45 port for service and maintenance tasks.

Ratings of Remote I/O Units will be indicated in bill of materials, and except as otherwise specified, all equipment shall be designed and supplied to the following requirement.

Minimum requirement for a Remote I/O unit:

Operating environment	-10 to +55°C (prevent humidity condensation)
Digital Inputs	16 digital inputs (individually isolated)
Digital Outputs	8 digital outputs (individually isolated)
Power Supply	125 V nominal, 80 % to 115 % range
Output Protocol	100 Base FX, Ethernet IEC 61850-8-1 protocol
Alarm Output	1 output contacts for Remote I/O 'fail to operate'
Synchronization	PTP (IEC/IEEE 61850-9-3), or 1PPS
Optical fibers	multimode with LC (preferable) or ST connectors
Installation	Flush mount or semi-flush mount

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1008-8 Merging Unit (MU). MUs, in this Specification, shall be either Stand Alone Merging Unit (SAMU), Digital Merging Unit (DMU), or Conditioning Monitoring Unit (CMU). All MUs shall be of the IEDs which completely support for IEC 61850 communications directly embedded into the MUs. The MUs shall be and connected to the communication infrastructure for data sharing and meet the real-time communication requirements for automatic functions.

The MUs shall convert copper signals to and from digital optical signals. Copper signals shall include analog outputs from current transformers, voltage transformers, and transducers as well as contact inputs and contact outputs from the equipment installed in the switchyard or GIS. The data presentation and the configuration of the afore-said MUs shall be compatible with the overall system communication and data exchange requirements. MUs shall convert the data from several devices such as CTs, PTs, power transformer, and circuit breaker, and send the converted data to the process LAN. The process LAN conveys the converted data (voltage and current samples and apparatus status) from MUs installed nearby the switchyard to the Protection IEDs that process the converted data into the values for measurements and decisions.

Each MU is embedded with IEC 61850-9-2LE communication protocol. IEC 61850-9-2LE communication protocol allows vertical communication to bay level IEDs which is from one or several vendors. The said IEDs shall be able to exchange information and to use it in the performance of their functions and for correct co-operation. The MUs shall use multicast transmission to notify those IEDs that have registered to receive the data. A MU can, by publishing a SV or GOOSE message, report its status. It can also request a control action to be directed at any device in the network.

All MUs and components necessary to complete a system shall be fully tropicalized, contained in a common enclosure, and shall be complete with all interconnections and wiring for back-connection. Enclosures shall be rectangular, dustproof, suitable for flush panel mounting or rack mounting as specified, with a removable transparent cover, or a cover with a transparent window, with provision for sealing. Operation indicating lights and identifying labels shall be provided with each relaying system and shall be clearly visible and identifiable.

MUs shall be adequately protected against damage from incoming surges and shall meet Surge Withstand Capability test standard (ANSI C37.90.1). Each MU shall utilize a DC-to-DC converter-type regulated power supply to provide transient surge isolation between the station battery and the electronic components of the relay system. Each DC-to-DC converter shall be designed to protect it from high voltage and surge, and shall provide two electrically separate contacts for remote annunciation of output voltage failure. Each power supply shall be designed for continuous operation, and be immune to damage from accidental short circuiting of the input or output DC supply. Each MU shall not generate any signal, noise, or impulse on the input DC supply leads which is greater than 300 millivolts peak to peak.

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Testing function according to IEC 61850-7-1 shall be supported to perform functional, commissioning or maintenance tests. Hence, the following options are required to be available in related type of MU.

- Receiving multicast simulation signals instead of actual signals
- Receiving test input signals instead of actual signals
- Setting a function or a group of functions of the system in test mode

Each MU system shall be provided with test facilities for secondary injection testing and for isolating the DC supply, current circuits, potential circuits, tripping circuits, and all other output contacts. All test switches shall be arranged so that the current transformer secondary circuit cannot be open-circuited in any position while the test plugs or cover plugs are being inserted or removed. The internal contacts of test switches shall be normally sprung together by themselves to complete the circuit link. Test plugs shall be furnished with each type of test switches.

All DC supply circuits for MU systems shall be monitored by a loss of DC alarm relay (27XR). Each shall be auxiliary relay, standard speed with slow dropout characteristics. Each relay shall be furnished with two (2) electrically separate normally closed contacts. These contacts shall be: one contact shall be wired to send alarm contact and the other shall be wired to terminal blocks for future use.

The Contractor shall ensure that each MU function is independent of others and can be individually isolated to allow each alone to be taken out of service for testing or operational purposes. Test facilities shall be provided with each MU.

Each MU shall be configured to comply with all EGAT's needed functions before delivery. Configuration setting of the MU, which is programmable, shall be supplied in CD-ROM.

The instruction manuals shall be prepared with the object of providing sufficient detailed technical information of each type of protective relays to enable EGAT to efficiently carry out commissioning and routine testing. In this regard, each instruction manual shall give full details of circuit operation, circuitry and components. All technical data, operating time curves, sample calculations and other characteristics shall be based upon 50 hertz operation. The manuals shall also provide guidelines on the tracing of faults, ease the ordering of the replacement parts and meet the requirements as listed in Drawings and Documents to be Furnished by the Contractor under Special Conditions of Contract Documents. The manuals shall be submitted to EGAT at least 3 months prior to the beginning of the commissioning process.

Each MU shall have provisions for monitoring any hardware failures so they can be repaired before they affect relay operation. These provisions shall also include output contacts for initiating the Remote I/O. All output contacts shall be electrically separate normally open contacts.

The proposed MUs shall be products from approved manufacturer specified in EGAT ACCEPTED MANUFACTURER LIST FOR RELAY.

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Certification.

- The type test of the MU shall be certified according to IEC 61850-8-1 and IEC 61850-9-2LE standard, by the third party who has been authorized by ISO/IEC 17025 standard or equivalent. The Bidder shall supply the type test report to EGAT during bid evaluation period. The MU shall not be acceptable if that type test is not available.
- The factory test report of MU shall be supplied with the MU at the time deliver to EGAT.

1008-8.1 Stand Alone Merging Unit (SAMU). As defined by IEC 61850-9-2LE, sampled analog values are transmitted by so-called Stand-Alone Merging Unit (SAMU). The SAMU time correlates and merges analog data from individual phases or measuring points in the substation before transmitting them via the deterministic Ethernet network, where the data can be accessed by protection and control devices. In the case of Non-Conventional Instrument Transformers (NCITs), the SAMUs receive their data through optical connections from the NCITs. Because this connection is optical, the location of the SAMU is independent of the cable length.

The maximum processing delay time of the protection related NCITs' MU as well as SAMUs shall be less than 2ms, as specified in IEC 61869-9

Each SAMU shall fulfill the performance class P7 (transfer time is within 3 ms) and time synchronization class T4 (accuracy is in the range of 4 µs), both regarding to IEC 61850-5.

The main function of the SAMU is to combine the current and voltage inputs from a three-phase system including the zero sequence components and to transmit the measured values as a SV data stream to all IEDs subscribing to that data. The SAMU for current and voltage is referred to as AMU and VMU, respectively. The IED performing the SAMU function may contain several logical SAMU devices.

SAMUs continuously measure multiple analog CT/VT values from primary equipment and digitize them according to IEC 61850-9-2LE standard. Data shifted at the receiving IEDs by just microseconds will result in protection algorithm malfunction. Once converted to digital format and time-stamped, the SVs are then sent via unsolicited multicast onto the high-speed fiber optic Ethernet network, IEC 61850-9-2LE "Process Bus". The Ethernet switch with IEEE 1588 v2 and 1PPS support shall make implementation of the IEC 61850-9-2LE "Process Bus" by providing reliable and precise time synchronization over the substation Ethernet network.

IEC 61850-9-2LE defined two distinct sampling rates for the SV-based process bus.

- 80 samples per nominal system frequency cycle for protective relay IEDs
- 256 samples per nominal system frequency cycle for energy meters

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For EGAT, the 50 Hz power system this translates to 4,000 Hz and 12,800 Hz. 80 samples per cycle shall be sufficient to satisfy most of the common protection functions, whereas 256 samples per cycle is used for high-speed functions such as power quality monitoring. Separate SV streams must be synchronized to a common time base when being used for the same function. SAMU shall at least fulfill time synchronization class T4 (4µs) according to IEC 61850-5. The synchronization methods are one pulse per second (1PPS) as described in IEC 61850-9-2LE and IEC 61588 (PTP). The implementation shall follow the profile as specified in IEC/IEEE 61850-9-3.

Ratings of MUs will be indicated in bill of materials, and except as otherwise specified, all equipment shall be designed and supplied to the following requirement.

Minimum requirements

Operating environment	-10°C to +55°C (prevent humidity condensation)
4 Current Inputs (AMU)	1 or 5 A nominal, 20 x range, < 0.2 VA
4 Voltage Inputs (VMU)	115 V nominal, 1.5 x range, < 0.2 VA
Frequency	50 Hz
SV stream	Conforming to IEC 61850-9-2LE
Power Supply	125 VDC nominal, 80 % to 115 % range
Communication port	2 of 100BASE, 1300 or 1310 nm, LC (preferable) or ST type connector for OFC specified in clause 1008-4.11
Redundancy Protocol	PRP or HSR (specified in bidding document)
Alarm Output	1 output contacts for MU 'fail to operate'
Synchronization	PTP (IEC/IEEE 61850-9-3) and 1PPS
Sampling rate	80 Samples per cycle for protective IEDs
	256 Samples per cycle for energy meters (or function related to power quality)

1008-8.2 Digital Merging Unit (DMU). The circuit breakers, disconnecting switches, earthing switches, and on-load tap changers are process level devices. To control and exchange information between these switchgears and the bay level equipment, DMU is introduced. The control and status signals shall be converted to digital form first and the DMU is responsible for collecting the digital data synchronously and transmitting these data between the switchgear and bay level devices or gateway.

Each DMU shall provide contact outputs (or additional auxiliary relays) to complete the functions of power circuit breaker tripping, trouble alarm, or any indication. All contacts shall be rated to carry each rated circuit current (for making and/or breaking) without damage for all conditions in protection functions. Generally, tripping contacts shall be rated to carry at least 30A, 300V for 1 second, 5A, 300V at continuous duty, and be capable of

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interrupting of 0.2A of inductive current (L/R ≤ 40 ms) in a 125V DC control circuit. Each contact output shall be electrically separate contact.

Each DMU shall fulfill the performance class P1 (transfer time is within 3 ms) regarding to IEC 61850-5. Ratings of DMUs will be indicated in bill of materials, and except as otherwise specified, all equipment shall be designed and supplied to the following requirement.

Minimum requirements

Operating environment	-10°C to +55°C (prevent humidity condensation)
The number of Binary Inputs	Specified in TOR
The number of Binary Outputs	Specified in TOR
Power Supply	125 VDC nominal, 80 % to 115 % range
Communication port	2 of 100BASE, 1300 or 1310 nm, LC (preferable) or ST type connector for OFC specified in clause 1008-4.11
Redundancy Protocol	PRP or HSR (specified in bidding document)
Alarm Output	1 output contacts for DMU 'fail to operate'
Synchronization	PTP (IEC/IEEE 61850-9-3) and 1PPS

Logic

The following function blocks are required for DMU to fulfil the design criteria.

- AND function block
- OR function block
- Flip-flop function block or equivalent to perform lockout & reset function

1008-8.3 Condition Monitoring Unit (CMU). The operating conditions of switchgear and power transformers are in process level. To monitor the temperature of windings, position of on-load tap changer, and pressure of insulated gas, etc. of these switchgears, CMU is introduced. The operating condition signals shall be converted to digital form first and the MU is responsible for collecting the digital data synchronously and transmitting these data from the switchgear to bay level devices or gateways.

Ratings of CMUs will be indicated in bill of materials, and except as otherwise specified, all equipment shall be designed and supplied to the following requirement.

Minimum requirements

Operating environment	-10 to +55°C (prevent humidity condensation)
Analog Inputs	4 to 20 mA
Power Supply	125 VDC nominal, 80 % to 115 % range

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Communication port	2 of 100BASE, 1300 or 1310 nm, LC (preferable) or ST type connector for OFC specified in clause 1008-4.11
Redundancy Protocol	PRP or HSR (specified in bidding document)
Alarm Output	1 output contacts for CMU 'fail to operate'
Synchronization	PTP (IEC/IEEE 61850-9-3) and 1PPS

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1008-9 Energy Meters. Each three-phase, high precision or grid energy meter shall be inspected according to IEC standard or equality international standard with aging reliability, safety and accuracy. Each energy meter shall be the solid-state type comprising of kilowatt-hours meter and kilovar-hours meter integrally mounted in the same enclosure. Each energy meter shall be suitable for operation with the instrument transformers. Programming facilities shall be provided with each energy meter for any parameters setting.

Each high precision energy meter shall be 4 quadrants measurement of active, reactive and apparent energy meter and bi-directional. Each energy meter shall have display sequence (manual and automatic scrolling), load profile and event recorder function. Each energy meter shall be fully supported for automatic energy meter reading and shall have an approved test by using the existing EGAT Automatic Meter Reading (AMR) software.

Current Measuring Circuit.

Nominal current (In)	5A RMS and can be set to be 1A RMS.
Measuring range	50mA-5A RMS for In=5A 10mA-1A RMS for In=1A
Measuring accuracy	Class 0.2S for active power [W] Class 0.5S for reactive power [VAr]
Starting current	not more than 0.1% of In at unity power factor
Nominal frequency	50 Hz

Voltage Measuring Circuit.

Nominal voltage (Un)	$115/\sqrt{3}$ kV
Connection type	3 phase 4 wire
Measuring range	57.7-130 V AC (phase to neutral for 3P4W)
Nominal frequency	50 Hz

Accuracy

Each energy meter shall meet the following requirements:

- The active energy of the energy meter shall comply with accuracy class 0.2S according to IEC 62053-22 standard or latest equivalent standard.
- The reactive energy of the energy meter, shall comply with accuracy class 0.5S according to IEC 62053-24 standard or latest equivalent standard. Otherwise, the percentage error from the accuracy test report as specified in clause “Calibration certificate and test report” including uncertainty values shall not exceed +/- 0.5%.

Display requirement.

The display screen of each energy meter shall not be less than 8 digits, and shall be set to display at least as the following measurement values:

- Active Energy
- Reactive Energy
- Apparent Energy
- Instantaneous primary or secondary Current L1, L2, L3

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- Instantaneous primary or secondary voltage L1, L2, L3 (line to neutral voltage)
- Voltage Phase Sequence
- Instantaneous active Power
- Instantaneous reactive Power
- Instantaneous power Factor
- Instantaneous frequency
- Maximum Demand and its timestamp over the billing period which shall be set to display total maximum demand and/or maximum demand for each tariff rate period of both active and reactive demand.
- Billing data: The billing values are the summarized measured energy at the end of each billing period (monthly period), which shall be selectable to display as the consumption energy values and the cumulative energy values, comprise of the total energy and the energy of each tariff rate.

Data storage.

The minimum requirement of data storage of each energy meter shall be as follows:

- The memory of the energy meter shall be able to store at least the 14 measured values load profile of thirty (30) minutes time interval for not less than 180 days (or not less than 8,640 records).
- The memory of the energy meter shall be able to store the 10 measured values of billing values for not less than 15 records (not less than 15 monthly period records).

Power Supply and battery backup.

- Main power supply (main p/s): using voltage measuring circuit (VT), 57.7-130 VAC (phase to neutral)
- Auxiliary power supply (aux p/s): suitable for both 200-230 VAC (L-N), 50 Hz and 110-125 VDC
- The energy meter shall normally draw power from main p/s and will changeover to draw power from aux p/s automatically if the main p/s is not available, without any effects to the accuracy of the energy meter.
- In the case that the proposed energy meter supports only for aux p/s, the Bidder shall provide the relay or the transfer switch which is used for switching between two (2) sources of aux p/s (VAC and VDC). This device shall be approved by EGAT staff before delivery to EGAT. Moreover, the number of these devices shall not be less than the number of the energy meters.
- The energy meter shall be equipped with battery backup, to keep the real time clock of the energy meter running during the loss of power supply.

Communication ports and protocols.

The energy meter shall comprise of at least the communication ports as follows:

- Optical port 1 port (flag or opticom port according to IEC1107 or ANSI standard, for local communication)

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- RS-485 port 1 port (for multi-drop communication connections)
- Ethernet port 1 port – RJ45 connector (for IP base communication)

User shall communicate with the energy meter as the following methods:

- Conditions for communication:
  - Local accessing: The energy meter shall be local accessed by using all above three (3) ports.
  - Remote accessing: The energy meter shall be remote accessed via RS-485 port and Ethernet port.
  - The energy meter shall be able to be accessed via all above ports simultaneously and independently.
  - The energy meter shall support Parallel Redundancy Protocol (PRP). Otherwise, RedBox must be provided.
- Communication protocol:
  - The energy meter shall support data communication via all above communication ports by using DLMS/COSEM protocol.
  - The energy meter shall comply with IEC 61850-8-1 for communication to station-level devices.
  - The bidder shall provide the communication protocol (DLMS/COSEM) and other necessary information of the proposed energy meters (such as OBIS Code, memory mapping etc.) to EGAT and/or the third party appointed by EGAT, to develop the interface (energy meter accessing) software for using in EGAT system.
  - The communication protocol and necessary information shall be both of hard copy and electronic files.

Time synchronization.

- The calendar clock of the energy meter shall be synchronized by the existing EGAT AMR software. Moreover, the said calendar clock shall be able to be synchronized by local standard time source (GPS receiver). Therefore, each energy meter shall be equipped with the additional suitable port for connecting to the GPS receiver other than the above communication ports.
- The bidder must provide the list of the GPS receiver(s) (manufacturer, model, type) which fully supported for local time synchronization of the proposed energy meter.

Tariff structure.

- The energy meter shall support at least 4 tariff rates for each of 4 quadrants of active and reactive energy measurement in each billing period, these measured values shall be referred to “billing values”.
- The energy meter shall support maximum demand (block interval demand) calculation for each above tariff rates corresponding to the selectable interval of fifteen (15) or thirty (30) minutes. The maximum demand and its timestamp shall be recorded in the energy meter, and can be set to display on front panel or read by the service software.

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- The billing reset for ending of billing period shall be automatically reset by calendar time programming which shall be at least per month.
- The meter shall support not less than 4 TOU rate and not less than 100 special days.

Load Profile.

- The load profile is the periodic historical measurement data which is recorded in the energy meter.
- The period of load profile shall be selectable for 1-, 5-, 10-, 15-, 30- or 60-minute time interval.
- The measured data which is recorded in load profile shall comprise of at least timestamp and the following data:
    - The average demand profile (kW, kVAr, kVA) which shall be selectable and/or energy profile (kWh, kVArh, kVAh).
    - The voltage & currents of measuring circuit, which may be primary and/or secondary side values of instrument transformer, for line to neutral voltage.
- Each energy meter shall support for events logging data. Irregular and/or specified events shall be captured and recorded in the energy meter.

Meter Security.

- The energy meter shall be protected by the verification seal, the internal parts of the energy meter shall not be physical accessed without breaking the seal.
- The parameter setting of energy meter shall be protected by the hardware lock or users/passwords programming.
- The users/passwords shall be assigned into many security levels of users and/or user groups depending on authentication of the authorized works.
-

Calibration

The energy meter shall be calibrated and/or tested using the pulse stream from LEDs or infrared on the front panel that has rate proportional to the measured power. EGAT shall be able to adjust the percentage error manually or via software program. If the energy meter has never been used in EGAT before, the calibration software shall be provided by the bidder.

Calibration certificate and test report.

Type test

- The proposed energy meter model shall be tested (type test) and certified by third party laboratory who is accredited according to ISO/IEC 17025 standard or equivalent, the test shall be done according to the following standards or latest better standards:
    - IEC 62052-11: Electricity metering equipment (AC) – General requirements, tests and test conditions – Metering equipment

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- IEC 62053-22: Electricity metering equipment (a.c.) – Static meters for active energy (classes 0.2S and 0.5S), (requirement for indoor use)
- IEC 62053-24: Electricity metering equipment (a.c.) –Static meters for reactive energy (classes 0.5S, 1S and 1).

Individual accuracy test (accuracy calibration):

- For the purpose of the readiness to install (readiness to use), the individual energy meter shall be calibrated by EGAT Energy Meter Calibration Laboratory (EGAT EMC Lab) or laboratory who is accredited according to ISO/IEC 17025 standard.
- The accuracy calibration shall be done according to IEC 62053-22 and IEC 62053-24 standard (or latest equivalent standards) for active and reactive energy respectively.
- The reference standard meter for calibration shall have accuracy class 0.05 or better.
- The energy meter shall be calibrated under the EGAT's meter master configuration.
- The minimum accuracy test points shall be carried out as the following table:

Energy Direction	Load Point (Test Points)
Both export and import active energy (total 8 points)	IEC62053-22 Export active energy - 100%In at unity power factor - 100%In at PF 0.5 inductive - 50%In at unity power factor - 10%In at unity power factor Import active energy - 100%In at unity power factor - 100%In at PF 0.5 inductive - 50%In at unity power factor - 10%In at unity power factor
Both export and import reactive energy (total 4 points)	IEC 62053-24 Export reactive energy - 100%In at sinφ = 1.0 - 100%In at sinφ = 0.5 inductive Export reactive energy - 100%In at sinφ = 1.0 - 100%In at sinφ = 0.5 inductive
Test of no-load condition	IEC62052-11
Starting (only for active energy but both import and export direction)	IEC62052-11
Meter constant (dial test or dosage test)	IEC62052-11

Remark: In, shall be 5A or 1A, depending on the rated secondary current of the CT at the installation point.

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Calibration certificate and test report provision:

- The bidder shall supply both type test report of the proposed energy meter model and calibration certificate of the accuracy test, to EGAT during commissioning period. Otherwise, the proposed energy meter shall not be accepted.

Software(s).
The energy meter shall be delivered to EGAT with the software(s) as the following characteristics:

Parameter setting software.
- The Bidder shall supply the meter parameter setting software for the proposed energy meters in the case that energy meter could not be programmed by EGAT existing software.

Calibration software.
- The Bidder shall supply the meter calibration software (the percentage error adjustment of the meter) to calibrate all delivered energy meters in case those delivered energy meters could not be calibrated by EGAT existing software.
- The calibration software shall be the latest version without expiration, the Bidder has to provide the official confirmation letter or document related to the expiration of this calibration software as the part of bidding documents.

Software manual(s).
- All of above software shall deliver to EGAT with complete set of instruction manuals at least in English version.
- The instruction manuals shall comprise theory of operation and applications, installation and system arrangement, spare part lists, and detailed circuit diagram as necessary for repair and maintenance.
- The instruction manuals shall be at least electronic files stored in CD-ROM or better storage device.

Important remark for software(s).
- All of above software shall operate under Microsoft windows operating system environment (latest version).

Installation and accessories.
Each energy meter shall be 19-inch rack mounted type, back side connected shall be essailec connectors

- Installation rack
  - The rack shall be made of galvanized steel material.
  - Dimension and functionality shall be as depicted in typical drawing no. TP-E-10.21.
- Essailec connectors

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- The energy meter(s) shall be delivered with complete set of Essailec connectors which is installed in installation rack, using for installation of voltage and current measuring circuit, communication, and etc.
- The above backplate shall be installed on the rear side of the above 19-inch rack.

- The connectors on rear side of each energy meter
  - The rear (back) side of each energy meter shall be equipped with Essailec connectors (mail pins), the pins arrangement shall be suitable to install for the above 19-inch rack.

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1008-10 Fault Recording System. The fault recording system (FRS) shall be of the IEDs which completely support for IEC 61850 communications directly embedded into the devices. The FRS shall be an instrument designed for sensing, acquiring, storing and recording critical high-speed data during power system faults and disturbances, including synchrophasor measurement as defined in the Specification No.1003. The FRS shall be tested to comply with the international standards of the IEC and ANSI/IEEE C37.2-2008. The system which is supplied to EGAT shall be standard version. Any additional modification to the standard version in order to meet EGAT specification shall not be accepted. Details of each function in the system shall be completely described in the manual.

The main ratings and features of the FRS shall be defined in the specification no.1003, however, for the IEC 61850 based SA, the FRS shall have the additional following features:

- Capability to easily monitor and record GOOSE messages from multiple IEDs within the substation
- Sending MMS to station level
- Current and Voltage data coming from the MU as Sampled Values (if required by EGAT)
- Time Synchronization via IRIG-B, 1PPS, or PTP compliant with IEC/IEEE 61850-9-3
- Using the IEC 61850 Substation Configuration Language (SCL)

The FRS shall be IEC 61850 ready for GOOSE messages, which are capture and filtered by one of the Ethernet interfaces installed at the communications module. The equipment can detect all binary inputs within the substation.

The FRS shall be fitted with at least dual network Ethernet port with Parallel Redundancy Protocol (PRP) for communication to redundant station-bus networks, and another dual network Ethernet port for communication to process-bus network (if required by EGAT). In the case that the FRS does not support PRP, RedBox is required to perform the communication redundancy. EGAT prefer optical fiber interface module 100baseFX for station-bus network and Optical fiber interface module 100baseFX for process-bus.

The design of the Fault Recording System panel layout shall be as described in typical drawing TP-E-10.22.

Certification.
The conformance test of the FRS shall be certified according to IEC 61850-10 standard, by the third party who have been authorized by ISO/IEC 17025 standard or equivalent. The Bidder shall supply the test report to EGAT during bid evaluation period. The FRS shall not be acceptable if that test is not available.

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1008-11 Details of Panel, Cubicle and Cabinet Assembly. Each panel section shall consist of an assembly made from not less than No. 2.5 mm leveled sheet steel and formed steel members as required to form a rigid self-supporting structure. If the proposed leveled sheet steel does not conform to the above-said, the Contractor shall submit the technical clarification and the past supply records for two (2) years. In addition, the Contractor shall guarantee the stability and quality of each switchboard section. No surface joints shall be made on the outside surfaces of panels. No holes or fasteners shall be visible as viewed from the front of the panels. Panels shall be designed without any permanent bottom braces and the bottoms shall be open. They shall be furnished with channel bases. The front and rear panels of the panels shall have bent angle or flange edges with an outside radius not exceeding 10 mm.

1008-11.1 Ground Buses. A 6 mm by 25 mm or 5 mm by 30 mm cross-section bare copper ground bus shall be provided at the bottom of each panel and each cabinet. The length shall not be less than 90 percent of the panel/cabinet's width. Terminal lugs to which the metallic cases of meters, instruments, relays and grounding circuits of all other equipment connected shall be suitable for cable size of 6 sq.mm. The grounding buses shall be solidly bolted to the steel framework so as to make good electrical contact. Solderless lugs or terminals shall also be provided on the ground buses for terminating No. 4/0 AWG stranded copper ground cables from the substation grounding system.

1008-11.2 Power Supply Disconnects. Power supplies for panel mounted devices shall be provided with Miniature Circuit Breaker (MCB) connected to isolate the devices from power supplies in the tripped or open condition. MCB shall be located within the panels. Engraved nameplates shall be installed beside each set of MCB for identification.

Except for voltage supply of the potential transformer secondary which supplies to distance relay or current differential relay with distance protection, sliding switch bridge terminal block shall be required instead of MCB.

Power supply to each nature of control circuit and the potential transformer secondary supply to each metering circuit shall be separated and required separated MCB protection provided.

All devices installed in the panels shall be designed for users to access the components at least 30 mm intervals either horizontally or vertically.

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1008-11.3 Nameplates. Nameplates shall be furnished and mounted by the Contractor. Each assembly, each piece of equipment mounted on an assembly, and each power and control circuit shall be provided with a nameplate. All nameplates shall be of laminated plastic material, black on the surface with a white internal layer. Lettering shall be machine-engraved into the nameplate to form white letters against a black background. All panel mounted nameplates shall be in accordance with the respective drawings showing nameplate schedule. A sample nameplate, showing the style of engraving to be used shall be submitted to EGAT for approval. Nameplate engraving shall be subject to approval of EGAT.

Finished panel surfaces shall be free from waves, bellies, or other imperfections. Exterior and interior surfaces shall be cleaned by sanding and steam cleaning, ground smooth, filled, primed, sanded and shall be finish-painted inside and outside with ANSI 61 medium gray (RAL 7036 semi gloss). One quart of matching paint shall be furnished under each item of equipment for touching up damaged places.

1008-11.4 Copper Cable Wiring and Termination. All wiring used within panels shall conform to the NEC and NEMA standards and shall be rated 600V, tinned, stranded copper switchboard wire, polyvinyl chloride insulated and in gray color. All wiring shall be 1.5 mm2 except for current transformer circuits which shall be 2.5 mm2. All hinged wiring shall be extra flexible. After assembly, all control wiring shall be given a dielectric test of 1,500 V

between live parts and ground, and between opposite polarities. Internal wiring of each basic panel assembly and each cabinet shall be neatly and carefully installed in suitable wiring ducts with removable covers and complete to conveniently located terminal blocks for connecting to incoming and outgoing leads.

Before connected to the terminal blocks, all wiring shall be terminated with blade type cable lugs. Multiple wires in one cable lug shall not be acceptable. The cable lugs shall perfectly match the terminal blocks and shall be plugged in without any modifications to the cable lugs.

The terminal arrangement shall group all leads for each particular function to facilitate connections to the incoming and outgoing cables. The arrangement shall be subject to the approval of EGAT. Terminals for each CT circuit shall be grouped together and separated from terminals for other CT circuits. At least 20 per cent spare terminals shall be provided for future use.

Wiring between inter-panels shall be made and routed through vertical raceways of the panels and cabinets. Such wiring shall also be terminated and reconnected in terminal blocks in order to permit convenient separation of individual panels or cabinets.

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All incoming and outgoing cables shall enter the panels and the cabinets through cable slots in the floor underneath the panels and the cabinets. Splices or tee connections shall not be permitted in control wiring or instrument leads.

Any control boards or cabinets that are split for shipment shall have terminal blocks adjacent to the split and shall be provided with wiring required to interconnect the split units.

1008-11.5 Terminal Block, Wire and Device Designations. The terminal blocks shall be of non-flammable, self-extinguishing, non-hygroscopic insulating material, rated for 400 V and shall conform to IEC 947-7-1 and IEC 947-1 standards. The terminal blocks shall have adequate current carrying capacity and shall be suitable for use in tropical climate. Terminals shall maintain good electrical, mechanical, chemical, and other properties even at operating temperature as high as 120ºC and shall have excellent mechanical strength and hardness; they shall be flexible but difficult to bend or break even applied with thread and torque from the connected wires. Insulating barrier between adjacent terminals shall be integral part of the terminal block. All terminal blocks and terminations shall be grouped according to circuit functions. Each terminal block shall have removable white marking strip for marking circuit designation. One spare blank marking strip shall be furnished with each terminal block. The terminal blocks shall be well arranged in order that they permit safe wiring works on any terminal while all adjacent terminals are live.

The terminal blocks shall be of the spring-loaded screw-on type, screw-on type or screwless type. The screw-on type terminals shall be designed in such a way that after the terminal block is unscrewed, the wire is still engaged to the terminal block. The screwless type terminals shall be designed to clamp the wire automatically after releasing or withdrawing the screwdriver.

The terminal blocks used for termination of the wiring to FRS and teleprotection equipment shall be knife disconnecting type.

All CT terminals and distance relays' PT terminals shall be provided with sliding switch bridge and test socket screws.

The terminal blocks shall be sized and rated in accordance with current carrying capacity of wires. The terminals for power and CT circuits shall be sized for 2x6 mm2 conductors, and those for PT and control circuits shall be sized for 2x4 mm2 conductors. The terminals for marshalling cabinet shall be sized for 2x2.5 mm2 conductors.

The terminal blocks for AC circuit and the terminal blocks for DC circuit shall be separately grouped as well as the AC terminal blocks shall be covered with transparent plastic box.

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The arrangement of all terminal blocks shall be such that incoming and outgoing leads can be easily arranged for connections to terminals. Terminal blocks shall be located so that the accessibility to them will not be lessened by interference from structural members or panel instruments. Ample space shall be provided to terminal blocks for termination of all external circuits.

Terminal blocks for blank panels will not be required; however, mounting brackets for these future blocks shall be provided.

Every point of terminal block and wire shall be assigned a designation, with identical designation on each corresponding terminal block and wire. This same designation shall also be indicated in the schematic and wiring diagrams. As a rule, a designation will not change until the wire is terminated or connected to other equipment. All wiring shall be designated at both ends by printing on wire designation sleeves.

Wire designation shall be by permanent method unaffected by heat, solvents, or steam, and not easily dislodged. Each designation on the terminal blocks shall be machine-lettered, stamped, engraved or neatly marked with permanent ink on the removable marking strips provided for each terminal block. Approximately 20% of spare wire designation sleeves shall be furnished. Adhesive labels shall not be acceptable.

The name or ANSI standard device number of each device shall be marked on the rear of the panels directly behind or adjacent to the corresponding device.

The following requirements shall be met for all wiring terminations within all type of cabinets. All connection points for external wires and cables shall be easily accessible for connection and disconnection and shall be permanently labeled for identification. Self-extinguishing, fireproof vinyl marking strips shall be used to identify all external connection blocks. Marking tags shall be read horizontally.

All terminal block shall snap directly on to a standard 35 mm DIN rail. Heavy-duty, screw-compression type terminal blocks, with isolation and test points shall be used for termination of field I/O cabling and shall be able to accommodate up to 6 mm2 solid or stranded wires. The electrical ratings shall be 15 A 500 V and dielectric withstand shall be at least 3 kV.

1008-11.6 Protection and Control Panel. Each protection and control panel shall be of the swing rack type, consisting of a swing rack assembly, top sheet and rear enclosure covering the back and ends of the entire structure. Each panel shall have a front cover door equipped with a glass window for viewing all targets and indications. The panel door shall be equipped with locking handle, latches, fully concealed hinges, and complete with screened louvers at the top and bottom.

Protection and control panel shall be contained mainly bay controller, protective relays, Remote I/O unit (if required by EGAT), indicating lamps,

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and terminal blocks. All devices in the panel shall be furnished complete with integral accessories, mounted and completely wired.

The panel door shall be hinged on the right-hand side, front view. The relay rack assembly shall be hinged on the left-hand side, front view. Each panel shall be designed for mounting standard 19-inch wide rack-mounted relays. Each relay rack assembly shall be arranged to swing through not less than 120 degrees from closed position to allow easy access to the back of the equipment mounted on the rack and to the interior of the panel.

Each panel shall be provided with a vertical wiring duct complete with a cover for factory wiring and a vertical raceway and a raceway cover to house, protect, and conceal the incoming cables. The vertical wiring duct and the vertical raceway shall be arranged as shown on the EGAT's typical drawing.

Terminal blocks shall be furnished and mounted in vertical rows on the back inside the panel and located between the wiring duct and the raceway as shown on the above drawing. All wiring which connects to the external circuits shall terminate on these terminal blocks. Provision shall be made for interconnection of wiring between panel sections.

Mounting brackets, as required, shall be arranged for mounting and wiring auxiliary equipment. They shall be located to allow access to terminal blocks mounted on the back inside of the panel.

Each panel shall be provided with cable entrances at the bottom of the panel. Openings of the swing rack where are not assembly utilized by equipment shall be covered by cover plates.

The panel size shall be 800 mm wide, 610 mm deep and the height shall be 2,300 mm plus a 40 mm channel bases.

Relay test blocks shall be provided for protective relay, BCU, and SAMU testing. All test blocks shall be used with test plugs. Two sets of test plugs, to make a complete test of a circuit, shall be supplied for EGAT for each Job Number.

1008-11.7 Metering Panel. Each metering panel shall be of the swing rack type, consisting of a swing rack assembly, top sheet and rear enclosure covering the

back and ends of the entire structure. Each panel shall have a front cover door equipped with a glass window for viewing all targets and indications. The panel door shall be equipped with locking handle, latches, fully concealed hinges, and complete with screened louvers at the top and bottom.

The panel size shall be 800 mm wide, 610 mm deep and the height shall be 2,300 mm plus a 40 mm channel bases.

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Test switches shall be of the built-in, back-connected type, finished in dull black for front of the metering panel mounting. All test switches shall be arranged to isolate completely the instruments from the instrument transformers and other external circuits and provide means for testing either from an external source of energy or from the instrument transformers by means of multipole test plugs which shall be provided for the purpose. A sufficient number of test plugs to make a complete test on one meter, instrument, or relay shall be furnished for each type of test switch. All test switches shall be arranged so that the current transformer secondary circuits cannot be open-circuited in any position while the test plugs or cover plugs are being inserted or removed. The internal contacts shall be normally sprung together by themselves to complete the circuit link.

Test switches and multipole test plugs shall be ABB, flexitest switches, type FT-1 or equivalent. All test blocks shall be used with test plugs. One set of test plug, to make a complete test of a circuit, shall be supplied for EGAT for each Job Number.

1008-11.8 Emergency Control Panel. All devices in the emergency control panel shall be furnished complete with integral accessories, mounted and completely wired. Each panel shall have a front cover door equipped with a glass window for viewing all control switches and indications.

Emergency control panels shall be furnished and designed in accordance with the EGAT's typical drawing. Each panel shall be an assembly enclosed at top and sides and shall have front access door. Indicating and control devices shall be mounted on the center plate. The front shall each be provided with a hinged flat mimic control board. Access doors shall be equipped with locks, latches and fully concealed hinge.

The panel size shall be 800 mm wide, 610 mm deep and the height shall be 2,300 mm plus a 40 mm channel bases.

Three (3) of six (6) inches ventilation fans per panel shall be mounted inside at the top. Their switch shall be located inside the panel. The power supply shall be 230 V, single-phase, 50 Hz, AC.

Each panel shall have vertical side members, which include vertical raceways and raceway covers for factory wiring, and shall be bolted to the right and left sides of the cubicle. These side members shall provide separate raceways to house, protect, and conceal the incoming cables.

Terminal blocks shall be furnished and mounted in vertical rows on both sides of the panel. The number of vertical rows and the arrangement of terminal blocks shall be in accordance with the EGAT's typical drawing. All wiring which connects to the external circuits shall terminate on these terminal blocks.

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Emergency control panel shall be factory assembled outdoor enclosure. Manufacturers shall take appropriate measure to protect against dust and spray of water up to 60 degrees from the vertical. All outdoor panels shall have a minimum protection class of IP 52 or NEMA 5. All measures shall be taken to prevent the ingress of moisture and the occurrence of corrosion on any part in the panel.

No holes shall be visible as viewed from the front of the cubicles. Outdoor panels shall be installed on a concrete pad with a level and smooth surface. All panels shall be designed to have bottom sheets and each bottom sheet which shall be provided with adequate quantity of holes for control cable entrance from underneath the panels. The cables entrance at the bottom of the panel shall be attached and secured with cable glands. The cable gland shall be guaranteed the same degree of protection as the enclosure on which it is mounted.

1008-11.9 Merging Unit Cubicle. Each cubicle shall have a front cover door equipped with locking handle, latches, fully concealed hinges, and complete with screened louvers at the top and bottom.

The merging unit cubicle shall be designed to function normally in an outdoor environment. In varying degrees, the cubicle shall be resistant to sunlight, water, and high temperature, etc. The cubicle shall be built to be resistant to corrosion.

Merging unit cubicle shall be fully weatherproof housing, double wall, and factory assembled outdoor enclosure. Ambient temperature will be between 0ºC and +45ºC. Temperature inside the cubicle shall be in the range of the temperature specified in “Operating environment” in part 1008-7. In the case that the natural air circulation is not sufficient to maintain the mentioned temperature, the cooling system shall be provided by the contractor to fulfill the condition. Manufacturers shall take appropriate measure to protect against dust and water splash from all direction. All outdoor panels shall have a minimum protection class of IP 54 or equivalent. All measures shall be taken to prevent the ingress of moisture and the occurrence of corrosion on any part in the cubicle. The rain-hood vents on the rear side and ventilation louvers on the front side shall be rain and insect resistance. The roof of the cubicle shall be sloped of 15 degrees.

An automatic space heater shall be provided in the cubicle. The heater shall be design to install in the location that will not cause the thermal problems with electronic devices, electrical insulation, and etc. The heater shall be installed above the Merging Unit.

Each cubicle shall be provided with a vertical wiring duct complete with a cover for factory wiring and a vertical raceway and a raceway cover to house, protect, and conceal the incoming cables. The vertical wiring duct and the vertical raceway shall be arranged as shown on the EGAT’s typical drawing.

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Terminal blocks shall be furnished and mounted in vertical rows on the back inside the cubicle. All wiring which connects to the external circuits shall terminate on these terminal blocks. Provision shall be made for interconnection of wiring between panel sections. Mounting brackets, as required, shall be arranged for mounting and wiring auxiliary equipment. They shall be located to allow access to terminal blocks mounted on the back inside of the cubicle. Each panel shall be provided with cable entrances at the bottom of the panel.

Test switches shall be of the built-in type or separate type as specified. Separate test switches shall be of the cubicles, back-connected type, finished in dull black for front-of-cubicle mounting. All test switches shall be arranged to isolate completely the stand-alone merging units from the conventional instrument transformers and other external circuits and provide means for testing either from an external source of energy or from the instrument transformers by means of multipole test plugs which shall be provided for the purpose.

All test switches shall be arranged so that the current transformer secondary circuits cannot be open-circuited in any position while the test plugs or cover plugs are being inserted or removed. The internal contacts shall be normally sprung together by themselves to complete the circuit link. Two sets of test plugs, to make a complete test of a circuit, shall be supplied for EGAT for each Job Number.

Test switches and multipole test plugs shall be ABB, Flexitest switches, type FT-1 or equivalent.

No holes shall be visible as viewed from the front of the cubicles. Outdoor cubicles shall be installed on a concrete pad with a level and smooth surface. All cubicles shall be designed to have bottom sheets and each bottom sheet which shall be provided with adequate quantity of holes for control cable entrance from underneath the panels. The cables entrance at the bottom of the cubicle shall be attached and secured with cable glands. The cable gland shall be guaranteed the same degree of protection as the enclosure on which it is mounted.

1008-11.10 Network Device Cabinet. The network device cabinet shall be made of electro-galvanized sheet steel. The equipment shall be 19” rack mounted. The mounting pole, frame structure shall be made of at least 2.0 mm, and base shall be made of at least 3.0 mm. The cabinet shall be complete with all internal wiring and connections. The cabinet shall be full size racks come with front and back doors (the steel frame with mesh or perforated circle ventilation surrounding at least 75% of door’s area) with swing handle lock. The front door shall be capable of being opened at least 160 degrees.

The cabinets shall be of fabricated steel construction providing a good combination of high load carrying capacity and rigidity. The 19” rack cabinet, 45U standard, shall be made fully galvanized iron plate.

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Inside the cabinet, a carrier system shall be provided and connections shall be mechanically made onto equipment and auxiliaries. In this way the 19" system, doors and lateral plates shall be earthed.

The Network Gateway, Ethernet Switches, E1 converter and GPS receiver shall be installed on rack mounted in a network device cabinet.

Network Device Cabinets shall be floor standing and shall permit anchoring to the floor. The size of the cabinet shall be as specified in TP-E-10.19. Locally manufactured cabinets shall be used for all cabinets. The design of cabinets shall conform to IEC 60297 equipment or equivalent.

Each cabinet shall have open space for airflow through the door, in order to provide all devices with enough cold airflow to dissipate the heat generated and ensure that the cold air is not restricted from entering the installed devices. Mesh or perforated doors should be used on the front and rear of all server cabinets, in order to allow hot air to flow away from the cabinet. All devices shall be placed at least 5 inches from the front and rear cabinet doors to provide sufficient space for accessories, such as handles and cables, as well as airflow.

Each cabinet shall install at least four top-mount fans in order to remove heat from the top of a cabinet. The use of top-mount 4-inch fans can actually impede heat dissipation by drawing cold air away from the electronic devices.

Eye bolts shall be installed at every corner of cabinet's top plate.

Cables shall be neatly contained and bundled when possible. Cables that are too long for the application, excessive cable slack and unneeded loops shall be avoided. Cable channels and cable guide rings shall available to install the cables on the mounting panels and the sidewalls.

Pocket suitable for storing all site-specific documentation and drawings shall be provided within the enclosure, on the front door. A nameplate shall be furnished for each cabinet. Nameplates shall be attached to the equipment with stainless steel pan head screws. The lettering shall be permanently engraved onto the nameplate. Nameplate identifiers for each cabinet shall be submitted to EGAT for approval.

1008-11.11 Communication Network Cables and Termination. The communication network within the substation should be capable of covering distances up to 1.5 km.

Radio frequency fields may induce disturbances that are conducted by wires in the substation. The equipment shall meet either IEC 61000-4-6 class 3 or IEEE C37.90.2 regarding induced disturbances. The specific requirement (IEC standard or IEEE standard) shall be agreed between Contractor and EGAT.

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1008-11.12 Communication Network Cabling Requirements. The contractor shall provide all intra- and inter-subsystem signal and power cabling for the

equipment including communications cabling. This shall include all interconnecting wires, cables, connectors, and terminations required for subsystem elements, interconnections, interfaces, main power source attachments and interconnections.

The contractor shall be responsible for the detailed design of the copper cable and fiber optic cable route and equipment installation location, to interface all substation switchgear equipment to the supplied equipment, in order to meet the requirements of this specification.

The contractor shall submit the results of the survey of the cable route and equipment installation location, including workshop drawings and installation procedures, to EGAT for approval before installation.

The main cabling of a network that all of the segments connect to is called the Backbone. Typically, the backbone is capable of carrying more information than the individual segments. For example, each segment may have a transfer rate of 100 Mbps (megabits per second) while the backbone may operate at 1000 Mbps (or 1Gbps).

The LAN supporting the distributed BCUs and Protective Relays shall utilize fiber optic cables, which may be of glass or plastic as necessary to satisfy the plant distribution distances and overall performance requirements and shall be approved by EGAT.

1008-11.13 Bill of Materials. Enlisting major equipment to be mounted on the protective relay panel, marshalling panel, emergency control panels, merging unit cubicle and network device cabinets, if not otherwise indicated elsewhere in this Specification, the bill of materials shall cover only the major equipment, or such equipment as will require particular information from the Bidder. It is to be understood that, all other associated auxiliary equipment and accessories, although not listed in the bill of materials, but necessary for the complete and sound functions of the panels and cabinets as described in this Specification, and as generally accepted as the applicable standards, shall be furnished by the Contractor. The Bidder at the time of bidding shall, to the best of his knowledge, furnish the list showing quantity and details of all the equipment he intends to supply.

The panels, cubicles and cabinets proposed shall give the best optimum result as called for in this Specification, and as basically required by standard electrical engineering practice. The Contractor, after having finished the design of the panels, cubicles and cabinets shall submit to EGAT for approval all the design details including individual equipment of the panels, cubicles and cabinets and to all associated equipment in the substation, and showing overall functions of the schematic diagrams. EGAT shall then review the schemes, and should any proper functions required in

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this Specification or required for sound engineering practice of the panels, cubicles and cabinets entail necessary modifications to the scheme or additional equipment other than those originally proposed by the Bidder at the time of bidding, EGAT will return the scheme to the Contractor to carry out the modification required without any extra charge to EGAT.

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1008-12 Testing and Commissioning.

1008-12.1 Conformance Testing. A conformance test is the type test for communication and – since communication establishes a system – the system related test of the incorporated IEDs. The conformance test shall be applied as specified in IEC 61850-10 to ensure that all suppliers comply with applicable requirements of communication standard, IEC 61850.

Conformance testing does not replace project specific system related tests such as the FAT and SAT. The FAT and SAT are based on EGAT's requirements for a dedicated substation automation system and are done by the system integrator. These tests increase the confidence level that all potential problems in the system have been identified and solved. These tests establish that the delivered substation automation system is performing as specified.

1008-12.2 Individual Test. The individual test shall be performed by contractor for each equipment in substation and shall be witnessed by EGAT's appointed inspector for verification.

1008-12.2.1 Communication Equipment. The test procedure shall be included, but not be limited to the following items:

- The details of equipment (for example: the name of each card or module and card serial numbers)
- Hardware Testing
- Software Testing
- Performance Testing
- Application Testing
- Interworking Testing
- Failure Scenario Testing
- Etc.

1008-12.3 Factory Acceptance Tests (FAT). The following tests shall be witnessed by EGAT's appointed inspector for verification of performance of system:

- Functional tests including performance test
- Communication tests
- Insulation resistance measurement
- System failure test
- Response time simulation
- System recovery test after power outage

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In addition to the FAT, fool proof tests shall be carried out which shall cover a set of unstructured tests.

The standard IEC 61850 describes the communication of devices in substations. GOOSE messages describe binary status signals over the substation network and are also used for relays tripping. Goose is based on multicast messages directly mapped to the Ethernet, where a message sent

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by one IED can be seen by several receivers. For relay testing in IEC 61850 substations, it is necessary to access to these data or catch the messages on the network.

The Factory Acceptance Tests consists in a simulation, as close as possible, of the real conditions of the installation; to prove that the system fulfils what was contracted between supplier and EGAT. Generally, a set of IEDs of each bay type is mounted in cubicles prepared to simulate the process, and then connected to the Ethernet bus and to station HMI, respecting what is the real system architecture. Typical tests are made for each bay, in order to check the correct operation of the IED, event report and HMI pictures, and in some cases also NCC communication can be simulated.

If global complex functions need to be tested, usually this requires that more IEDs of the same bay type have to be mounted in cubicles, to verify the correct behavior of the system as a whole. The FAT period is where it is still accepted that EGAT asks for small modifications to the initial specifications. All corrections to the system have to be made during or immediately after ending this period, in order to have a system as close as possible to the final version, when leaving the verification room.

Contractor shall submit the specification/procedure for Factory Acceptance Test (FAT) for approval. The purpose is to ensure that the Contractor has interpreted the specified requirements correctly. If the FAT involves only in a certain portion of the system for practical reasons, it has to be assured that this test configuration contains at least one unit of each and every type of equipment incorporated in the delivered system.

If the complete system consists of parts from various suppliers or some parts are already installed at site, the FAT shall be limited to sub-system tests. In such cases, the complete system test shall be performed at site together with the Site Acceptance Test (SAT). The system performance under all conditions occurring on the network shall be such that no loss of data occurs and the computer system shall not “crash” or “failure”. Prior to dispatch, the Contractor shall verify by tests that the operation of the equipment complies with the requirements specified in the requisition, and shall submit to EGAT, and shall report incorporating the results of all tests performed. A detailed tests list and its procedure for the FAT of the software and the hardware involved shall be submitted to EGAT prior to the test for the approval.

EGAT shall witness the functional FAT and shall carry out an inspection of the assembled equipment and related documents to verify compliance with the requirements. A procedure for the SAT shall be submitted to EGAT for approval before dispatch of the equipment. The Contractor shall submit to EGAT, for review and approval, the type test results of the electrical, disturbance and environmental immunity test requirement.

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The system and associated equipment shall be visually inspected for conformity with the latest issue of the approved drawings and documents. Spot checks shall be made to verify the following:

- Completeness of the data on the general equipment nameplates
- Visual examination (Appearance, Finish, Paint work, Wiring)
- Dimensional check
- Degree of protection of the enclosures
- Caution/ danger/ instruction plate
- Correct wiring of auxiliary devices
- Suitability of clamping, earthing and terminating arrangement
- Suitability of lifting lugs
- Correct labeling of functional units and auxiliary devices

Check of data flow on communication channels in accordance with the standard conditions concerning access organization, formats and bit sequences, time synchronization, timing, signal form and level and reaction to errors. The conformance test can be carried out and certified to the standard or to specifically described parts of the standard. The conformance test should be carried out by an ISO 9001 certified organization or system integrator.

1008-12.4 Site Acceptance Tests (SAT). Site acceptance tests (SAT) shall be carried out to check that no damage has occurred to components/ subsystems in transit. These tests shall also check all protective and control devices operate as intended and that all interfaces with other systems are compatible and function correctly. The test is also to confirm a completeness of all connection between devices.

The Site Acceptance Tests (SAT) consists in a repetition of the FAT procedures, but now with the real process including the existing devices and all other devices provided by EGAT. The objective is to deliver a fully tested system to EGAT. No special differences were found comparing with the previous projects. Only should be taken in account the preparation of the physical conditions, before the commissioning team comes to substation, since there are new communication devices like managed switches that require software programming, a different communication structure and some more aspects that can delay the real start of the commissioning tests.

In addition to SAT, Site Integration Test (SIT) and availability tests shall be carried out. The SIT shall ensure the system is satisfactorily established and functions correctly at site and also checks whether the system has been properly integrated in the installation. In addition to SAT and SIT, the availability tests shall be conducted to prove that the required and specified availability of software and hardware is achieved by checking for their reliability. All these tests shall be performed on completed installation for demonstrating that the system has been integrated in the installation and all

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specified performance requirements are in accordance with purchase documents. The test results/readings shall be recorded in agreed format and submitted as part of final documents.

The SAT shall be performed to ensure the correctness of different equipment delivered and the functions of these equipment to meet the Functional specifications as agreed upon after the final commissioning is carried out at site. The SAT shall also require detailed checks to verify the installation. The testing shall include minimum of the following inter-operability tests for the system and the relays in the switchgear panels.

- Communication with relays involving rating of I/Os
- Redundancy test
- Logic test in software

Contractor shall also provide, at no extra cost to EGAT, all equipment and instruments required for performance testing of equipment. These shall be taken back by the Contractor after the satisfactory completion of the performance tests. Calibration certificates shall accompany all the instruments.

Contractor shall also propose training at site, the scope of which shall be given by EGAT. The test configuration shall besides of the standard functions allowed for testing:

- Performance of operation including switching-over of all redundant components
- Sequence of event recording in case of multi-occurrence of signal avalanches as specified
- Automatic transformer regulations with transitions between the independent and the master/ follower mode
- Feeder interlocking

Subsequent subsections list the functional checks on various subsystems:

- Functional. The peripherals like, printers etc. shall be energized and proper operation of the peripherals checked by self tests on equipment, which have the facilities and others like Visual Display Units (VDUs) by connecting them to the system. These tests will be carried out over rated variation of input voltage and rated frequency arranged by the EGAT.
- Controls. The application software developed for controls shall be loaded into the system and a detailed check performed to ensure the correct operation of controls for all the different operations. Control shall be checked individually by the permissive interlocks step by step as per agreed specifications. By varying the different, inputs at random and checking to ensure that the right status reporting is done on the system, the healthiness of all digital output channels shall be checked with rated load connected when the status change is generated from the control software.

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- Displays. The following will be functionally checked:

Displays	Symbols, color, coding etc.
Controlling	Selection
Status changes	Representation of Open/Close facility and mode of operation
Variables	Engineering units, updating, representation
Events & Alarms	Generating of alarms and events by verifying inputs at random, color coding, formatting.
Trend	Proper selection, presentation under different time scales.

EGAT shall inspect the system and its associated equipment. Contractor shall allow EGAT's Inspectors all reasonable access to his factory and documentation at any time during manufacturing.

1008-13 Spare Parts and Quality Assurance. A list of spare parts shall be provided with the type number, style number, and catalog number of each spare part as required for each type of relays, instruments, meters, and auxiliary devices based upon 50 hertz operation and the voltages as applied to the circuit.

All special tools and accessories required for installation and normal operation and maintenance of the equipment shall be furnished to the System Protection Department. The notebook computer, software (stored in CD-ROM), manual to use the software and connector links between relays and PC should be furnished to the System Protection Department for each substation which relays protection can be connect by the computer. The specification of notebook computer should be clarified by user of the System Protection Department.

Quality Assurance (QA) shall follow the requirements of the specification documents as applicable. QA involvement will commence and follow through to completion and acceptance thus ensuring total conformity to EGAT's requirements. Unless otherwise stated in the purchase order, the manufacturer's quality system shall be based on the appropriate ISO 9000 standard and shall be described in a project specific Quality Plan.

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1008-14 Training and Software.

1008-14.1 On Site Training. After successful commissioning of the entire SA, the contractor will impart on-site training. Hands on training logic development, system configuration for extension of addition of bay, IED fault finding, trouble shooting, data analysis, changing of equipment parameters/input data, preventive maintenance of each equipment. The site training will be also of similar nature as outlined in the previous clause, except that here the training will be on actual commissioned system and all aspects shall be covered. The training shall be conducted at each substation separately, covered in the package. The Contractor shall submit the training modules for approval of the Employer. The training durations are at least 3 days. Actual duration of the training shall be as per approved training module.

The contractor shall recommend a menu of training courses for the purpose of preparing EGAT personnel to configure, operate, program, and maintain the delivered systems. It is understood that EGAT shall have no programming or configuration responsibilities for the systems under contract, but they may well need these skills after system deliveries.

EGAT and the contractor shall come to agreement in the Work Statement regarding which courses shall be presented prior to the Factory Acceptance Tests, so that EGAT has a solid foundation for witnessing and evaluating the structure and results of tests.

The contractor shall provide Simulation Test Tool for testing all IEDs (Protective Relays and BCUs), Remote I/O, Gateway, Industrial Firewall with routing feature, Ethernet Switch and station HMI within Ethernet Network according to the IEC 61850 communications standard and IEC 60870-5-104 companion standard for the informative interface protection equipment. Training shall be also provided.

1008-14.2 Software. The Contractor shall provide all system software required to run the IEC 61850 SA and station HMI and for communication between the controller and the IEDs. All software shall be menu-driven and user friendly.

System software includes any software or firmware used to implement or support the functions required by this technical specification. It is possible that software includes certain programmable logic applications if those applications are in fact an extension of system software. System software does not include programmable logic or other application implementations if required and specified in the bidding document.

The software shall provide automatic restart of the IEC 61850 SA upon power restoration, memory parity errors, hardware failures and manual request. The software shall initialize the SA and begin execution of the SA functions without intervention by the station HMI. All restarts shall be reported and alarm to the station HMI.

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The SA design shall be independent of any communication protocol that would impose restrictions on the flexibility or functionality of the SA. Protocol change shall be accomplished by software changes only.

In addition to the above, the Contractor shall provide on the PC-based workstation, User configurable software. The SA software shall allow the

configuration of a suitable information filter and development of a hierarchical control structure. The station HMI software shall be user friendly. The station HMI software interface shall at least include the following requirements:

- At the foot of each screen, various system information and shortcuts shall be displayed, as required for operational features.
- This shall include the alarm, banner, date, time and function key information, etc.
- Alarms shall be annunciated with alarm sound.

BidNo.BBA1-DS-01 DRAFT

เอกสารไม่ควบคุม
รับรองสำเนาโดย หพอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

DRAFT

SECTION J

DRAWINGS

J. DRAWINGS

J-1. Drawings

The following drawings are attached hereto and made a part of the Contract Documents:

List of Design Drawings

No.	Description	Dwg. No.	Sheet	Rev.
	BHUMIBOL 2 SUBSTATION			
01	230 KV METERING AND RELAYING DIAGRAM	BB2-E-1	1/4	-
02	LIST OF PROTECTIVE IED AND SIGNAL DIAGRAM	BB2-E-1	2/4	-
03	LIST OF PROTECTIVE IED AND SIGNAL DIAGRAM	BB2-E-1	3/4	-
04	LIST OF PROTECTIVE IED AND SIGNAL DIAGRAM	BB2-E-1	4/4	-

List of Standard Drawings

No.	Description	Dwg. No.	Sheet	Rev.
05	CONTROL SWITCH AND SELECTOR SWITCH CONTACT TABULATION	TP-E-9.1	-	10
06	PANEL CONSTRUCTION OF BLANK 19" RACK	TP-E-10.19	-	2
07	DETAILS OF E1 CONVERTER PANEL	TP-E-10.20	-	1
08	DETAIL OF PANEL LAYOUT & ACCESSORIES FOR METERING PANEL	TP-E-10.21	1/1	-
09	FAULT RECORDING SYSTEM SWITCHBOARD PANEL	TP-E-10.22	-	-
10	TYPICAL SCHEDULE FOR NAMEPLATES	TP-E-11	1/6	4
11	TYPICAL SCHEDULE FOR NAMEPLATES	TP-E-11	2/6	1
12	TYPICAL SCHEDULE FOR NAMEPLATES	TP-E-11	3/6	1
13	TYPICAL SCHEDULE FOR NAMEPLATES	TP-E-11	4/6	1
14	TYPICAL SCHEDULE FOR NAMEPLATES	TP-E-11	5/6	1
15	TYPICAL SCHEDULE FOR NAMEPLATES	TP-E-11	6/6	1
16	CT.JUNCTION BOX TYPICAL CONSTRUCTION	TP-E-18.2	-	6
17	PT AND CT JUNCTION BOX TYPICAL CONSTRUCTION	TP-E-18.4	-	11
18	DIGITAL SUBSTATION SYSTEM LOGICAL NODES	TP-E-20.2	1/2	-
19	DIGITAL SUBSTATION SYSTEM LOGICAL NODES	TP-E-20.2	2/2	-
20	DIGITAL SUBSTATION SYSTEM NETWORK TOPOLOGY	TP-E-20.3	1/2	4
21	DIGITAL SUBSTATION SYSTEM METERING TOPOLOGY	TP-E-20.3	2/2	-
22	DIGITAL SUBSTATION SYSTEM (AIS) 230 KV AND BELOW BREAKER CONTROL SCHEMATIC DIAGRAM	TP-E-20.4	-	2
23	DIGITAL SUBSTATION SYSTEM 115/22 KV TRANSFORMER OPERATION SCHEMATIC DIAGRAM	TP-E-20.5	1/5	1

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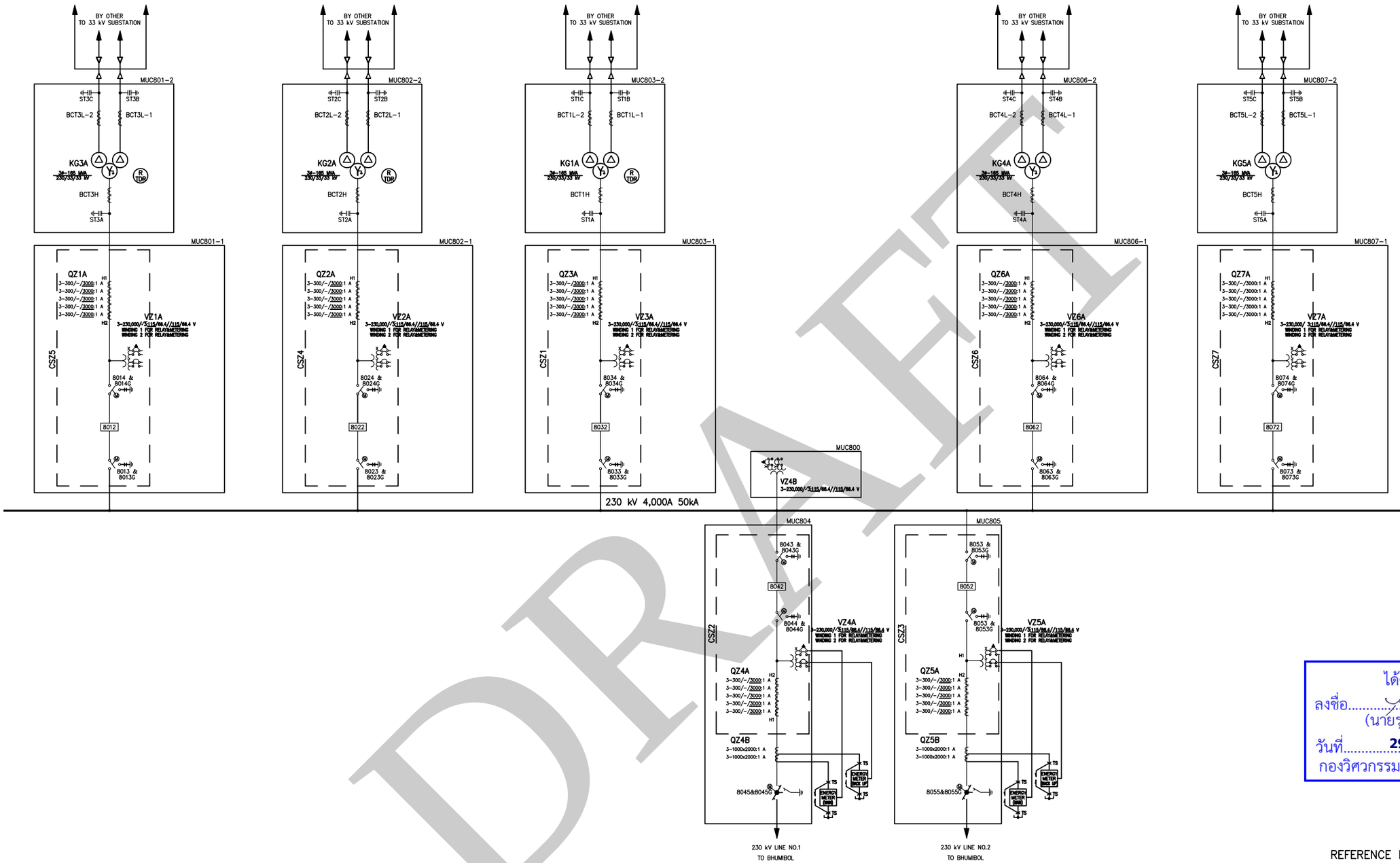
No.	Description	Dwg. No.	Sheet	Rev.
24	TYPICAL DIGITAL SUBSTATION SCHEMATIC DIAGRAM FOR FOUR-TRANSFORMER PARALLEL OPERATION	TP-E-20.5	2/5	-
25	TYPICAL DIGITAL SUBSTATION SCHEMATIC DIAGRAM FOR FOUR-TRANSFORMER PARALLEL OPERATION	TP-E-20.5	3/5	-
26	230/115 KV TRANSFORMER STATUS AND ALARM DIGITAL SUBSTATION	TP-E-20.5	4/5	1
27	230/115 KV TRANSFORMER STATUS AND ALARM DIGITAL SUBSTATION	TP-E-20.5	5/5	-
28	DIGITAL SUBSTATION SYSTEM DETAIL OF ETHERNET SWITCH PANEL CONSTRUCTION	TP-E-20.6	1/3	2
29	DIGITAL SUBSTATION SYSTEM DETAIL OF PANEL CONSTRUCTION 22 KV AND 33 KV CAPACITOR BANK SINGLE LINE DIAGRAM	TP-E-20.6	2/3	2
30	DIGITAL SUBSTATION SYSTEM DETAIL OF PANEL CONSTRUCTION 69 KV AND 115 KV CAPACITOR BANK SINGLE LINE DIAGRAM	TP-E-20.6	3/3	3
31	PT. JUNCTION BOX APPLICATIONS FOR DIGITAL SUBSTATION SYSTEM	TP-E-20.7	1/3	1
32	PT JUNCTION BOX FOR DIGITAL SUBSTATION SYSTEM TYPE PT-D1, PT-D2, PT-D3 AND PT-D4 LAY-OUT	TP-E-20.7	2/3	2
33	PT JUNCTION BOX FOR DIGITAL SUBSTATION SYSTEM TYPICAL CONSTRUCTION	TP-E-20.7	3/3	-
34	DIGITAL SUBSTATION SYSTEM HMI OPERATOR CONSOLE DESK LAYOUT WITHOUT DOOR	TP-E-20.8	-	1
35	MERGING UNIT CUBICLE TYPE TYPE CRITERIA	TP-E-20.9	1/5	-
36	MERGING UNIT CUBICLE TYPE FOR AIS MAIN AND TRANSFER BUS ARRANGEMENT	TP-E-20.9	2/5	1
37	MERGING UNIT CUBICLE TYPE FOR GIS BREAKER AND A HALF BUS ARRANGEMENT	TP-E-20.9	3/5	1
38	MERGING UNIT CUBICLE TYPE FOR GIS DOUBLE BUS SINGLE BREAKER ARRANGEMENT	TP-E-20.9	4/5	1
39	MERGING UNIT CUBICLE TYPE FOR 22 KV SWITCHGEAR	TP-E-20.9	5/5	1
40	GPS SWITCHBOARD PANEL	TP-E-20.10	-	1
41	DIGITAL SUBSTATION METERING SYSTEM SCHEMATIC DIAGRAM	TP-E-20.11	1/2	1
42	DIGITAL SUBSTATION METERING SYSTEM SCHEMATIC DIAGRAM	TP-E-20.11	2/2	-
43	DIGITAL SUBSTATION SYSTEM (GIS) 230KV BREAKER CONTROL SCHEMATIC DIAGRAM	TP-E-20.12	1/7	-
44	DIGITAL SUBSTATION SYSTEM (GIS) 230KV EQUIPMENT STATUS AND ALARM	TP-E-20.12	2/7	-
45	DIGITAL SUBSTATION SYSTEM (GIS) 230KV EQUIPMENT STATUS AND ALARM	TP-E-20.12	3/7	-
46	DIGITAL SUBSTATION SYSTEM (GIS) 230KV EQUIPMENT STATUS AND ALARM	TP-E-20.12	4/7	-
47	DIGITAL SUBSTATION SYSTEM (GIS) 115 KV AND BELOW BREAKER CONTROL SCHEMATIC DIAGRAM	TP-E-20.12	5/7	-
48	DIGITAL SUBSTATION SYSTEM (GIS) 115 KV AND BELOW EQUIPMENT STATUS AND ALARM	TP-E-20.12	6/7	-
49	DIGITAL SUBSTATION SYSTEM (GIS) 115 KV AND BELOW EQUIPMENT STATUS AND ALARM	TP-E-20.12	7/7	-
50	ROUTING AND INSTALLATION OF OPTIC FIBER CABLE	TP-E-20.13	-	-
51	SWING RACK TYPE FOR DIGITAL SUBSTATION	TP-E-20.14	-	-
52	125 VDC SUPPLY FOR MERGING UNIT	TP-E-20.15	-	-

DRAFT

DWG.NO.	REV.
BB2-E-1	1
	4
	-

LEGEND	DESCRIPTION
ENERGY METER	KILOWATT HOUR AND KILOVAR HOUR COMBIMETER
	INDICATING PROTECTION FUNCTION
	CT DEVICE CLASS "5P20"
	WYE CONNECTED CURRENT TRANSFORMER
	DELTA CONNECTED CURRENT TRANSFORMER
	CURRENT TEST SWITCH
	POTENTIAL TEST SWITCH
	MCB LOCATED AT SWITCHYARD
	MCB LOCATED AT THE ASSOCIATED BOARD



ได้ตรวจสอบแล้ว
ลงชื่อ.....
(นายรุหาญ รุจิธัญธาร)
วันที่..... **29 Jul 2025**
กองวิศวกรรมระบบควบคุมและป้องกัน

REFERENCE DRAWINGS

BHUMIBOL 2 SUBSTATION

SINGLE LINE DIAGRAM.....DWG.NO. BB2-S-1 SH.1-2

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REV.NO.	JOB NO.		DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	BBS1-01-S01	NEW 230 kV AIS SUBSTATION	-	-	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	L.SIRAPAT	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: BHUMIBOL 2 SUBSTATION
DESIGNED	L.SIRAPAT	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: 230 kV METERING AND RELAYING DIAGRAM
VERIFIED	.....		
APPROVED	..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO.: BBS1-01-S01 / REPLACING DWG.NO.: / DWG.NO.: BB2-E-1 / REV.: 1, 4, -

FEEDER	MU	SV CB.	EQUIPMENT	PROTECTION FUNCTION													BCU	FRS
	PRIMARY IED			87B	50BF-1 NOT USE	50BF-2 NOT USE	50BF-3 NOT USE	50BF-4 NOT USE	50BF-5 NOT USE	50BF-6 NOT USE	50BF-7 NOT USE	50BF-8 NOT USE	50BF-9 NOT USE	50BF-10 NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
230 kV BUS	MUC800-PRI	1	VZ4B CORE X														X	3
	MUC801-1-PRI	1	QZ1A CORE X	I														
			VZ1A CORE X															
	MUC802-1-PRI	1	QZ2A CORE X	I														
			VZ2A CORE X															
	MUC803-1-PRI	1	QZ3A CORE X	I														
			VZ3A CORE X															
	MUC804-PRI	1	QZ4A CORE X	I														
			VZ4A CORE X															
	MUC805-PRI	1	QZ5A CORE X	I														
			VZ5A CORE X															
	MUC806-1-PRI	1	QZ6A CORE X	I														
			VZ6A CORE X															
	MUC807-1-PRI	1	QZ7A CORE X	I														
			VZ7A CORE X															
	SECONDARY IED			87B	50BF-1 NOT USE	50BF-2 NOT USE	50BF-3 NOT USE	50BF-4 NOT USE	50BF-5 NOT USE	50BF-6 NOT USE	50BF-7 NOT USE	50BF-8 NOT USE	50BF-9 NOT USE	50BF-10 NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC800-SEC	1	VZ4B CORE Y															
	MUC801-1-SEC	1	QZ1A CORE Y	I														
	MUC802-1-SEC	1	QZ2A CORE Y	I														
	MUC803-1-SEC	1	QZ3A CORE Y	I														
	MUC804-SEC	1	QZ4A CORE Y	I														
			VZ4A CORE Y															
	MUC805-SEC	1	QZ5A CORE Y	I														
			VZ5A CORE Y															
	MUC806-1-SEC	1	QZ6A CORE Y	I														
	MUC807-1-SEC	1	QZ7A CORE Y	I														
230/33 kV KG3A	PRIMARY IED			87T	51TH 51THG	51TL 51TLG-1	51TL 51TLG-2	50BF-BO1	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC801-1-PRI	1	QZ1A CORE X	X	X			I										
			VZ1A CORE X														X	
	MUC801-2-PRI	1	BCT3H CORE X														X	3
		1	BCT3L-1 CORE X			X												3
		1	BCT3L-2 CORE X				X											3
	SECONDARY IED			87T	51TH 51THG	51TL 51TLG-1	51TL 51TLG-2	50BF-BO1	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC801-1-SEC	1	QZ1A CORE Y	X	X			I										
	MUC801-2-SEC	1	BCT3L-1 CORE X			X												
		1	BCT3L-2 CORE X				X											

LOW IMPEDANCE
FOR 12 FEEDERS
2 SWITCHING ZONE

**THE PROPOSED MAIN EQUIPMENT, [I.E. PROTECTION RELAY, BAY CONTROL UNIT, AND MERGING UNIT], SHALL BE FROM A MAXIMUM OF TWO (2) MANUFACTURERS.

ได้ตรวจสอบแล้ว
ลงชื่อ.....
(นายรุหาญ รุจิธัญธาร)
วันที่ 29 Jul 2025
กองวิศวกรรมระบบควบคุมและป้องกัน

NOTES

1. X = FORWARD CURRENT DIRECTION CONFIGURATION
   I = INVERSE CURRENT DIRECTION CONFIGURATION
2. FRS IN THIS TABLE SHOW NUMBER OF CHANNEL.
3. TYPE OF MERGING UNIT CUBICLE IS REFERED TO TP-E-20.9

IED FOR PRIMARY AND SECONDARY FOR LINE NO.1 & 2 TO BHUMIBOL SUPPLY BY EGAT (IED : GE MULTILIN L90, E1 CONVERTER : GE P591)

FOR BIDDING ONLY

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	BBS1-01-S01	NEW 230 kV AIS SUBSTATION	-	-	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	L.SIRAPAT	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: BHUMIBOL 2 SUBSTATION
DESIGNED	L.SIRAPAT	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: LIST OF PROTECTIVE IED AND SIGNAL DIAGRAM
VERIFIED	.....	APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE	JOB NO. BBS1-01-S01 / REPLACING DWG.NO. / DWG.NO. BB2-E-1 / REV. 2 4 -

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DWG.NO. BB2-E-1 REV. 2 4 -

FEEDER	MU	SV CB.	EQUIPMENT	PROTECTION FUNCTION													BCU	FRS
230/33 kV KG2A	PRIMARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80Z	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC802-1-PRI	1	QZ2A CORE X	X	X			I										
			VZ2A CORE X														X	
	MUC802-2-PRI	1	BCT2H CORE X														X	3
		1	BCT2L-1 CORE X			X												3
		1	BCT2L-2 CORE X				X											3
	SECONDARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80Z	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC802-1-SEC	1	QZ3A CORE Y	X	X			I										
	MUC802-2-SEC	1	BCT2L-1 CORE X			X												
		1	BCT2L-2 CORE X				X											
230/33 kV KG1A	PRIMARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80Z	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC803-1-PRI	1	QZ3A CORE X	X	X			I										
			VZ3A CORE X														X	
	MUC803-2-PRI	1	BCT1H CORE X														X	3
		1	BCT1L-1 CORE X			X												3
		1	BCT1L-2 CORE X				X											3
	SECONDARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80Z	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC803-1-SEC	1	QZ3A CORE Y	X	X			I										
	MUC803-2-SEC	1	BCT1L-1 CORE X			X												
		1	BCT1L-2 CORE X				X											
230 kV LINE NO.1 TO BHUMIBOL (SIR<4)	PRIMARY IED			87L E1	21BU	79	25	50BF-80Z	50BF-2 NOT USE	67N NOT USE	67 67N NOT USE	81U NOT USE	27LS NOT USE	51G NOT USE	51S 51SG NOT USE			
	MUC800-PRI	1	VZ4B CORE X				X											
	MUC804-PRI	1	QZ4A CORE X	X	X			I									X	3
			VZ4A CORE X				X										X	3
	SECONDARY IED			87L E1	21BU	79	25	50BF-80Z	50BF-2 NOT USE	67N NOT USE	67 67N NOT USE	81U NOT USE	27LS NOT USE	51G NOT USE	51S 51SG NOT USE			
	MUC800-SEC	1	VZ4B CORE Y				X											
	MUC804-SEC	1	QZ4A CORE Y	X	X			I										
			VZ4A CORE Y				X											
230 kV LINE NO.2 TO BHUMIBOL (SIR<4)	PRIMARY IED			87L E1	21BU	79	25	50BF-80Z	50BF-2 NOT USE	67N NOT USE	67 67N NOT USE	81U NOT USE	27LS NOT USE	51G NOT USE	51S 51SG NOT USE			
	MUC800-PRI	1	VZ4B CORE X				X											
	MUC805-PRI	1	QZ5A CORE X	X	X			I									X	3
			VZ5A CORE X				X										X	3
	SECONDARY IED			87L E1	21BU	79	25	50BF-80Z	50BF-2 NOT USE	67N NOT USE	67 67N NOT USE	81U NOT USE	27LS NOT USE	51G NOT USE	51S 51SG NOT USE			
	MUC800-SEC	1	VZ4B CORE Y				X											
	MUC805-SEC	1	QZ5A CORE Y	X	X			I										
			VZ5A CORE Y				X											

**THE PROPOSED MAIN EQUIPMENT, [I.E. PROTECTION RELAY, BAY CONTROL UNIT, AND MERGING UNIT], SHALL BE FROM A MAXIMUM OF TWO (2) MANUFACTURERS.

ได้ตรวจสอบแล้ว
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NOTES

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2. FRS IN THIS TABLE SHOW NUMBER OF CHANNEL.
3. TYPE OF MERGING UNIT CUBICLE IS REFERED TO TP-E-20.9

IED FOR PRIMARY AND SECONDARY FOR LINE NO.1 & 2 TO BHUMIBOL SUPPLY BY EGAT (IED : GE MULTILIN L90, E1 CONVERTER : GE P591)

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	BBS1-01-S01	NEW 230 kV AIS SUBSTATION	-	-	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	L.SIRAPAT	RECOMMENDED AND VALIDATED: CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: BHUMIBOL 2 SUBSTATION
DESIGNED	L.SIRAPAT	CONCURRED: ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: LIST OF PROTECTIVE IED AND SIGNAL DIAGRAM
VERIFIED	.....	APPROVED: DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION — DATE	JOB NO. BBS1-01-S01 / REPLACING DWG.NO. / DWG.NO. BB2-E-1 / REV. 3 → 4

DWG.NO.	REV.
BB2-E-1	3 → 4

FEEDER	MU	SV CB.	EQUIPMENT	PROTECTION FUNCTION													BCU	FRS
230/33 kV KG4A	PRIMARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80S	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC806-1-PRI	1	QZ6A CORE X	X	X			I										
			VZ6A CORE X														X	
	MUC806-2-PRI	1	BCT4H CORE X														X	3
		1	BCT4L-1 CORE X			X												3
		1	BCT4L-2 CORE X				X											3
	SECONDARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80S	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC806-1-SEC	1	QZ4A CORE Y	X	X			I										
	MUC806-2-SEC	1	BCT4L-1 CORE X			X												
		1	BCT4L-2 CORE X				X											
230/33 kV KG5A	PRIMARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80S	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC807-1-PRI	1	QZ7A CORE X	X	X			I										
			VZ7A CORE X														X	
	MUC807-2-PRI	1	BCT5H CORE X														X	3
		1	BCT5L-1 CORE X			X												3
		1	BCT5L-2 CORE X				X											3
	SECONDARY IED			87T	51TH 51THG	51TL 51TL-1	51TL 51TL-2	50BF-80S	50BF-2 NOT USE	51GB-1 NOT USE	51GB-2 NOT USE	81U NOT USE	27LS NOT USE	51OL NOT USE	50BF-11 NOT USE	50BF-12 NOT USE		
	MUC807-1-SEC	1	QZ7A CORE Y	X	X			I										
	MUC807-2-SEC	1	BCT5L-1 CORE X			X												
		1	BCT5L-2 CORE X				X											

**THE PROPOSED MAIN EQUIPMENT, [I.E. PROTECTION RELAY, BAY CONTROL UNIT, AND MERGING UNIT], SHALL BE FROM A MAXIMUM OF TWO (2) MANUFACTURERS.

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IED FOR PRIMARY AND SECONDARY FOR LINE NO.1 & 2 TO BHUMIBOL SUPPLY BY EGAT (IED : GE MULTILIN L90, E1 CONVERTER : GE P591)

FOR BIDDING ONLY

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	BBS1-01-S01	NEW 230 kV AIS SUBSTATION	-	-	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	L.SIRAPAT	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: BHUMIBOL 2 SUBSTATION
DESIGNED	L.SIRAPAT	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: LIST OF PROTECTIVE IED AND SIGNAL DIAGRAM
VERIFIED	.....	APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE	JOB NO. BBS1-01-S01 / REPLACING DWG.NO. / DWG.NO. BB2-E-1 / REV. 4 -

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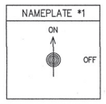
DO NOT AMEND MANUALLY

DWG.NO. BB2-E-1 | REV. 4 -

NAMEPLATE *1



CONTACT	POSITION	
	ON	OFF
1 – 2	X	
3 – 4	X	
5 – 6	X	
7 – 8	X	
9 – 10	X	
11 – 12	X	
13 – 14	X	
15 – 16		X
17 – 18		X
19 – 20		X

FIGURE 1	MAINTAINED CONTACT TYPE
87–CO	DIFFERENTIAL CUT–OFF SWITCH
DTT–CO	DIRECT TRANSFER TRIP CUT–OFF SWITCH
86A–CO	TRANSFORMER LOCKOUT CUT–OFF SWITCH

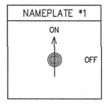
43SP *1

CONTACT	POSITION					
	IND	M1234	M234	M134	M124	M123
1 – 2	X		X			
3 – 4	X		X			
5 – 6	X		X			
7 – 8	X		X			
9 – 10		X		X	X	X
11 – 12		X		X	X	X
13 – 14		X		X	X	X
15 – 16		X		X	X	X
17 – 18		X			X	X
19 – 20		X		X		X
21 – 22		X		X	X	
23 – 24		X		X	X	X
25 – 26	X			X		
27 – 28	X			X		
29 – 30	X			X		
31 – 32	X			X		
33 – 34	X		X	X		
35 – 36		X		X	X	X
37 – 38			X			
39 – 40			X			
41 – 42			X			
43 – 44			X			
45 – 46			X			
47 – 48		X	X		X	X
49 – 50			X			
51 – 52					X	
53 – 54				X		
55 – 56	X					
57 – 58			X			
59 – 60		X				
61 – 62						X
63 – 64					X	
65 – 66	X				X	
67 – 68	X				X	
69 – 70	X				X	
71 – 72	X				X	
73 – 74	X				X	
75 – 76		X			X	X
77 – 78		X	X	X		X
79 – 80		X	X	X		X
81 – 82	X					X
83 – 84	X					X
85 – 86	X					X
87 – 88	X					X
89 – 90	X					X
91 – 92		X	X	X	X	X
93 – 94		X		X	X	X
95 – 96		X	X		X	X
97 – 98		X	X	X		X
99 – 100		X	X	X	X	
101 – 102			X			
103 – 104	X					

FIGURE 2	MAINTAINED CONTACT TYPE
43SP	TRANSFORMER PARALLEL MODE SELECTOR SWITCH

NOTE
1. THE NAMEPLATE SHOULD BE FOLLOWED UP ON TP–E–11

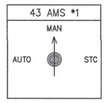
NAMEPLATE *1



CONTACT	POSITION	
	ON	OFF
1 – 2	X	
3 – 4	X	
5 – 6	X	
7 – 8	X	

FIGURE 3	MAINTAINED CONTACT TYPE
SS	SYNCHRONIZING SWITCH
50BF–CO	BREAKER FAILURE CUT–OFF SWITCH
43RCC	SYSTEM REMOTE CONTROL SWITCH
EPS	EMERGENCY PERMISSION SWITCH
50/51S–CO	STUB CUT–OFF SWITCH
86EF–CO	EARTH FAULT LOCKOUT CUT–OFF SWITCH
81–CO	UNDER FREQUENCY CUT–OFF SWITCH
27–CO	UNDER VOLTAGE CUT–OFF SWITCH
50/510L–CO	OVERLOAD SHEDDING CUT–OFF SWITCH

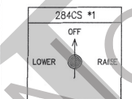
43 AMS *1



CONTACT	POSITION		
	AUTO	MAN	STC
1 – 2			X
3 – 4	X		
5 – 6		X	
7 – 8	X		
9 – 10	X		
11 – 12			X
13 – 14			X
15 – 16	X		
17 – 18		X	
19 – 20			X
21 – 22	X		
23 – 24		X	
25 – 26			X
27 – 28	X		

FIGURE 4	MAINTAINED CONTACT TYPE
43AMS	AUTOMATIC–MANUAL–STATION CONTROL SELECTOR SWITCH

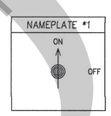
284CS *1



CONTACT	POSITION		
	LOWER	OFF	RAISE
1 – 2	X		
3 – 4			X
5 – 6	X		
7 – 8			X

FIGURE 5	MAINTAINED CONTACT TYPE
284CS	TRANSFORMER ON LOAD TAP CHANGER CONTROL SWITCH

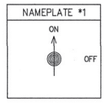
NAMEPLATE *1



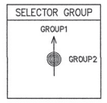
CONTACT	POSITION	
	ON	OFF
1 – 2	X	
3 – 4	X	
5 – 6	X	
7 – 8	X	
9 – 10	X	
11 – 12	X	
13 – 14	X	
15 – 16	X	
17 – 18	X	
19 – 20	X	
21 – 22	X	
23 – 24	X	

FIGURE 6	MAINTAINED CONTACT TYPE
RSS	RESTORATION SYNCHRONIZING SWITCH

NAMEPLATE *1



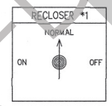
SELECTOR GROUP



CONTACT	POSITION	
	ON	OFF
1 – 2	X	
3 – 4	X	
5 – 6	X	
7 – 8	X	
9 – 10	X	
11 – 12	X	
13 – 14	X	
15 – 16	X	
17 – 18	X	
19 – 20	X	
21 – 22	X	
23 – 24	X	
25 – 26	X	
27 – 28		X
29 – 30		X
31 – 32		X
33 – 34		X
35 – 36		X
37 – 38		X
39 – 40		X

FIGURE 7	MAINTAINED CONTACT TYPE
PTT–CO	PERMISSIVE TRANSFER TRIP CUT–OFF SWITCH
43COS	LOCAL/RTU CONTROL MODE SELECTOR SWITCH
85–CO	CARRIER CUT–OFF SWITCH
21–SG	GROUP SETTING SELECTOR GROUP SWITCH

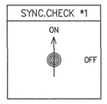
RECLOSER *1



CONTACT	POSITION		
	ON	NORMAL	OFF
1 – 2	X	→	
3 – 4	X	→	
5 – 6	X	→	
7 – 8	X	→	
9 – 10		←	X
11 – 12		←	X
13 – 14		←	X
15 – 16		←	X

FIGURE 8	MOMENTARY CONTACT TYPE
79CO	RECLOSER CUT–OFF SWITCH

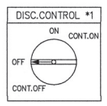
SYNC.CHECK *1



CONTACT	POSITION	
	ON	OFF
1 – 2	X	
3 – 4	X	
5 – 6	X	
7 – 8	X	
9 – 10		X
11 – 12		X
13 – 14		X
15 – 16		X

FIGURE 9	MAINTAINED CONTACT TYPE
25CO	SYNCHRO CHECK CUT–OFF SWITCH

DISC.CONTROL *1



PUSH TURN 45°

CONTACT	POSITION			
	CONTROL "ON"	ON	OFF	CONTROL "OFF"
1 – 2			X	X
3 – 4	X	X		
5 – 6	X			
7 – 8	X			
9 – 10	X			
11 – 12				X
13 – 14				X
15 – 16				X

FIGURE 10	MAINTAINED CONTACT TYPE
DCS	DISCREPANCY CONTROL SWITCH

BKR. CONTROL *1

CONTACT	POSITION				
	PULL TO LOCKOUT	TRIP	RETURN AFTER TRIP	CLOSE	CLOSE
1 – 2				←	X
3 – 4	X	X →			
5 – 6		→	X	X	←
7 – 8		→	X	X	←
9 – 10				X	← X
11 – 12				X	← X
13 – 14		X →			
15 – 16				←	X
17 – 18		X →			
19 – 20				←	X

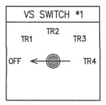
FIGURE 11	MOMENTARY CONTACT TYPE
CS	BREAKER CONTROL SWITCH

TRIP TRANSFER *1

CONTACT	POSITION	
	NORMAL	TIE
1 – 2		X
3 – 4	X	
5 – 6		X
7 – 8	X	
9 – 10		X
11 – 12	X	
13 – 14		X
15 – 16	X	
17 – 18		X
19 – 20	X	
21 – 22		X
23 – 24	X	
25 – 26		X
27 – 28	X	
29 – 30		X
31 – 32	X	
33 – 34		X
35 – 36	X	
37 – 38		X
39 – 40	X	
41 – 42		X
43 – 44	X	
45 – 46		X
47 – 48	X	
49 – 50		X
51 – 52	X	
53 – 54		X
55 – 56	X	
57 – 58		X
59 – 60	X	
61 – 62		X
63 – 64	X	
65 – 66		X
67 – 68	X	
69 – 70		X
71 – 72	X	

FIGURE 12	MAINTAINED CONTACT TYPE
43	TRIP TRANSFER SWITCH

VS SWITCH *1



CONTACT	POSITION				
	OFF	TR1	TR2	TR3	TR4
1 – 2		X			
3 – 4		X			
5 – 6			X		
7 – 8			X		
9 – 10				X	
11 – 12				X	
13 – 14					X
15 – 16					X

FIGURE 13	MAINTAINED CONTACT TYPE
VS	VOLTMETER SELECTOR SWITCH

BIG NO DRAFT

เอกสารไม่ควบคุม
รับรองสำเนาโดย หหอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

CABINET NO W1
RUN NO. A013

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
10	–	ADD 81–CO, 27–CO AND 50/510L–CO. REVISE CONTACTS OF 21–SG, PTT–CO, 43CCS AND 85–CO.	P.SIRAWICH	P.SIRAWICH						
9	–	ADD 21–SG, 86EF–CO, RSS CHANGE CONTACTS OF 87–CO, DTT–CO, 86A–CO, 43RCC, EPS, 50/51S–CO, PTT–CO, 43CCS, 85–CO,43, VS AND DELETE VTS, AS	J.WEERAYUT	J.WEERAYUT						
8	–	ADD STUB CUT–OFF SWITCH	S.Jirapa	–						
7	–	ADD PTTCO, EPS, CHANGE CONTACTS OF 43RCC,43CCS,85CO AND DELETE LOCKOUT RELAY	J.Surapong	–						
6	–	REPLACE MO BY DCS, CHANGE CONTATS OF 79CO,85CO AND LOCKOUT RELAY	–	–						

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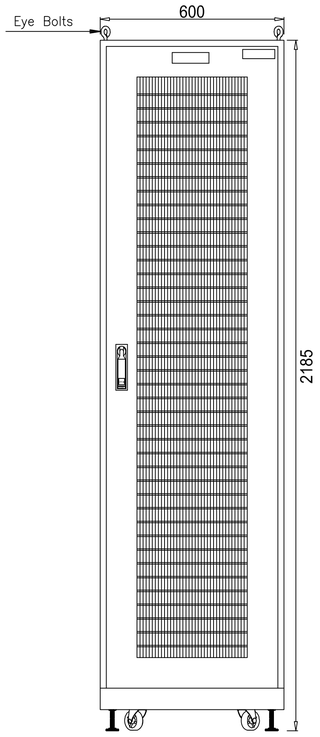
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$$Name

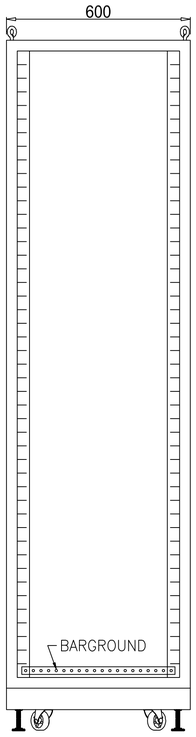
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	P.SIRAWICH	VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	P.SIRAWICH	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION–1	DESCRIPTION OF DETAIL DRAWING: CONTROL SWITCH AND SELECTOR SWITCH CONTACT TABULATION
VERIFIED	H. KANAPOT	CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED	ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT	DATE 1 MAR 2024	JOB NO. – / REPLACING DWG.NO. – / DWG.NO. TP – E – 9.1 / REV. – 10

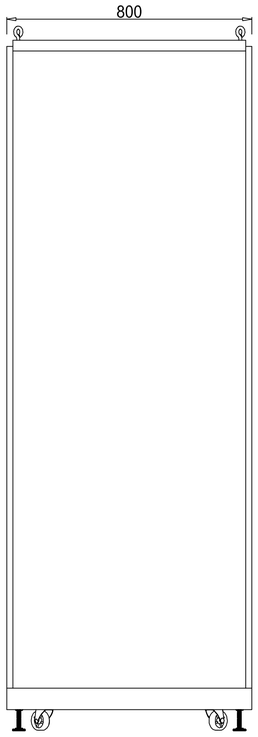
DWG.NO.	TP-E-10.19	–
REV.	–	2



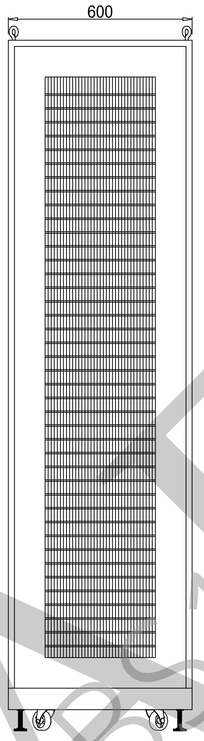
FRONT VIEW



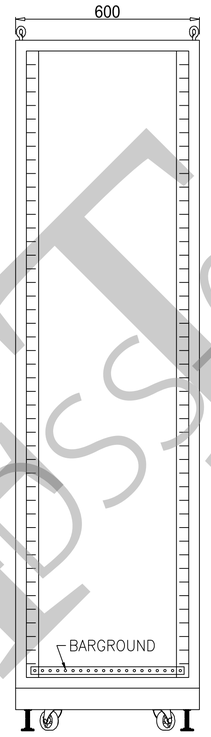
FRONT VIEW WITH OUT DOOR



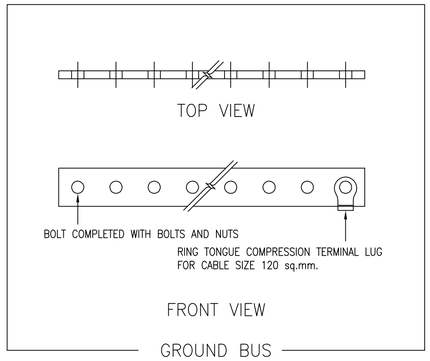
SIDE VIEW

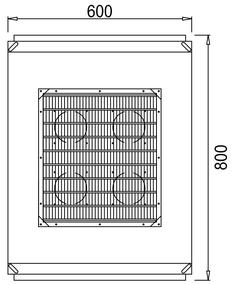


REAR VIEW

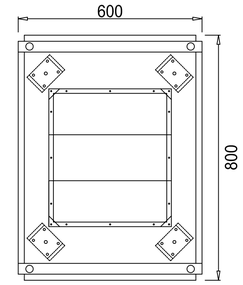


REAR VIEW WITHOUT DOOR

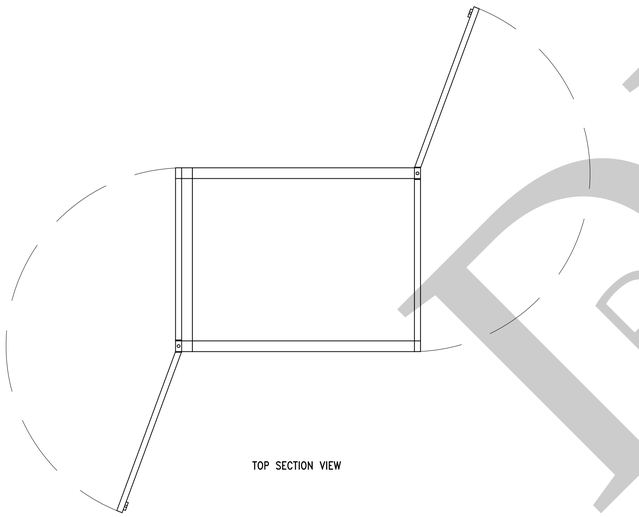




TOP VIEW



BOTTOM VIEW



TOP SECTION VIEW

ENLARGED VIEW OF EQUIPMENT LAY-OUT

FOUNDATION PLATE

เอกสารไม่ควบคุม
รับรองสำเนาโดย หพอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

NOTES

1. PANEL SHALL BE DESIGNED AND MANUFACTURED ACCORDING TO THE STANDARD OF ANSI/EIA-310D-1992 [Rev.EIA-310C] IEC 60297-1, IEC 60297-2, BS 5954 PART 2, DIN 41494.
2. THE SUITABLE VENTILATION FANS SHALL BE MOUNTED INSIDE PANEL AT THE TOP. THE AC SOCKET STRIPS SHALL ALSO BE SUFFICIENTLY PROVIDED FOR USE.
3. CABLE ENTRY MANAGEMENT SHALL BE HAD FUNCTIONS AS FOLLOWS:
   - MARSHALLING FOR ALL OF CABLE ENTRY
   - FIRE SPREADING STOPPER
   - MOISTURE PREVENTION
4. SPARES OF CABLE ENTRY WHICH ARE POWER CABLE AND FIBER OPTIC SHALL BE PROVIDED AT LEAST 50% OF THE ACTUAL USING.

REFERENCES

1. SPECIFICATION NO.1008/SPECIFICATION NO.1002/SPECIFICATION NO.1005

DRAFT
BidNo.PBS101

ISO 9001 TSE : 2015
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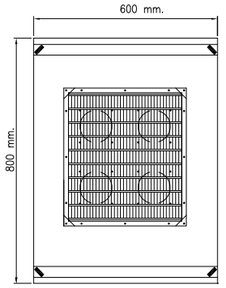
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
2	–	ADD DETAILS OF CABLE ENTRY MANAGEMENT AND REVISE SIZE OF CABINET	C.KANITHA	C.KANITHA	–	–	–	–	–	–
1	–	REVISE PANEL CONSTRUCTION OF BLANK 19" RACK	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–
–	–	PANEL CONSTRUCTION OF BLANK 19" RACK	P.PIYAWAT	P.PIYAWAT	–	–	–	–	–	–

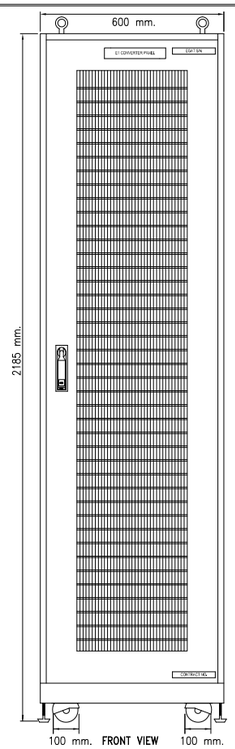
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING PANEL CONSTRUCTION OF BLANK 19" RACK
VERIFIED	SIRAPAT		
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-10.19 / REV. – 2

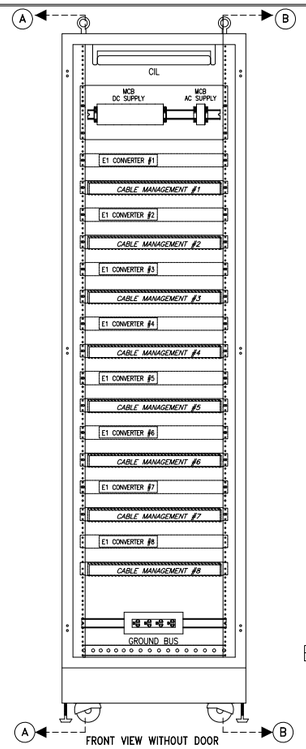
DWG.NO.	REV.
TP-E-10.20	-
	1



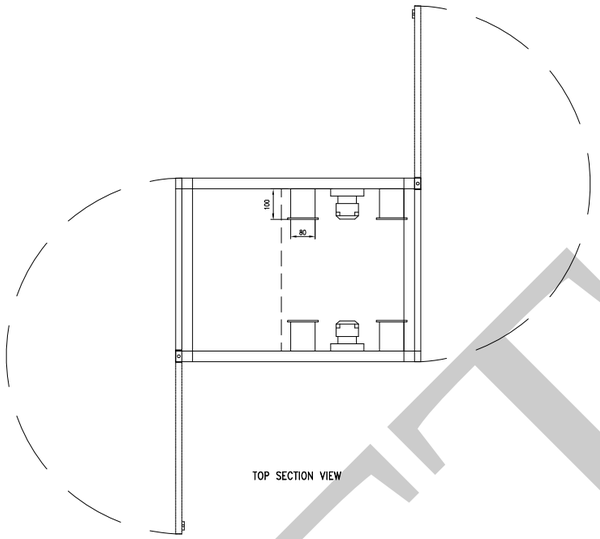
TOP VIEW



FRONT VIEW

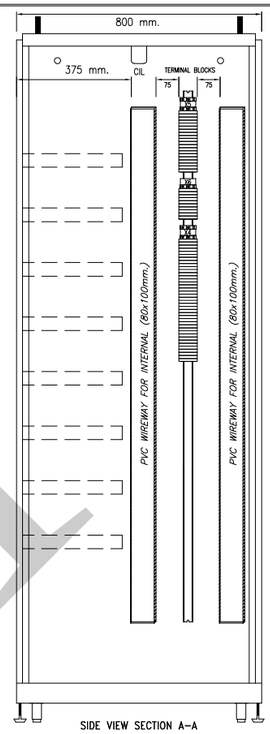


FRONT VIEW WITHOUT DOOR

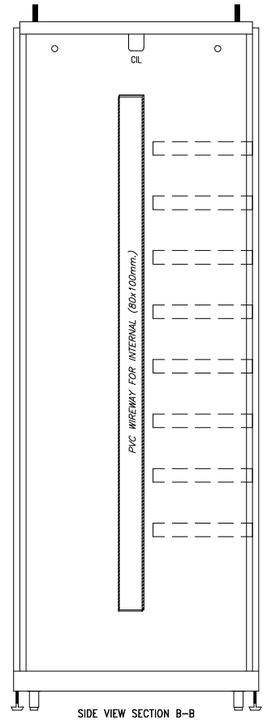


TOP SECTION VIEW

ENLARGED VIEW OF EQUIPMENT LAY-OUT E1 CONVERTER PANEL



SIDE VIEW SECTION A-A

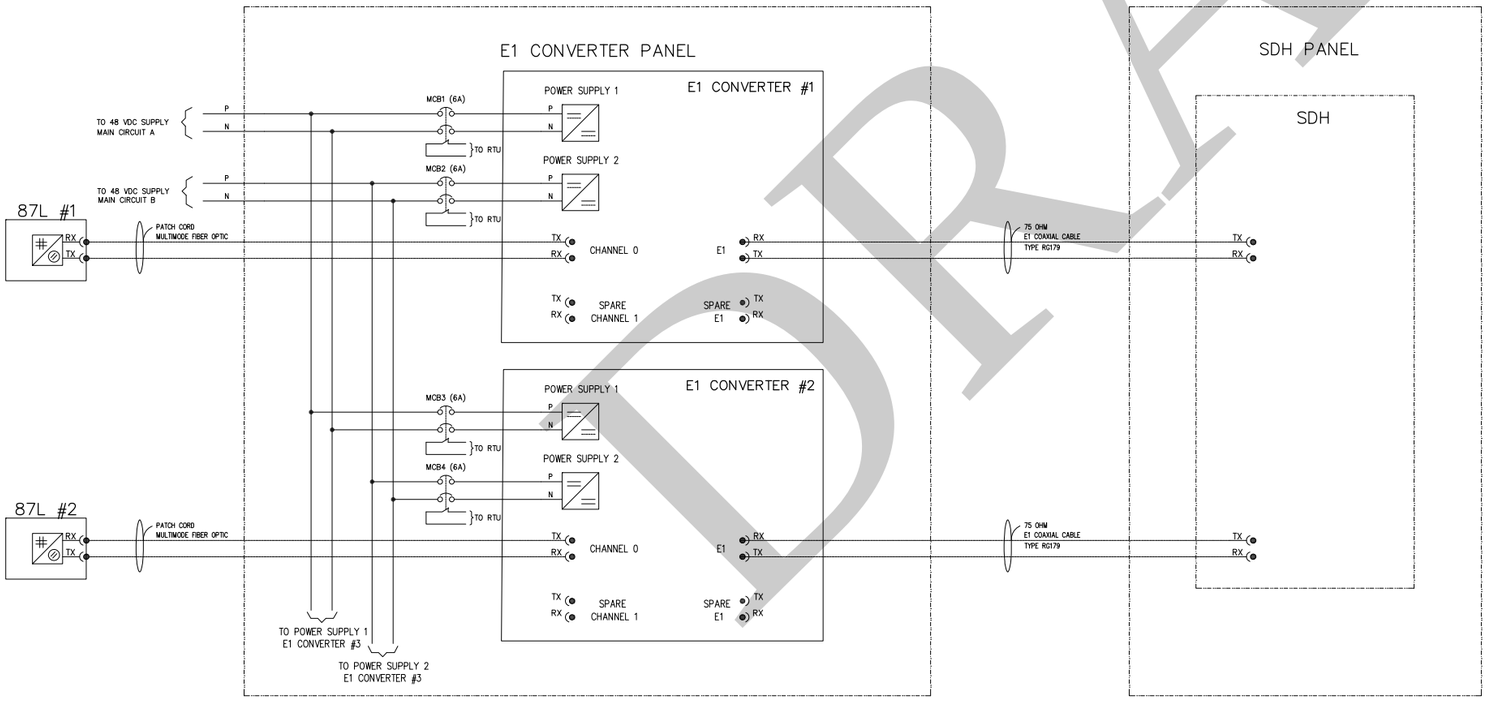


SIDE VIEW SECTION B-B

THE CONNECTION AMONG RELAY PANEL, E1 CONVERTER PANEL AND SDH PANEL

CONTROL AND PROTECTION SYSTEM

TELECOMMUNICATION SYSTEM



TERMINAL	AMOUNT AT LEAST	FUNCTION
X4	40 PCS.	RTU
X5	20 PCS.	DC SUPPLY
X6	10 PCS.	AC SUPPLY

E1 CONVERTER PANEL (1 EACH)

1. E1 CONVERTER (C37.94) SHALL BE MULTIMODE TYPE. EACH E1 CONVERTER SHALL BE MASTER CLOCK AND SHALL HAS CLOCK SYNCHRONIZING FUNCTION. THE POWER SUPPLY SHALL BE 48 VDC ± 20%.
2. ONE (1) SET OF MULTIMODE OPTICAL FIBER PATCH CORD CABLE FOR CONNECTING BETWEEN LINE CURRENT DIFFERENTIAL RELAY (87L) AND E1 CONVERTER SHALL BE SUPPLIED AND INSTALLED FOR EACH E1 CONVERTER. SEE S6 DRAWINGS FOR THE LENGTH OF PATCH CORD CABLES.
3. ONE (1) SET OF E1 COAXIAL CABLE FOR CONNECTING BETWEEN E1 CONVERTER AND SDH SHALL BE SUPPLIED AND INSTALLED FOR EACH E1 CONVERTER. SEE S6 DRAWINGS FOR THE LENGTH OF COAXIAL CABLES AND THE LENGTH SHOULD NOT EXCEED 30 METERS. THE CONNECTOR TYPE OF THE COAXIAL CABLE AT ONE SIDE SHALL BE "BNC 75 OHM PLUGS CONNECTOR" AND THE ONE AT THE OTHER SIDE DEPENDS ON THE RELAY SUPPLIED BY THE CONTRACTOR.
4. THE SIZING OF EACH E1 CONVERTER SHALL BE 1U HIGH COMPACT SIZE AND SHALL BE SUITABLE FOR INSTALLATION IN 19" RACK CARBINET. THE MAXIMUM NUMBER OF E1 CONVERTERS AND ACCESSORIES ARE EIGHT (8) SETS PER PANEL, SEE E2 DRAWINGS FOR THE DETAIL.
5. IN CASE THE E1 CONVERTER HAS ONLY 1 PORT OF POWER SUPPLY, TWO (2) SETS OF MCBS FOR EACH E1 CONVERTER SHALL BE SUPPLIED. ONE (1) SET FOR 48 VDC SUPPLY MAIN CIRCUIT A, THE OTHER FOR SPARE.
6. THE COLOR OF CABINET SHALL BE DARK GREY (COLOR CODE # RAL7036)

REFERENCE : TP-E-10.19
SPECIFICATION NO.1002
SPECIFICATION NO.1005
SPECIFICATION NO.1008
DWG.NO. XXX-E2
DWG.NO. XXX-E6
DWG.NO. XXX-S6

ได้ตรวจสอบแล้ว
ลงชื่อ.....
(นายรุหาญ รุจิธัญธารา)
วันที่..... 29 Jul 2025
กองวิศวกรรมระบบควบคุมและป้องกัน

DRAFT

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	-	REVISE SIZE AND DETAIL OF E1 CONVERTER FRONT PANEL	S.PHATHARAPON	S.PHATHARAPON	-	-	-	-	-	-
-	-	TYPICAL DRAWING FOR EQUIPMENT LAY-OUT & THE CONNECTION AMONG E1 CONVERTER PANEL, RELAY PANEL AND SDH PANEL	-	-	-	-	-	-	-	-

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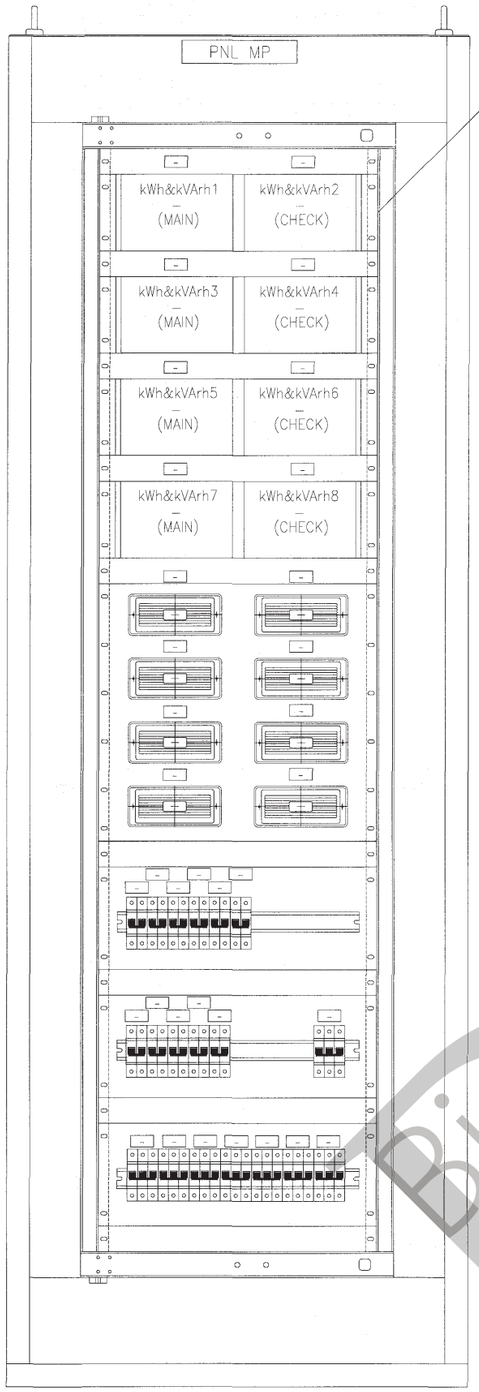
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$$$Name

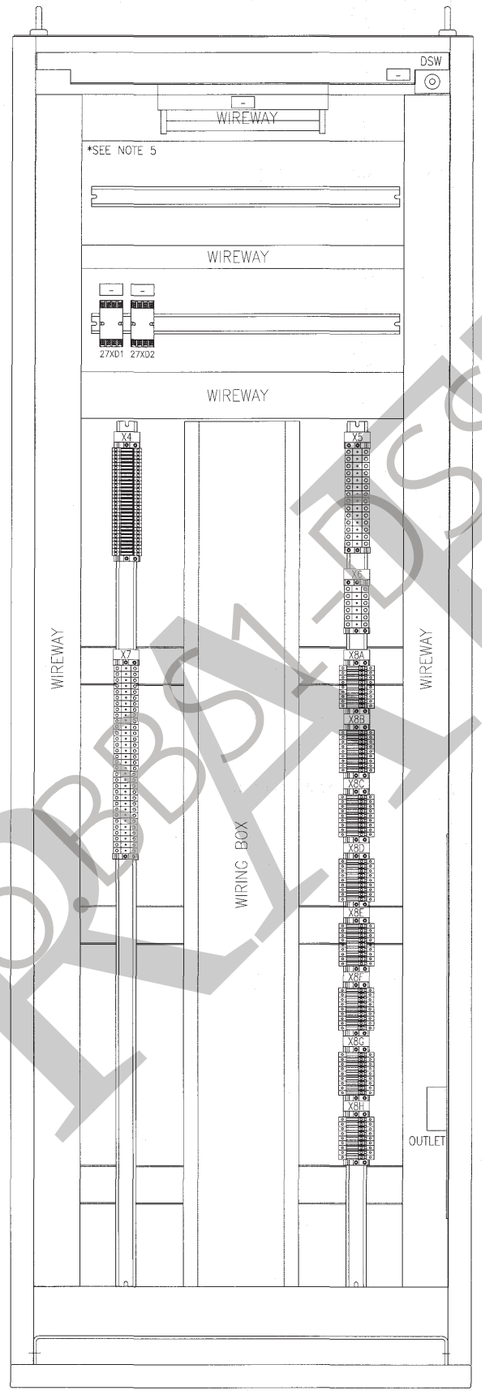
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN H. CHINDARHA	VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED H. CHINDARHA	RECOMMENDED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	DETAILS OF E1 CONVERTER PANEL
VERIFIED	CONCURRED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		
APPROVED ..... ASSISTANT GOVERNOR - TRANSMISSION SYSTEM DEVELOPMENT	DATE	JOB NO.	REPLACING DWG.NO. / DWG.NO. TP-E-10.20 / REV. - 1

REV.	DWG.NO.
-	TP-E-10.21
1	

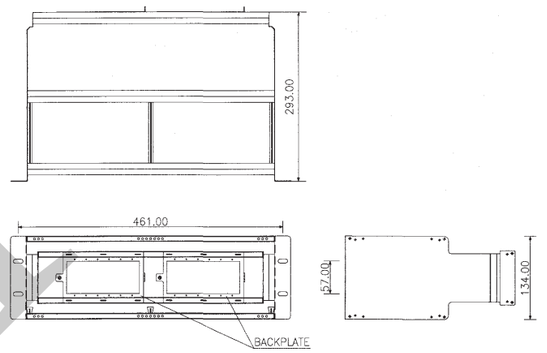


FRONT VIEW (WITHOUT DOOR)



FRONT VIEW (WITHOUT SWING RACK)

DETAIL A
INSTALLATION RACK



1. THE METERING PANEL SHALL BE DELIVERED WITH FOUR (4) INSTALLATION RACKS.
2. THE INSTALLATION RACK SHALL BE CAPABLE OF INSTALLATION UP TO TWO (2) UNITS OF PROPOSED ENERGY METER.
3. THE INSTALLATION RACK SHALL BE MADE OF GALVANIZED STEEL MATERIAL.

NOTES
1. PANEL SHOWN IN THIS DRAWING IS SWING RACK TYPE PANEL AS DESCRIBED IN DWG.NO. TP-E-10.1.
2. NAMEPLATE IN THIS PANEL SHALL BE REFERRED TO DWG.NO. TP-E-11.
3. TYPE AND QUANTITY OF ACCESSORIES SHALL BE REFERRED TO THE DESIGN SPECIFIED IN DWG.NO. TP-E-5.1.
4. ALL ACCESSORIES, EXCEPT FOR TEST BLOCK, SHALL BE PROVIDED ADEQUATELY FOR EIGHT (8) ENERGY METERS.
5. ADDITIONAL ACCESSORIES REQUIRED TO FULFILL DESIGNED COMMUNICATION (e.g., REDBOX, CONVERTER, AND MODEM), SHALL BE INSTALLED, PREFERABLY IN THIS AREA.

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ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
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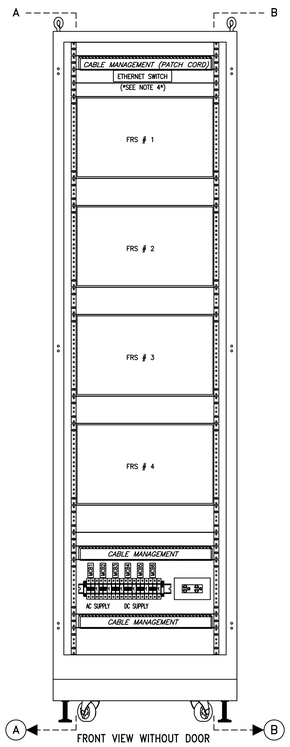
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	DETAIL OF PANEL CONSTRUCTION METERING PANEL	P.PIYAWAT	K.NAPAT	-	-	-	-	-	-

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$Name

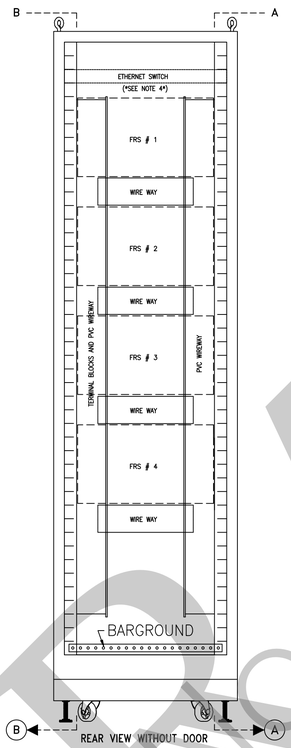
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	S.KANATHIP	VALIDATED (CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT)	DRAWING NAME: TYPICAL DRAWING
DESIGNED	S.KANATHIP	RECOMMENDED (ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1)	DESCRIPTION OF DETAIL DRAWING: DETAIL OF PANEL LAYOUT & ACCESSORIES FOR METERING PANEL
VERIFIED		CONCURRED (DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION)	
APPROVED	(ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT)	DATE 30 ส.ค. 2565	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-10.21 / REV. 1 -

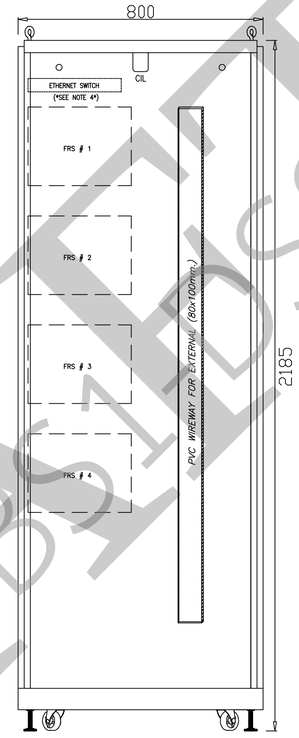
DWG.NO.	REV.
TP-E-10.22	-



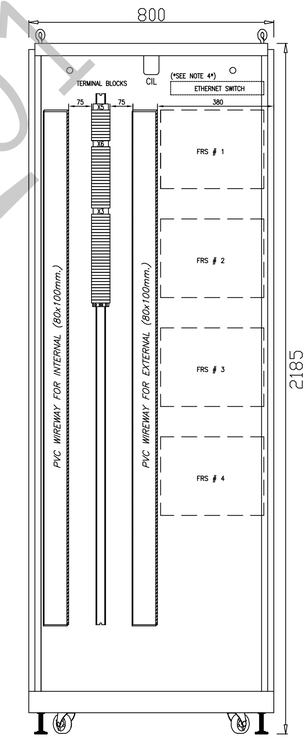
FRONT VIEW WITHOUT DOOR



REAR VIEW WITHOUT DOOR



SIDE VIEW SECTION A-A



SIDE VIEW SECTION B-B

NOTES

1. PANEL SHOWN IN THIS DRAWING 19" RACK PANEL AS SHOWN IN DWG. TP-E-10.19
2. FAULT RECORDING SYSTEM SHALL MEET SPECIFICATION REF.1008.
3. FAULT RECORDING SYSTEM PANEL NO NEED FAN AND VENTILATION FOR COOLING SYSTEM.
4. MANAGED ETHERNET SWITCH IS REQUIRED WITH SUFFICIENT PORTS FOR REMOTE CONFIGURATION AND PMU FUNCTION.

REFERENCES

1. SPECIFICATION NO.1008

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ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
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Bid No.BBS01

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	FAULT RECORDING SYSTEM SWITCHBOARD PANEL	S.PHATHARAPON	S.PHATHARAPON	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	S.PHATHARAPON	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	S.PHATHARAPON	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING FAULT RECORDING SYSTEM SWITCHBOARD PANEL
VERIFIED	S.T.RAPAT		
APPROVED	DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-10.22 / REV. - -

DWG.NO.	REV.
TP – E – 11	1
	6
	4

TYPICAL NAMEPLATE FOR BUS PROTECTION (LOW IMPEDANCE)

NAMEPLATE SCHEDULE PANEL 801R

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	801R	PANEL 801R	230kV BUS NO.1	PRIMARY PROTECTION
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	87B1P-A	BUS DIFF. NO.1 PRI	& CT SUPERVISION	RELAY PH.A
20x50	87B1P-B	BUS DIFF. NO.1 PRI	& CT SUPERVISION	RELAY PH.B
20x50	87B1P-C	BUS DIFF. NO.1 PRI	& CT SUPERVISION	RELAY PH.C
20x50	87B1P-CO	BUS DIFF. NO.1 PRI	CUT-OFF SWITCH	
20x50	86B1P-PB	BUS DIFF. LOCKOUT RELAY	RESET PUSH BUTTON	
20x50	87B1P-TB1	BUS DIFF. NO.1 PRI	& CT SUPERVISION	TEST BLOCK 1
20x50	87B1P-TB2	BUS DIFF. NO.1 PRI	& CT SUPERVISION	TEST BLOCK 2
20x50	87B1P-TB3	BUS DIFF. NO.1 PRI	& CT SUPERVISION	TEST BLOCK 3
20x50	86B1P-1	BUS DIFF. NO.1 PRI	LOCKOUT RELAY 1	
20x50	86B1P-2	BUS DIFF. NO.1 PRI	LOCKOUT RELAY 2	
20x50	27XR1	27XR1	DC UNDERVOLTAGE FOR	BUS DIFF. RELAY
20x50	27XR2	27XR2	DC UNDERVOLTAGE FOR	LOCKOUT BUS DIFF.
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 125VDC FOR	BUS DIFF. NO.1 PRI	& CT SUPERVISION

TYPICAL NAMEPLATE FOR BUS PROTECTION (HIGH IMPEDANCE)

NAMEPLATE SCHEDULE PANEL 802R

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	802R	PANEL 802R	230kV BUS NO.1	SECONDARY PROTECTION
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	87B1S	BUS DIFF. NO.1 SEC	RELAY	
20x50	87B1S-TB	BUS DIFF. NO.1 SEC	TEST BLOCK	
20x50	86B1S-1	BUS DIFF. NO.1 SEC	LOCKOUT RELAY 1	
20x50	86B1S-2	BUS DIFF. NO.1 SEC	LOCKOUT RELAY 2	
20x50	95B1SX	CT SUPERVISION	LOCKOUT RELAY	
20x50	87B1S-CO	BUS DIFF. NO.1 SEC	CUT-OFF SWITCH	
20x50	86B1S-PB	BUS DIFF. LOCKOUT	RESET PUSH BUTTON	
20x50	95B1SX-PB	CT SUPERVISION LOCKOUT	RESET PUSH BUTTON	
20x50	27XR1	27XR1	DC UNDERVOLTAGE FOR	BUS DIFF. RELAY
20x50	27XR2	27XR2	DC UNDERVOLTAGE FOR	LOCKOUT BUS DIFF.
20x50	R1A	R1A	RESISTOR WITH METROSIL	FOR PH.A
20x50	R1B	R1B	RESISTOR WITH METROSIL	FOR PH.B
20x50	R1C	R1C	RESISTOR WITH METROSIL	FOR PH.C
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE

SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	BUS DIFF. NO.1 SEC

TYPICAL NAMEPLATE FOR REMOTE I/O

NAMEPLATE SCHEDULE EGAT-PEA INTERFACING PANEL

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	RIO	EGAT-PEA INTERFACING	115kV LINE TO PEA	
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	RIO-1	REMOTE I/O NO.1	115kV PEA NO.1	
20x50	RIO-2	REMOTE I/O NO.2	115kV PEA NO.2	
20x50	RIO-3	REMOTE I/O NO.3	115kV PEA NO.3	
20x50	FTC	FIBER OPTIC BOX	(EGAT'S FTC)	
20x50	K11	PEA NO.1 BKR.1A	AUX. RELAY	
20x50	K12	PEA NO.1 BKR.2A	AUX. RELAY	
20x50	K13	PEA NO.1 DS	AUX. RELAY	
20x50	K14	PEA NO.1 DTT RECEIVE	AUX. RELAY	
20x50	K15	SPARE	AUX. RELAY	
20x50	K16	SPARE	AUX. RELAY	
20x50	K17	SPARE	AUX. RELAY	
20x50	K18	SPARE	AUX. RELAY	
20x50	27XR1	27XR1	DC UNDERVOLTAGE FOR	REMOTE I/O NO.1
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE

SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	REMOTE I/O NO.1

TYPICAL NAMEPLATE FOR TRANSDUCER

NAMEPLATE SCHEDULE PANEL TDR11(FRONT)

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	TDR1	230kV TRANSDUCER PANEL	TDR1 (FRONT)	
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	DC-TDR1	DC-TDR1	125VDC DISTRI. BOARD	
20x50	DC-TDR2	DC-TDR2	48VDC DISTRI. BOARD	
20x50	AC-TDR1	AC-TDR1	230VAC DISTRI. BOARD	
20x50	V-TDR1	V-TDR1	BUS NO.1	
20x50	V-TDR2	V-TDR2	BUS NO.2	
20x50	T-TDR3	T-TDR3	CONTROL ROOM	
20x50	W&Var-TDR1	W&Var-TDR1	LINE NO.1 TO WN	
20x50	V-TDR3	V-TDR3	LINE NO.1 TO WN	
20x50	W&Var-TDR2	W&Var-TDR2	KT1A	
20x50	V-TDR6	V-TDR6	KT1A	
20x50	A-TDR1	A-TDR1	KT1A	
20x50	R-TDR1	R-TDR1	KT1A	
20x50	T-TDR1	T-TDR1	KT1A	
20x50	W&Var-TDR3	W&Var-TDR3	LINE NO.1 TO PEA	
20x50	V-TDR7	V-TDR7	LINE NO.1 TO PEA	PHASE A-B
20x50	V-TDR8	V-TDR8	LINE NO.1 TO PEA	PHASE B-C
20x50	V-TDR9	V-TDR9	LINE NO.1 TO PEA	PHASE C-A
20x50	A-TDR2	A-TDR2	LINE NO.1 TO PEA	
20x50	TS1	W&Var-TDR1	CURR.&POT.TEST SW.	
20x50	27VTR	VOLTAGE TRANSFER	RELAY	
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE PANEL TDR11(FRONT)

SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	SUPPLY TDR (LINE)
20x50	MCB3	MCB3 125VDC FOR	SUPPLY TDR (TR.)
20x50	MCB4	MCB4 125VDC FOR	SUPPLY TDR (PEA)
20x50	MCB5	MCB5 125VDC FOR	SUPPLY TDR (COMMON)
20x50	MCB6	MCB6 230VAC FOR	V-TDR1 AC DIST. BOARD
20x50	MCB7	MCB7 125VDC FOR	V-TDR1 DC DIST. BOARD
20x50	MCB8	MCB8 48VDC FOR	V-TDR2 DC DIST. BOARD
20x50	MCB9	MCB9 115VAC FOR	PT BUS NO.1 (27VTR)
20x50	MCB10	MCB10 115VAC FOR	PT BUS NO.2 (27VTR)
20x50	MCB11	MCB11 115VAC FOR	PT BUS NO.1 (V-TDR1)
20x50	MCB12	MCB12 115VAC FOR	PT BUS NO.2 (V-TDR2)
20x50	MCB13	MCB13 115VAC FOR	W&Var-TDR1
20x50	MCB14	MCB14 115VAC FOR	W&Var-TDR2
20x50	MCB15	MCB15 115VAC FOR	W&Var-TDR3
20x50	MCB16	MCB16 115VAC FOR	V-TDR6

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ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

TYPICAL NAMEPLATE FOR INTERPOSING

NAMEPLATE SCHEDULE PANEL IP11(FRONT)

SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	IP11 (F)	PANEL IP11 (FRONT)	230kV INTERPOSING RELAY
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	CTX-851	CTX-851	BKR.80512
20x50	CCX-851	CCX-851	BKR.80512
20x50	CCDC-851	CCDC-851	BKR.80512
20x50	CCAC-851	CCAC-851	BKR.80512
20x50	CTX-852	CTX-852	BKR.80522
20x50	CCX-852	CCX-852	BKR.80522
20x50	CCDC-852	CCDC-852	BKR.80522
20x50	CCAC-852	CCAC-852	BKR.80522
20x50	CTX-853	CTX-853	BKR.80532
20x50	CCX-853	CCX-853	BKR.80532
20x50	CCDC-853	CCDC-853	BKR.80532
20x50	CCAC-853	CCAC-853	BKR.80532
20x50	RX1	RX1	RAISE KT1A
20x50	LX1	LX1	LOWER KT1A
20x50	79COCX-851	79COCX-851	LATCHING RELAY
20x50	27XB1-851	27XB1-851	DC SUPPLY ALARM
20x50	27XB2-851	27XB2-851	DC SUPPLY ALARM
20x50	27XB1-852	27XB1-852	DC SUPPLY ALARM
20x50	27XB2-852	27XB2-852	DC SUPPLY ALARM
20x50	27XB1-853	27XB1-853	DC SUPPLY ALARM
20x50	27XB2-853	27XB2-853	DC SUPPLY ALARM
20x50	27R	DC UNDERVOLTAGE	RELAY
20x50	27RX	DC UNDERVOLTAGE	AUX. RELAY
20x50	27R-TB	DC UNDERVOLTAGE	TEST BLOCK
20x50	PBC-851	PBC-851	CLOSE BKR.80512
20x50	PBT-851	PBT-851	OPEN BKR.80512
20x50	PBC-852	PBC-852	CLOSE BKR.80522
20x50	PBT-852	PBT-852	OPEN BKR.80522
20x50	PBC-853	PBC-853	CLOSE BKR.30532
20x50	PBT-853	PBT-853	OPEN BKR.80532
20x50	PB-SYNC	PB MANUAL	SYNC. BYPASS
20x50	KS-851	KS-851	CONTROL BKR.80512
20x50	KS-852	KS-852	CONTROL BKR.80522
20x50	KS-853	KS-853	CONTROL BKR.80532
20x50	PB-R1	PB-R1	RAISE KT1A
20x50	PB-L1	PB-L1	LOWER KT1A
20x50	V	VOLTMETER	
20x50	VS	VOLTMETER	SELECTOR SW.
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE

SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 115VAC VZ5A FOR	SYNC CHECK RELAY
20x50	MCB3	MCB3 115VAC VZ5B FOR	SYNC CHECK RELAY
20x50	MCB4	MCB4 115VAC FOR	LOW SIDE VOLTAGE KT1A
20x50	MCB5	MCB5 125VDC FOR	REACTOR UNDERVOLTAGE RELAY
20x50	MCB-851	MCB 125VDC FOR	CONTROL BKR.80512
20x50	MCB-852	MCB 125VDC FOR	CONTROL BKR.80522
20x50	MCB-853	MCB 125VDC FOR	CONTROL BKR.80532

TYPICAL NAMEPLATE FOR METERING

NAMEPLATE SCHEDULE PANEL

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	MP1	PANEL MP1	115kV METERING PANEL	
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	kW&kVarH1	kWH1 (MAIN)	115kV LINE NO.1 TO PEA	
20x50	kW&kVarH2	kWH2 (CHECK)	115kV LINE NO.1 TO PEA	
20x50	TS1	kWH1 (MAIN)	CURR.&POT.TEST SW.	
20x50	TS2	kWH2 (CHECK)	CURR.&POT.TEST SW.	
20x50	27XD1	27XD1	DC UNDERVOLTAGE FOR	kWH (MAIN)
20x50	27XD2	27XD2	DC UNDERVOLTAGE FOR	kWH (CHECK)
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE PANEL

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 125VDC FOR	kWH1 (MAIN) SUPPLY	
20x50	MCB3	MCB3 125VDC FOR	kWH2 (CHECK) SUPPLY	
20x50	MCB4	MCB4 PT FOR	kWH1 (MAIN)	115kV LINE NO.1 TO PEA
20x50	MCB5	MCB5 PT FOR	kWH2 (CHECK)	115kV LINE NO.1 TO PEA
20x50	MCB6	MCB6 220VAC FOR	MODEM METERING	

CABINET NO. W1
RUN NO. 1603

NOTES

1. THE DRAWING SHOWS NAMEPLATE SCHEDULE FOR SUBSTATION IN ORDER TO BE GUIDELINE FOR THE CONTRACTOR'S DESIGN IN GENERAL. THE CONTRACTOR SHALL DESIGN SPECIFIC OR ACTUAL SCHEDULE AND THEN SUBMIT TO EGAT FOR APPROVAL.
2. NAMEPLATES ARE ALSO REQUIRED FOR ALL EQUIPMENT ON THE MOUNTING BRACKETS OR HINGED PANEL INSIDE THE BOARD.
3. Contract No. AND EGAT Serial No. SHALL BE INFORMED LATER BY EGAT.

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
4	–	REVISE TYPICAL NAMEPLATE DESCRIPTION	P.Sirawich	–	–	–	–	–	–	–
3	–	REVISE AND ADD TYPICAL NAMEPLATE DESCRIPTION	K.Napat	–	–	–	–	–	–	–
2	–	ADD NAMEPLATE OF EGAT SERIAL NO.	W.Natthapong	–	–	–	–	–	–	–
1	–	REVISE NAMEPLATE DESCRIPTION	W.Natthapong	–	–	–	–	–	–	–

$$$

DWG.NO. TP – E – 11 | REV. 2 | 6 | 1

TYPICAL NAMEPLATE FOR 22 kV C–BANK

NAMEPLATE SCHEDULE PANEL C22–1			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	C–BANK NO.1	PANEL C22–1	22 kV CAPACITOR BANK NO.1
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	27XB1	DC SUPPLY ALARM	FOR BKR.
20x50	27XB2	DC SUPPLY ALARM	FOR BKR.
20x50	27XR1	DC SUPPLY ALARM	FOR 59,60CH,60CL
20x50	27XR2	DC SUPPLY ALARM	FOR 52bx
20x50	52bX	CB STATUS	AUX.TRIP
20x50	59C	OVERVOLTAGE RELAY	RELAY
20x50	59C–TB	OVERVOLTAGE RELAY	TEST BLOCK
20x50	60CH	VOLTAGE UNBALANCE	SENSING RELAY
20x50	60CH–TB	VOLTAGE UNBALANCE	SENSING TEST BLOCK
20x50	60CL	VOLTAGE UNBALANCE	SENSING RELAY
20x50	60CL–TB	VOLTAGE UNBALANCE	SENSING TEST BLOCK
20x50	62bX	BREAKER TIME DELAY	
20x50	AUX–PT–A	AUX. PT	PHASE A
20x50	AUX–PT–B	AUX. PT	PHASE B
20x50	AUX–PT–C	AUX. PT	PHASE C
20x50	CS	BREAKER CONTROL	SWITCH
20x50	KS	CONTROL BREAKER	
20x50	SMP	DISCONNECTOR	STATUS
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 110VAC FOR	AUX. PT	
20x50	MCB3	MCB3 110VAC FOR	OVERVOLTAGE RELAY	
20x50	MCB4	MCB4 110VAC FOR	VOLTAGE UNBALANCE	SENSING RELAY
20x50	MCB5	MCB5 125VDC FOR	MAIN DC PROTECTION SYSTEM	
20x50	MCB6	MCB6 125VDC FOR	52bX	
20x50	MCB7	MCB7 125VDC FOR	CONTROL BKR.	
20x50	MCB8	MCB8 125VDC FOR	SEMAPHORE INDICATOR	AND OUTLET

TYPICAL NAMEPLATE MARSHALLING FOR CONTROL

NAMEPLATE SCHEDULE PANEL MPC11(FRONT)			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	MPC11	PANEL MPC11 (FRONT)	MARSHALLING FOR CONTROL SYSTEM
20x140	EGAT S/N	Contract No.	EGAT serial No.
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE PANEL MPC11(FRONT)			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET

TYPICAL NAMEPLATE OF MARSHALLING PANEL FOR RTU

NAMEPLATE SCHEDULE PANEL MP–RTU11(FRONT)			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	MP–RTU11	PANEL MP–RTU11 (FRONT)	MARSHALLING FOR RTU
20x140	EGAT S/N	Contract No.	EGAT serial No.
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE PANEL MP–RTU11(FRONT)			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCR1 230VAC FOR	LIGHTING & OUTLET

TYPICAL NAMEPLATE FOR 115 kV C–BANK

NAMEPLATE SCHEDULE PANEL C115–2			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	C–BANK NO.2	PANEL C115–2	115 kV CAPACITOR BANK NO.2
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	27XB1	DC SUPPLY ALARM	FOR BKR.
20x50	27XB2	DC SUPPLY ALARM	FOR BKR.
20x50	27XR1	DC SUPPLY ALARM	FOR 51C,59C,27C,60C1
20x50	27XR2	DC SUPPLY ALARM	FOR 60C2
20x50	27XR3	DC SUPPLY ALARM	FOR 50BF
20x50	27C	UNDERVOLTAGE	RELAY
20x50	27C–TB	UNDERVOLTAGE	TEST BLOCK
20x50	50BF	BREAKER FAILURE	RELAY
20x50	50BF–CO	BREAKER FAILURE	CUT–OFF SWITCH
20x50	50BF–TB	BREAKER FAILURE	TEST BLOCK
20x50	51C/51CG	OVERCURRENT	RELAY
20x50	51C/51CG–TB	OVERCURRENT	TEST BLOCK
20x50	59C	OVERVOLTAGE	RELAY
20x50	59C–TB	OVERVOLTAGE	TEST BLOCK
20x50	60C1	CURRENT UNBALANCE	SENSING RELAY 1
20x50	60C2	CURRENT UNBALANCE	SENSING RELAY 2
20x50	60C–TB	CURRENT UNBALANCE	SENSING TEST BLOCK
20x50	62bX	BREAKER TIME DELAY	
20x50	86BF	BREAKER FAILURE	LOCKOUT RELAY
20x50	86BF–PB	BREAKER FAILURE LOCKOUT	RESET PUSH BUTTON
20x50	94C1	OVERCURRENT AND OVERVOLTAGE	TRIPPING RELAY
20x50	94C2	CURRENT UNBALANCE SENSING	TRIPPING RELAY
20x50	CS	BREAKER CONTROL	SWITCH
20x50	KS	CONTROL BREAKER	
20x50	SMP	DISCONNECTOR	STATUS
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 115VAC FOR	OVERVOLTAGE RELAY	
20x50	MCB3	MCB3 115VAC FOR	UNDERVOLTAGE RELAY	
20x50	MCB4	MCB4 125VDC FOR	OVERCURRENT &	OVERVOLTAGE RELAY
20x50	MCB5	MCB5 125VDC FOR	CURRENT UNBALANCE	SENSING RELAY
20x50	MCB6	MCB6 125VDC FOR	BREAKER FAILURE RELAY	
20x50	MCB7	MCB7 125VDC FOR	CONTROL BKR.	
20x50	MCB8	MCB8 125VDC FOR	SEMAPHORE INDICATOR	AND OUTLET

TYPICAL NAMEPLATE OF MARSHALLING PANEL FOR FRS

NAMEPLATE SCHEDULE PANEL MP–FRS11(FRONT)			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	MP–FRS11	PANEL MP–FRS11(FRONT)	MARSHALLING FAULT RECORDING SYSTEM
20x140	EGAT S/N	Contract No.	EGAT serial No.
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE PANEL MP–FRS11(FRONT)			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 115VAC FOR	BUS NO.1
20x50	MCB3	MCB3 115VAC FOR	BUS NO.2
20x50	MCB4	MCB4 115VAC FOR	LINE NO.1 TO SAI NOI
20x50	MCB5	MCB5 115VAC FOR	LINE NO.2 TO SAI NOI
20x50	MCB6	MCB6	SPARE

TYPICAL NAMEPLATE FOR 230 kV C–BANK

NAMEPLATE SCHEDULE PANEL C230–3			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	C–BANK NO.3	PANEL C230–3	230 kV CAPACITOR BANK NO.3
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	27XB1	DC SUPPLY ALARM	FOR BKR.
20x50	27XB2	DC SUPPLY ALARM	FOR BKR.
20x50	27XR1	DC SUPPLY ALARM	FOR 51C,59C
20x50	27XR2	DC SUPPLY ALARM	FOR 60C1,60C2
20x50	27XR3	DC SUPPLY ALARM	FOR 50BF
20x50	50BF	BREAKER FAILURE	RELAY
20x50	50BF–CO	BREAKER FAILURE	CUT–OFF SWITCH
20x50	50BF–TB	BREAKER FAILURE	TEST BLOCK
20x50	51C/51CG	OVERCURRENT	RELAY
20x50	51C/51CG–TB	OVERCURRENT	TEST BLOCK
20x50	59C	OVERVOLTAGE	RELAY
20x50	59C–TB	OVERVOLTAGE	TEST BLOCK
20x50	60C1	CURRENT UNBALANCE	SENSING RELAY 1
20x50	60C1–TB	CURRENT UNBALANCE	SENSING TEST BLOCK 1
20x50	60C2	CURRENT UNBALANCE	SENSING RELAY 2
20x50	60C2–TB	CURRENT UNBALANCE	SENSING TEST BLOCK 2
20x50	62bX	BREAKER TIME DELAY	
20x50	86BF	BREAKER FAILURE	LOCKOUT RELAY
20x50	86BF–PB	BREAKER FAILURE LOCKOUT	RESET PUSH BUTTON
20x50	94C1	OVER CURRENT AND OVERVOLTAGE	TRIPPING RELAY
20x50	94C2	CURRENT UNBALANCE SENSING	TRIPPING RELAY
20x50	CS	BREAKER CONTROL	SWITCH
20x50	KS	CON.ROL BREAKER	
20x50	SMP	DISCONNECTOR	STATUS
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 115VAC FOR	OVERVOLTAGE RELAY	
20x50	MCB3	MCB3 125VDC FOR	OVERCURRENT &	OVERVOLTAGE RELAY
20x50	MCB4	MCB4 125VDC FOR	CURRENT UNBALANCE	SENSING RELAY
20x50	MCB5	MCB5 125VDC FOR	BREAKER FAILURE RELAY	
20x50	MCB6	MCB6 125VDC FOR	CONTROL BKR.	
20x50	MCB7	MCB7 125VDC FOR	SEMAPHORE INDICATOR	AND OUTLET

TYPICAL NAMEPLATE OF MARSHALLING PANEL FOR TELEPROTECTION

NAMEPLATE SCHEDULE PANEL MP–TELE11(FRONT)				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	MP–TELE11(F)	PANEL MP–TELE11(FRONT)	230kV TELEPROTECTION	
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	27XR1	27XR1	DC SUPPLY ALARM	
20x50	CRF1	CRF1 (PTT1)	230kV LINE NO.1	TO SARABURI 2
20x50	CRR1	CRR1 (PTT1)	230kV LINE NO.1	TO SARABURI 2
20x50	CRS1	CRS1 (PTT1)	230kV LINE NO.1	TO SARABURI 2
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE PANEL MP–TELE11(FRONT)			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 48VDC FOR	CONTROL CIRCUIT

เอกสารไม่ควบคุม
รับรองสำเนาโดย หหอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 พฤศจิกายน 2568

NOTES

1. THE DRAWING SHOWS NAMEPLATE SCHEDULE FOR SUBSTATION IN ORDER TO BE GUIDELINE FOR THE CONTRACTOR'S DESIGN IN GENERAL. THE CONTRACTOR SHALL DESIGN SPECIFIC OR ACTUAL SCHEDULE AND THEN SUBMIT TO EGAT FOR APPROVAL.
2. NAMEPLATES ARE ALSO REQUIRED FOR ALL EQUIPMENT ON THE MOUNTING BRACKETS OR HINGED PANEL INSIDE THE BOARD.
3. Contract No. AND EGAT Serial No. SHALL BE INFORMED LATER BY EGAT.

CABINET NO. W1
RUN NO. 1604

BID DRAFT

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	REVISE TYPICAL NAMEPLATE DESCRIPTION	P.Sirawich	–	–	–	–	–	–	–
–	–	REVISE AND ADD TYPICAL NAMEPLATE DESCRIPTION	K.Napat	–	–	–	–	–	–	–

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$Date
$$$$$$$$$$$$$Name

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	P.Sirawich	VALIDATED CHIEF, CONTROL AND PROTECTION ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	P.Sirawich	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DESCRIPTION OF DETAIL DRAWING: TYPICAL SCHEDULE FOR NAMEPLATES
VERIFIED		CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED		DATE 30/1/18 ASSISTANT GOVERNOR – TRANSMISSION SYSTEM ENGINEERING	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP – E – 11 / REV. 2 | 6 | 1

DWG.NO. TP – E – 11 | REV. 3 | 6 | 1

TYPICAL NAMEPLATE FOR 115 kV LINE PROTECTION

NAMEPLATE SCHEDULE PANEL 701R			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	701R	PANEL 701R	115kV LINE NO.1 TO PEA
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	87L1	LINE DIFFERENTIAL	RELAY
20x50	87L1-TB1	LINE DIFFERENTIAL	TEST BLOCK 1
20x50	87L1-TB2	LINE DIFFERENTIAL	TEST BLOCK 2
20x50	87L1-CO	LINE DIFFERENTIAL	CUT-OFF SWITCH
20x50	94P1	LINE DIFFERENTIAL	AUX. TRIP
20x50	67/67N-TB1	DIRECTIONAL O/C	TEST BLOCK
20x50	67/67N	DIRECTIONAL O/C	RELAY
20x50	67X	DIRECTIONAL O/C	AUX. TRIP
20x50	79-CO	AUTO RECLOSE	CUT-OFF SWITCH
20x50	50BFCO-701	BKR.7012 FAIL	CUT-OFF SWITCH
20x50	86BF-701PB	BKR.7012 LOCKOUT	RESET PUSH BUTTON
20x50	86DTT	DIRECT TRANSFER TRIP	LOCKOUT RELAY
20x50	86DTT-CO	DIRECT TRANSFER TRIP	CUT-OFF SWITCH
20x50	86DTT-PB	DIRECT TRANSFER TRIP	LOCKOUT RESET PUSH BUTTON
20x50	79+25-TB1	AUTO RECLOSE&SYNC.RELAY	TEST BLOCK 1
20x50	79+25-TB2	AUTO RECLOSE&SYNC.RELAY	TEST BLOCK 2
20x50	79X	AUTO RECLOSE&SYNC.RELAY	AUX. TRIP
20x50	79+25	AUTO RECLOSE & SYNC.	RELAY
20x50	50BF-701-TB1	BKR.7012 FAIL	TEST BLOCK 1
20x50	50BF-701	BKR.7012 FAIL	RELAY
20x50	52bx	BKR.7012 AUXILIARY	RELAY
20x50	21BU	DISTANCE RELAY	
20x50	21BU-TB1	DISTANCE RELAY	TEST BLOCK 1
20x50	27XR1	DC UNDERVOLTAGE FOR	PRI1 LINE DIFF. RELAY
20x50	27XR2	DC UNDERVOLTAGE FOR	DIRECTIONAL O/C RELAY
20x50	27XR3	DC UNDERVOLTAGE FOR	AUTO RECLOSE&SYNC.RELAY
20x50	27XR4	DC UNDERVOLTAGE FOR	BKR.7012 FAIL
20x50	27XR5	DC UNDERVOLTAGE FOR	DIRECT TRANSFER TRIP
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 115VAC FOR	PT LINE	AUTO RECLOSE&SYNC.RELAY
20x50	MCB3	MCB3 115VAC FOR	PT BUS	AUTO RECLOSE&SYNC.RELAY
20x50	MCB4	MCB4 125VDC FOR	LINE DIFF. RELAY	
20x50	MCB5	MCB5 125VDC FOR	DIRECTIONAL O/C	RELAY
20x50	MCB6	MCB6 125VDC FOR	AUTO RECLOSE	&SYNC. RELAY
20x50	MCB7	MCB7 125VDC FOR	BKR.7012 FAIL	
20x50	MCB8	MCB8 125VDC FOR	DIRECT TRANSFER TRIP	
20x50	MCB9	MCB9 125VDC FOR	DIRECT TRANSFER TRIP	FOR SPP(VSPP/ETC.)

TYPICAL NAMEPLATE FOR 115/22,33 kV TRANSFORMER PROTECTION

NAMEPLATE SCHEDULE PANEL 105R			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	105R	PANEL 105R	115/22kV TRANSFORMER KT1A
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	87K	KT1A DIFFERENTIAL	RELAY
20x50	87K-TB1	KT1A DIFFERENTIAL	TEST BLOCK 1
20x50	87K-TB2	KT1A DIFFERENTIAL	TEST BLOCK 2
20x50	86K	KT1A DIFFERENTIAL	LOCKOUT RELAY
20x50	51T-TB	HIGH SIDE OVERCURRENT	TEST BLOCK
20x50	51-1-TB	LOW SIDE OVERCURRENT	TEST BLOCK
20x50	51T/51TG1	HIGH SIDE OVERCURRENT	RELAY
20x50	51-1/51G1	LOW SIDE OVERCURRENT	RELAY
20x50	51X	OVERCURRENT	AUX. TRIP
20x50	87K-CO	KT1A DIFFERENTIAL	CUT-OFF SWITCH
20x50	86K-PB	KT1A DIFF. LOCKOUT	RESET PUSH BUTTON
20x50	50BFCO-711	BKR.70112 FAIL	CUT-OFF SWITCH
20x50	86BF-711PB	BKR.70112 LOCKOUT	RESET PUSH BUTTON
20x50	50BF-711-TB	BKR.70112 FAIL	TEST BLOCK
20x50	50BF-711	BKR.70112 FAIL	RELAY
20x50	86BF-711	BKR.70112 FAIL	LOCKOUT RELAY
20x50	27XR1	DC UNDERVOLTAGE FOR	KT1A DIFFERENTIAL
20x50	27XR2	DC UNDERVOLTAGE FOR	BKR.70112 FAIL
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

MCB NAMEPLATE SCHEDULE			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	TRANSFORMER DIFF.
20x50	MCB3	MCB3 125VDC FOR	HS OVERCURRENT
20x50	MCB4	MCB4 125VDC FOR	LS OVERCURRENT
20x50	MCB5	MCB6 125VDC FOR	BKR.70112 FAIL

BID NO. DRAFT DSS-01

เอกสารไม่ควบคุม
รับรองสำเนาโดย หหอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

NOTES

1. THE DRAWING SHOWS NAMEPLATE SCHEDULE FOR SUBSTATION IN ORDER TO BE GUIDELINE FOR THE CONTRACTOR'S DESIGN IN GENERAL. THE CONTRACTOR SHALL DESIGN SPECIFIC OR ACTUAL SCHEDULE AND THEN SUBMIT TO EGAT FOR APPROVAL.
2. NAMEPLATES ARE ALSO REQUIRED FOR ALL EQUIPMENT ON THE MOUNTING BRACKETS OR HINGED PANEL INSIDE THE BOARD.
3. Contract No. AND EGAT Serial No. SHALL BE INFORMED LATER BY EGAT.

CABINET NO. W1
RUN NO. 1.05

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	REVISE TYPICAL NAMEPLATE DESCRIPTION	P.Sirawich	–	–	–	–	–	–	–
–	–	REVISE AND ADD TYPICAL NAMEPLATE DESCRIPTION	K.Napat	–	–	–	–	–	–	–

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$Name

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	P.Sirawich	VALIDATED CHIEF, CONTROL AND PROTECTION ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	P.Sirawich	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DESCRIPTION OF DETAIL DRAWING: TYPICAL SCHEDULE FOR NAMEPLATES
VERIFIED		CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED	ASSISTANT GOVERNOR – TRANSMISSION SYSTEM ENGINEERING	DATE 30/1/18	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP – E – 11 / REV. 3 / 6 / 1

DWG.NO. TP – E – 11

REV. 4 6 1

TYPICAL NAMEPLATE FOR 230 kV PRIMARY LINE PROTECTION

NAMEPLATE SCHEDULE PANEL 807R				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	807R	PANEL 807R	230kV LINE NO.2 TO WANG NOI	PRIMARY PROTECTION
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	87L1	PRI LINE DIFFERENTIAL	RELAY	
20x50	87L1-TB1	PRI LINE DIFFERENTIAL	TEST BLOCK 1	
20x50	87L1-TB2	PRI LINE DIFFERENTIAL	TEST BLOCK 2	
20x50	87L1-TB3	PRI LINE DIFFERENTIAL	TEST BLOCK 3	
20x50	87L1-CO	PRI LINE DIFFERENTIAL	CUT-OFF SWITCH	
20x50	94P1	PRI LINE DIFFERENTIAL	AUX. TRIP	
20x50	94P1-A	PRI LINE DIFFERENTIAL	AUX. TRIP PH.A	
20x50	94P1-B	PRI LINE DIFFERENTIAL	AUX. TRIP PH.B	
20x50	94P1-C	PRI LINE DIFFERENTIAL	AUX. TRIP PH.C	
20x50	79+25	AUTO RECLOSE & SYNC.	RELAY	
20x50	79+25-TB1	AUTO RECLOSE&SYNC.RELAY	TEST BLOCK 1	
20x50	79+25-TB2	AUTO RECLOSE&SYNC.RELAY	TEST BLOCK 2	
20x50	79X	AUTO RECLOSE&SYNC.RELAY	AUX. TRIP	
20x50	79-CO	AUTO RECLOSE	CUT-OFF SWITCH	
20x50	27XR1	DC UNDERVOLTAGE FOR	PRI LINE DIFF. RELAY	
20x50	27XR2	DC UNDERVOLTAGE FOR	AUTO RECLOSE&SYNC.RELAY	
20x50	51S/51SG	STUB OVERCURRENT	RELAY	
20x50	51S/51SG-TB	STUB OVERCURRENT	TEST BLOCK	
20x50	51S-CO	STUB OVERCURRENT	CUT-OFF SWITCH	
20x50	86S-PB	STUB OVERCURRENT	LOCKOUT RESET PUSH BUTTON	
20x50	86S	STUB OVERCURRENT	LOCKOUT RELAY	
20x50	89X-8221-1	89X-8221-1	AUX. TRIP 1	
20x50	89X-8221-2	89X-8221-2	AUX. TRIP 2	
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 115VAC FOR	PT LINE	AUTO RECLOSE&SYNC.RELAY
20x50	MCB3	MCB3 115VAC FOR	PT BUS	AUTO RECLOSE&SYNC.RELAY
20x50	MCB4	MCB4 125VDC FOR	PRI LINE DIFF. RELAY	
20x50	MCB5	MCB5 125VDC FOR	AUTO RECLOSE	&SYNC RELAY

TYPICAL NAMEPLATE FOR 230 kV SECONDARY LINE PROTECTION

NAMEPLATE SCHEDULE PANEL 808R				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	808R	PANEL 808R	230kV LINE NO.2 TO WANG NOI	SECONDARY PROTECTION
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	87L2	SEC LINE DIFFERENTIAL	RELAY	
20x50	87L2-TB1	SEC LINE DIFFERENTIAL	TEST BLOCK 1	
20x50	87L2-TB2	SEC LINE DIFFERENTIAL	TEST BLOCK 2	
20x50	87L2-TB3	SEC LINE DIFFERENTIAL	TEST BLOCK 3	
20x50	87L2-CO	SEC LINE DIFFERENTIAL	CUT-OFF SWITCH	
20x50	94P2	SEC LINE DIFFERENTIAL	AUX. TRIP	
20x50	94P2-A	SEC LINE DIFFERENTIAL	AUX. TRIP PH.A	
20x50	94P2-B	SEC LINE DIFFERENTIAL	AUX. TRIP PH.B	
20x50	94P2-C	SEC LINE DIFFERENTIAL	AUX. TRIP PH.C	
20x50	86DTT	DIRECT TRANSFER TRIP	LOCKOUT RELAY	
20x50	86DTT-CO	DIRECT TRANSFER TRIP	CUT-OFF SWITCH	
20x50	86DTT-PB	DIRECT TRANSFER TRIP	LOCKOUT RESET PUSH BUTTON	
20x50	50BF-841	BKR.80412 FAIL	RELAY	
20x50	50BF-841-TB1	BKR.80412 FAIL	TEST BLOCK 1	
20x50	50BF-841-TB2	BKR.80412 FAIL	TEST BLOCK 2	
20x50	50BFCO-841	BKR.80412 FAIL	CUT-OFF SWITCH	
20x50	50BF-843	BKR.80432 FAIL	RELAY	
20x50	50BF-843-TB1	BKR.80432 FAIL	TEST BLOCK 1	
20x50	50BFCO-843	BKR.80432 FAIL	CUT-OFF SWITCH	
20x50	86BF-841	BKR.80412 FAIL	LOCKOUT RELAY	
20x50	86BF-841PB	BKR.80412 LOCKOUT	RESET PUSH BUTTON	
20x50	86BF-843	BKR.80432 FAIL	LOCKOUT RELAY	
20x50	86BF-843PB	BKR.80432 LOCKOUT	RESET PUSH BUTTON	
20x50	27XR1	DC UNDERVOLTAGE FOR	SEC LINE DIFF. RELAY	
20x50	27XR2	DC UNDERVOLTAGE FOR	DIRECT TRANSFER TRIP	
20x50	27XR3	DC UNDERVOLTAGE FOR	BKR.80412 FAIL	
20x50	27XR4	DC UNDERVOLTAGE FOR	BKR.80432 FAIL	
20x50	21P2	SEC DISTANCE RELAY		
20x50	21P2-TB1	SEC DISTANCE RELAY	TEST BLOCK 1	
20x50	21P2-TB2	SEC DISTANCE RELAY	TEST BLOCK 2	
20x50	21P2-TB3	SEC DISTANCE RELAY	TEST BLOCK 3	
20x50	21P2-SG	GROUP SETTING	SELECTOR SW.	
20x50	PTT2-CO	PERMISSIVE TRANSFER TRIP	CUT-OFF SWITCH	
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	SEC DISTANCE RELAY
20x50	MCB3	MCB3 125VDC FOR	SEC LINE DIFF. RELAY
20x50	MCB4	MCB4 125VDC FOR	DIRECT TRANSFER TRIP
20x50	MCB5	MCB5 125VDC FOR	BKR.80412 FAIL
20x50	MCB6	MCB6 125VDC FOR	BKR.80432 FAIL

TYPICAL NAMEPLATE FOR 230/115,69 kV TRANSFORMER PROTECTION

NAMEPLATE SCHEDULE PANEL 215R				
SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	215R	PANEL 215R	230/115kV TRANSFORMER KT1A	
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	87K1	KT1A DIFFERENTIAL	RELAY	
20x50	87K1-TB1	KT1A DIFFERENTIAL	TEST BLOCK 1	
20x50	87K1-TB2	KT1A DIFFERENTIAL	TEST BLOCK 2	
20x50	86K1	KT1A DIFFERENTIAL	LOCKOUT RELAY	
20x50	51T1-TB	HIGH SIDE OVERCURRENT	TEST BLOCK	
20x50	51-1-TB	LOW SIDE OVERCURRENT	TEST BLOCK	
20x50	51T1/51TG1	HIGH SIDE OVERCURRENT	RELAY	
20x50	51-1/51G1	LOW SIDE OVERCURRENT	RELAY	
20x50	51GB1-1-TB1	OVERCURRENT GROUND BU.	TEST BLOCK 1	
20x50	51GB2-1-TB2	OVERCURRENT GROUND BU.	TEST BLOCK 2	
20x50	51GB1-1	OVERCURRENT GROUND BU.	RELAY 1	
20x50	51GB2-1	OVERCURRENT GROUND BU.	RELAY 2	
20x50	87K1-CO	KT1A DIFFERENTIAL	CUT-OFF SWITCH	
20x50	86K1-PB	KT1A DIFF. LOCKOUT	RESET PUSH BUTTON	
20x50	50BFCO-833	BKR.80332 FAIL	CUT-OFF SWITCH	
20x50	86BF-833PB	BKR.80332 LOCKOUT	RESET PUSH BUTTON	
20x50	50BF-833-TB	BKR.80332 FAIL	TEST BLOCK	
20x50	50BF-833	BKR.80332 FAIL	RELAY	
20x50	86BF-833	BKR.80332 FAIL	LOCKOUT RELAY	
20x50	51-11/51G11-TB	TERTIARY OVERCURRENT	TEST BLOCK	
20x50	51-11/51G11	TERTIARY OVERCURRENT	RELAY	
20x50	59N-1-TB	RESIDUAL OVERVOLTAGE	TEST BLOCK	
20x50	59N-1	RESIDUAL OVERVOLTAGE	RELAY	
20x50	27XR1	DC UNDERVOLTAGE FOR	KT1A DIFFERENTIAL	
20x50	27XR2	DC UNDERVOLTAGE FOR	BKR.80332 FAIL	
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 115VAC FOR	NEUTRAL (59N)
20x50	MCB3	MCB3 125VDC FOR	TRANSFORMER DIFF.
20x50	MCB4	MCB4 125VDC FOR	HS OVERCURRENT
20x50	MCB5	MCB5 125VDC FOR	LS OVERCURRENT
20x50	MCB6	MCB6 125VDC FOR	GB1 OVERCURRENT
20x50	MCB7	MCB7 125VDC FOR	GB2 OVERCURRENT
20x50	MCB8	MCB8 125VDC FOR	TERTIARY O/C
20x50	MCB9	MCB9 125VDC FOR	NEUTRAL (59N)
20x50	MCB10	MCB10 125VDC FOR	BKR.80332 FAIL

Bid Not Brkt DRAFT

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ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

NOTES

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2. NAMEPLATES ARE ALSO REQUIRED FOR ALL EQUIPMENT ON THE MOUNTING BRACKETS OR HINGED PANEL INSIDE THE BOARD.
3. Contract No. AND EGAT Serial No. SHALL BE INFORMED LATER BY EGAT.

CABINET NO. W1
RUN NO. 166

ISO 9001 TSEB1999
CAD CENTER
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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	REVISE TYPICAL NAMEPLATE DESCRIPTION	P.Sirawich	–	–	–	–	–	–	–
–	–	REVISE AND ADD TYPICAL NAMEPLATE DESCRIPTION	K.Napat	–	–	–	–	–	–	–

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$Name

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	P.Sirawich	VALIDATED CHIEF, CONTROL AND PROTECTION ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	P.Sirawich	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DESCRIPTION OF DETAIL DRAWING: TYPICAL SCHEDULE FOR NAMEPLATES
VERIFIED		CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED		DATE 30/1/18 ASSISTANT GOVERNOR – TRANSMISSION SYSTEM ENGINEERING	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP – E – 11 / REV. 4 6 1

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DWG.NO. TP – E – 11

TYPICAL NAMEPLATE FOR 500 kV PRIMARY LINE PROTECTION

NAMEPLATE SCHEDULE PANEL 107R

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	107R	PANEL 107R	500kV LINE NO.2 TO KHON KAEN 4	PRIMARY PROTECTION
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	87L	PRI LINE DIFFERENTIAL	RELAY	
20x50	87L-TB1	PRI LINE DIFFERENTIAL	TEST BLOCK 1	
20x50	87L-TB2	PRI LINE DIFFERENTIAL	TEST BLOCK 2	
20x50	87L-TB3	PRI LINE DIFFERENTIAL	TEST BLOCK 3	
20x50	87L-CO	PRI LINE DIFFERENTIAL	CUT-OFF SWITCH	
20x50	94P1-A	LINE DIFFERENTIAL	AUX. TRIP PH.A	
20x50	94P1-B	LINE DIFFERENTIAL	AUX. TRIP PH.B	
20x50	94P1-C	LINE DIFFERENTIAL	AUX. TRIP PH.C	
20x50	79+25-TB1	AUTO RECLOSE & SYNC. RELAY	TEST BLOCK 1	
20x50	79+25-TB2	AUTO RECLOSE & SYNC. RELAY	TEST BLOCK 2	
20x50	79X	AUTO RECLOSE & SYNC. RELAY	AUX. TRIP	
20x50	79+25	AUTO RECLOSE & SYNC.	RELAY	
20x50	79CO	AUTO RECLOSE	CUT-OFF SWITCH	
20x50	DTT1-CO	DIRECT TRANFER TRIP	OPGW CUT-OFF SWITCH	
20x50	62DTT1	CB STATUS	TIMER RELAY	
20x50	62TT1	TRANSFER TRIP OPGW	SYSTEM TIMER RELAY	
20x50	94TT1	TRANSFER TRIP OPGW	SYSTEM AUX. TRIP	
20x50	86TT1	TRANSFER TRIP OPGW	SYSTEM LOCKOUT RELAY	
20x50	86TT1-PB	TRANSFER TRIP LOCKOUT	RESET PUSH BUTTON	
20x50	PTT1-CO	PERMISSIVE TRANSFER TRIP	CUT-OFF SWITCH	
20x50	51S/51SG	STUB OVERCURRENT	CUT-OFF SWITCH	
20x50	51S/51SG-TB	STUB OVERCURRENT	TEST BLOCK	
20x50	51S-CO	STUB OVERCURRENT	RELAY	
20x50	86S	STUB OVERCURRENT	LOCKOUT RELAY	
20x50	86S-PB	STUB OVERCURRENT	LOCKOUT RESET PUSH BUTTON	
20x50	52bX1	CB STATUS	AUX. TRIP	
20x50	21P1	PRI DISTANCE RELAY		
20x50	21P1-TB1	PRI DISTANCE RELAY	TEST BLOCK 1	
20x50	21P1-TB2	PRI DISTANCE RELAY	TEST BLOCK 2	
20x50	21P1-TB3	PRI DISTANCE RELAY	TEST BLOCK 3	
20x50	27XR1	DC UNDERVOLTAGE FOR	PRI LINE DIFF. RELAY	
20x50	27XR2	DC UNDERVOLTAGE FOR	AUTO RECLOSE&SYNC.RELAY	
20x50	27XR3	DC UNDERVOLTAGE FOR	STUB OVERCURRENT	
20x50	27XR4	DC UNDERVOLTAGE FOR	DIRECT TRANSFER TRIP	
20x50	R1	RESISTOR FOR 62DTT1		
20x50	R2	RESISTOR FOR 62TT1		
20x50	89X-8221-1	89X-8221-1	AUX. TRIP 1	
20x50	89X-8221-2	89X-8221-2	AUX. TRIP 2	
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET	
20x50	MCB2	MCB2 66.4VAC VL	FOR SYNC CHECK	
20x50	MCB3	MCB3 66.4VAC VB	FOR SYNC CHECK	
20x50	MCB4	MCB4 125VDC FOR	PRI DISTANCE RELAY	
20x50	MCB5	MCB4 125VDC FOR	AUTO RECLOSE	& SYNC RELAY
20x50	MCB6	MCB4 125VDC FOR	STUB O/C RELAY	
20x50	MCB7	MCB4 125VDC FOR	DIRECT TRANSFER TRIP1	

TYPICAL NAMEPLATE FOR 500 kV SECONDARY LINE PROTECTION

NAMEPLATE SCHEDULE PANEL 108R

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	108R	PANEL 108R	500kV LINE NO.2 TO KHON KAEN 4	SECONDARY PROTECTION
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	21P2	SEC DISTANCE RELAY		
20x50	21P2-TB1	SEC DISTANCE RELAY	TEST BLOCK 1	
20x50	21P2-TB2	SEC DISTANCE RELAY	TEST BLOCK 2	
20x50	21P2-TB3	SEC DISTANCE RELAY	TEST BLOCK 3	
20x50	21P2-SG	GROUP SETTING	SELECTOR SW.	
20x50	94P2-A	SEC DISTANCE RELAY	AUX. TRIP PH.A	
20x50	94P2-B	SEC DISTANCE RELAY	AUX. TRIP PH.B	
20x50	94P2-C	SEC DISTANCE RELAY	AUX. TRIP PH.C	
20x50	24L	OVERFLUXING (V/Hz)	RELAY	
20x50	24LX	OVERFLUXING (V/Hz)	AUX. TRIP	
20x50	24L-TB	OVERFLUXING (V/Hz)	TEST BLOCK	
20x50	DTT2-CO	DIRECT TRANSFER TRIP	OPGW CUT-OFF SWITCH	
20x50	62DTT2	CB STATUS	TIMER RELAY	
20x50	62TT2	TRANSFER TRIP OPGW	SYSTEM TIMER RELAY	
20x50	94TT2	TRANSFER TRIP OPGW	SYSTEM AUX. TRIP	
20x50	86TT2	TRANSFER TRIP OPGW	SYSTEM LOCKOUT RELAY	
20x50	86TT2-PB	TRANSFER TRIP LOCKOUT	RESET PUSH BUTTON	
20x50	PTT2-CO	PERMISSIVE TRANSFER TRIP	CUT-OFF SWITCH	
20x50	50BF-921	BKR.90212 FAIL	RELAY	
20x50	50BF-921-TB1	BKR.90212 FAIL	TEST BLOCK 1	
20x50	50BF-921-TB2	BKR.90212 FAIL	TEST BLOCK 2	
20x50	50BFCO-921	BKR.90212 FAIL	CUT-OFF SWITCH	
20x50	50BF-922	BKR.90222 FAIL	RELAY	
20x50	50BF-922-TB1	BKR.90222 FAIL	TEST BLOCK 1	
20x50	50BF-922-TB2	BKR.90222 FAIL	TEST BLOCK 2	
20x50	50BFCO-922	BKR.90222 FAIL	CUT-OFF SWITCH	
20x50	86BF-921	BKR.90212 FAIL	LOCKOUT RELAY	
20x50	86BF-921PB	BKR.90212 FAIL	LOCKOUT RESET PUSH BUTTON	
20x50	86BF-922	BKR.90222 FAIL	LOCKOUT RELAY	
20x50	86BF-922PB	BKR.90222 FAIL	LOCKOUT RESET PUSH BUTTON	
20x50	52bX2	CB STATUS	AUX. TRIP	
20x50	27XR1	DC UNDERVOLTAGE FOR	SEC DISTANCE RELAY	
20x50	27XR2	DC UNDERVOLTAGE FOR	DIRECT TRANSFER TRIP	
20x50	27XR3	DC UNDERVOLTAGE FOR	BKR.90212 FAIL	
20x50	27XR4	DC UNDERVOLTAGE FOR	BKR.90222 FAIL	
20x50	R1	RESISTOR FOR 62DTT2		
20x50	R2	RESISTOR FOR 62TT2		
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE

SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	SEC DISTANCE RELAY
20x50	MCB3	MCB4 125VDC FOR	BKR.90212 FAIL
20x50	MCB4	MCB5 125VDC FOR	BKR.90222 FAIL
20x50	MCB5	MCB6 125VDC FOR	DIRECT TRANSFER TRIP2

TYPICAL NAMEPLATE FOR 500 kV REACTOR PROTECTION

NAMEPLATE SCHEDULE PANEL 109R

SIZE	LEGEND	FIRST LINE	SECOND LINE	THIRD LINE
35x160	109R	PANEL 109R	500kV LINE NO.2 TO KHON KAEN 4	REACTOR PROTECTION
20x140	EGAT S/N	Contract No.	EGAT serial No.	
20x50	87R	REACTOR DIFFERENTIAL	RELAY	
20x50	87R-TB	REACTOR DIFFERENTIAL	TEST BLOCK	
20x50	95R-TB	CT SUPERVISION	TEST BLOCK	
20x50	95R	CT SUPERVISION	RELAY	
20x50	86R-1	REACTOR DIFFERENTIAL	LOCKOUT RELAY 1	
20x50	86R-2	REACTOR DIFFERENTIAL	LOCKOUT RELAY 2	
20x50	87RN-TB	NEUTRAL REACTOR DIFFERENTIAL	TEST BLOCK	
20x50	95RNX	CT SUPERVISION	LOCKOUT RELAY	
20x50	86RN	NEUTRAL REACTOR DIFFERENTIAL	LOCKOUT RELAY	
20x50	87RN	NEUTRAL REACTOR DIFFERENTIAL	RELAY	
20x50	87R-CO	REACTOR DIFF.	CUT-OFF SWITCH	
20x50	86R-PB	REACTOR DIFF. LOCKOUT	RESET PUSH BUTTON	
20x50	87RN-CO	NEUTRAL REACTOR DIFF.	CUT-OFF SWITCH	
20x50	86RN-PB	NEUTRAL REACTOR LOCKOUT	RESET PUSH BUTTON	
20x50	95RN-PB	CT SUPERVISION	RESET PUSH BUTTON	
20x50	51R/51RG	REACTOR OVERCURRENT	RELAY	
20x50	51R/51RG-TB	REACTOR OVERCURRENT	TEST BLOCK	
20x50	27XR1	DC UNDERVOLTAGE FOR	REACTOR DIFF. LOCKOUT RELAY	
20x50	27XR2	DC UNDERVOLTAGE FOR	REACTOR DIFF. RELAY	
20x50	27XR3	DC UNDERVOLTAGE FOR	NEUTRAL REACTOR DIFF. RELAY	
20x50	27XR4	DC UNDERVOLTAGE FOR	REACTOR OVERCURRENT RELAY	
20x50	R1	VARISTOR UNIT		
20x50	R2	VARISTOR UNIT		
20x50	RP-1	RESISTOR	PHASE A	
20x50	RP-2	RESISTOR	PHASE B	
20x50	RP-3	RESISTOR	PHASE C	
12x28	DSW	DSW		
12x28	LAMP	LAMP		
12x28	OUTLET	OUTLET		

MCB NAMEPLATE SCHEDULE

SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	REACTOR DIFFERENTIAL
20x50	MCB3	MCB3 125VDC FOR	NEUTRAL REACTOR DIFF.
20x50	MCB4	MCB4 125VDC FOR	REACTOR OVERCURRENT

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CABINET NO. W1
RUN NO. 1603

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	REVISE TYPICAL NAMEPLATE DESCRIPTION	P.Sirawich	–	–	–	–	–	–	–
–	–	REVISE AND ADD TYPICAL NAMEPLATE DESCRIPTION	K.Napat	–	–	–	–	–	–	–

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TYPICAL NAMEPLATE FOR 500/230 kV PRIMARY TRANSFORMER PROTECTION

NAMEPLATE SCHEDULE PANEL 111R			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	111R	PANEL 111R	500/230kV TRANSFORMER KT1A
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	87K1P	PRI KT1A DIFFERENTIAL	RELAY
20x50	87K1P-TB1	PRI KT1A DIFFERENTIAL	TEST BLOCK 1
20x50	87K1P-TB2	PRI KT1A DIFFERENTIAL	TEST BLOCK 2
20x50	86K1P	PRI KT1A DIFFERENTIAL	LOCKOUT RELAY
20x50	87K1P-CO	PRI KT1A DIFFERENTIAL	CUT-OFF SWITCH
20x50	86K1P-PB	PRI KT1A DIFF. LOCKOUT	RESET PUSH BUTTON
20x50	50BFCO-943	BKR.90432 FAIL	CUT-OFF SWITCH
20x50	86BF-943PB	BKR.90432 LOCKOUT	RESET PUSH BUTTON
20x50	50BF-943-TB	BKR.90432 FAIL	TEST BLOCK
20x50	50BF+62BF-943	BKR.90432 FAIL	RELAY
20x50	86BF-943	BKR.90432 FAIL	LOCKOUT RELAY
20x50	27XR1	DC UNDERVOLTAGE FOR	KT1A DIFFERENTIAL
20x50	27XR2	DC UNDERVOLTAGE FOR	BKR.90432 FAIL
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

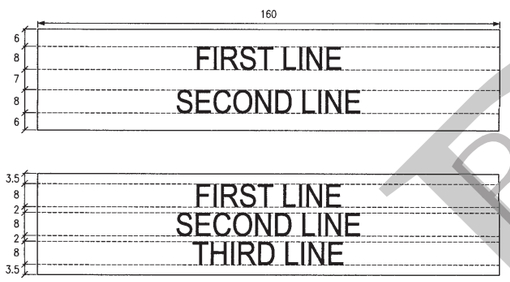
MCB NAMEPLATE SCHEDULE			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 125VDC FOR	BKR.90432 FAIL
20x50	MCB3	MCB3 125VDC FOR	PRI TRANSFORMER DIFF.

TYPICAL NAMEPLATE FOR 500/230 kV SECONDARY TRANSFORMER PROTECTION

NAMEPLATE SCHEDULE PANEL 112R			
SIZE	LEGEND	FIRST LINE	SECOND LINE
35x160	112R	PANEL 112R	500/230kV TRANSFORMER KT1A
20x140	EGAT S/N	Contract No.	EGAT serial No.
20x50	87K1S	SEC KT1A DIFFERENTIAL	RELAY
20x50	87K1S-TB1	SEC KT1A DIFFERENTIAL	TEST BLOCK 1
20x50	87K1S-TB2	SEC KT1A DIFFERENTIAL	TEST BLOCK 2
20x50	86K1S	SEC KT1A DIFFERENTIAL	LOCKOUT RELAY
20x50	51T4-TB	HIGH SIDE OVERCURRENT	TEST BLOCK
20x50	51-4-TB	LOW SIDE OVERCURRENT	TEST BLOCK
20x50	51T4/51TG4	HIGH SIDE OVERCURRENT	RELAY
20x50	51-4/51G4	LOW SIDE OVERCURRENT	RELAY
20x50	51GB1-4-TB1	OVERCURRENT GROUND BU.	TEST BLOCK 1
20x50	51GB2-4-TB2	OVERCURRENT GROUND BU.	TEST BLOCK 2
20x50	51GB1-4	OVERCURRENT GROUND BU.	RELAY 1
20x50	51GB2-4	OVERCURRENT GROUND BU.	RELAY 2
20x50	87K1S-CO	SEC KT1A DIFFERENTIAL	CUT-OFF SWITCH
20x50	86K1S-PB	SEC KT1A DIFF. LOCKOUT	RESET PUSH BUTTON
20x50	51-11/51G11-TB	TERTIARY OVERCURRENT	TEST BLOCK
20x50	51-11/51G11	TERTIARY OVERCURRENT	RELAY
20x50	59N-1-TB	RESIDUAL VOLTAGE	TEST BLOCK
20x50	59N-1	RESIDUAL VOLTAGE	RELAY
20x50	27XR1	DC UNDERVOLTAGE FOR	KT1A DIFFERENTIAL
20x50	27XR2	DC UNDERVOLTAGE FOR	KT1A OVERCURRENT
20x50	24K1	TRANSFORMER OVERFLUXING	RELAY
12x28	DSW	DSW	
12x28	LAMP	LAMP	
12x28	OUTLET	OUTLET	

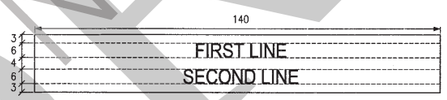
MCB NAMEPLATE SCHEDULE			
SIZE	LEGEND	FIRST LINE	SECOND LINE
20x50	MCB1	MCB1 230VAC FOR	LIGHTING & OUTLET
20x50	MCB2	MCB2 115VAC FOR	NEUTRAL (59N)
20x50	MCB3	MCB3 125VDC FOR	SEC TRANSFORMER DIFF.
20x50	MCB4	MCB4 125VDC FOR	HS OVERCURRENT
20x50	MCB5	MCB5 125VDC FOR	LS OVERCURRENT
20x50	MCB6	MCB6 125VDC FOR	TRANSFORMER OVERFLUXING
20x50	MCB7	MCB7 125VDC FOR	GB1 OVERCURRENT
20x50	MCB8	MCB8 125VDC FOR	GB2 OVERCURRENT
20x50	MCB9	MCB9 125VDC FOR	TERTIARY O/C
20x50	MCB10	MCB10 125VDC FOR	NEUTRAL (59N)

SIZE 35x160



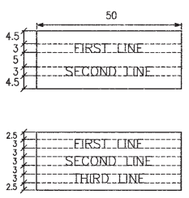
HEIGHT: 8.0 mm.
FONT-STYLE: ARIAL NARROW

SIZE 20x140



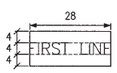
HEIGHT: 5.0 mm.
FONT-STYLE: ARIAL NARROW

SIZE 20x50



HEIGHT: 3.0 mm.
FONT-STYLE: RAILWAY 1L

SIZE 12x28



HEIGHT: 4.0 mm.
FONT-STYLE: RAILWAY 1L

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14 ตุลาคม 2568

NOTES

1. THE DRAWING SHOWS NAMEPLATE SCHEDULE FOR SUBSTATION IN ORDER TO BE GUIDELINE FOR THE CONTRACTOR'S DESIGN IN GENERAL. THE CONTRACTOR SHALL DESIGN SPECIFIC OR ACTUAL SCHEDULE AND THEN SUBMIT TO EGAT FOR APPROVAL.
2. NAMEPLATES ARE ALSO REQUIRED FOR ALL EQUIPMENT ON THE MOUNTING BRACKETS OR HINGED PANEL INSIDE THE BOARD.
3. Contract No. AND EGAT Serial No. SHALL BE INFORMED LATER BY EGAT.

CABINET NO. W1
RUN NO. 1606

BID NO. DRAFT

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	REVISE TYPICAL NAMEPLATE DESCRIPTION	P.Sirawich	–	–	–	–	–	–	–
–	–	REVISE AND ADD TYPICAL NAMEPLATE DESCRIPTION	K.Napat	–	–	–	–	–	–	–

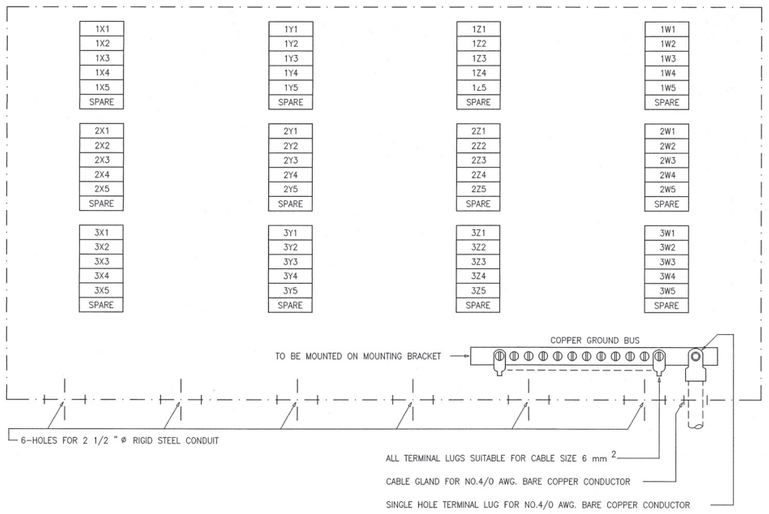
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$$Name

ELECTRICITY GENERATING AUTHORITY OF THAILAND

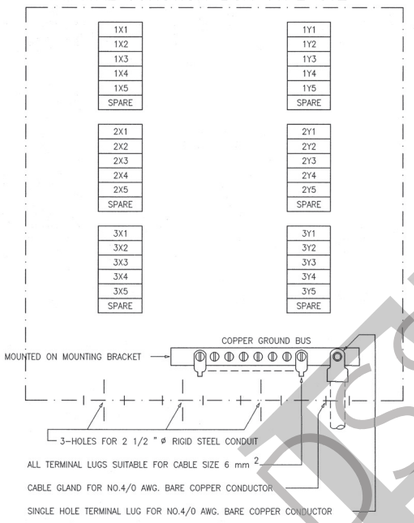
DRAWN	P.Sirawich	VALIDATED CHIEF, CONTROL AND PROTECTION ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	P.Sirawich	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DESCRIPTION OF DETAIL DRAWING: TYPICAL SCHEDULE FOR NAMEPLATES
VERIFIED		CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED	ASSISTANT GOVERNOR – TRANSMISSION SYSTEM ENGINEERING	DATE 30/11/18	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP – E – 11 / REV. 6 / 1

DWG.NO. TP – E – 18.2 | REV. –

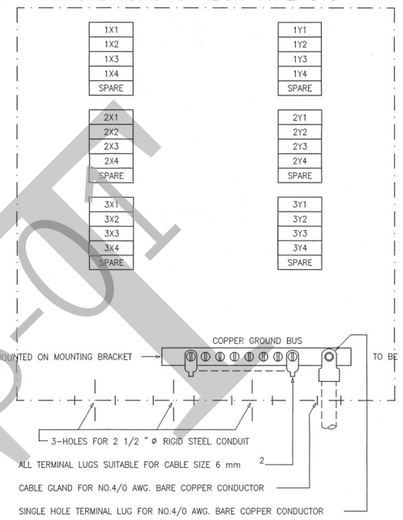
TYPICAL JUNCTION BOX TYPE CT1



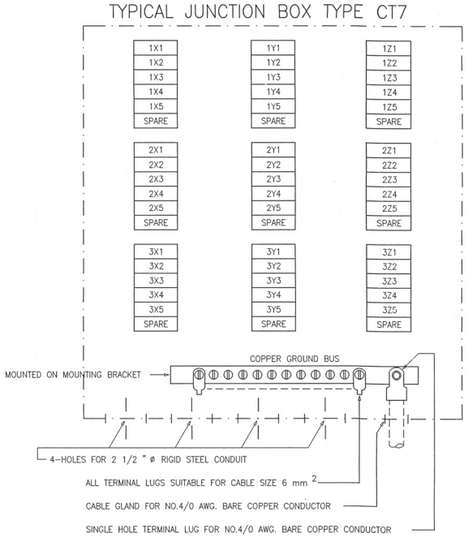
TYPICAL JUNCTION BOX TYPE CT2



TYPICAL JUNCTION BOX TYPE CT3



TYPICAL JUNCTION BOX TYPE CT7



TYPICAL JUNCTION BOX TYPE CT4

TYPICAL JUNCTION BOX TYPE CT6

NOTES

– THE FOLLOWING ACCESSORIES AND WIRING CONNECTION SHALL BE PROVIDED BY THE CONTRACTOR
  1. TERMINAL BLOCKS WITH DESIGNATION LABEL SUITABLE FOR COPPER CABLE SIZE UP TO 2x6 Sq.mm.PER TERMINAL,THESE TERMINAL BLOCKS SHALL BE OF 600 V MOLDED NONFLAMABLE THERMOSETTING MATERIAL TYPE WITH INSULATING BARRIER BETWEEN ADJACENT TERMINALS AND QUALITY SUITABLE FOR USE IN OUTDOOR CUBICLE.
  2. WIRING CONNECTION INDICATED BY SOLID LINE SHALL BE 6 Sq.mm. COPPER CABLE
  3. THE COPPER GROUND BUS SIZE SHALL BE 6 mm. THICK, 25 mm. WIDE OR 5 mm. THICK, 30 mm. WIDE, AND 530 mm. LONG COMPLETED WITH THE FOLLOWING ACCESSORIES :
     A. SCREWS 4 mm.DIAMETER AND TERMINAL LUGS AS SHOWN ON THIS DRAWING
     B. SINGLE HOLE TERMINAL LUG SUITABLE FOR BARE COPPER CONDUCTOR NO.4/0 AWG.
     C. STUD BOLT FOR FIXING WITH COPPER GROUND BUS
     D. CABLE GLAND SUITABLE FOR NO.4/0 AWG. BARE COPPER CONDUCTOR
  4. NAMEPLATE INDICATING TYPE OF JUNCTION BOX (AT THE FRONT OF THE BOX).
– THE FOLLOWING ACCESSORIES AND WIRING CONNECTION SHALL BE PROVIDED BY EGAT (FOR SUPPLY EQUIPMENT) OR BY CONTRACTOR (FOR TURN–KEY PROJECT)
  1. NO.4/0 AWG. BARE COPPER CONDUCTOR
  2. RIGID STEEL CONDUIT
  3. ALL SHIELD OF CONTROL CABLE SHALL BE SOLDERED TO 6 Sq.mm. INSULATED COPPER WIRE THEN CONNECTED TO COPPER GROUND BUS.
– THE DETAILS OF CT. JUNCTION BOXES CONSTRUCTION ARE SHOWN ON DWG.NO.TP–E–18.4

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CABINET NO. W1
DRAWING NO. 16.15

BIDDING DRAFT

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
6	–	REARRANGE TERMINAL BLOCKS OF CT6 JUNCTION BOX	P.Sarinya							
5	–	REVISE DETAIL FOR CT4	L.Ekarat							
4	–	REARRANGE TERMINAL BLOCKS OF ALL JUNCTION BOXES,REVISE CT6 AND VOID CT5	M.Chao							
3	–	REVISE NUMBER OF RSC CONDUIT BLOCK–OUT HOLES OF CT7 FROM 6 TO 4 AND REVISE TERMINAL BLOCKS OF CT3	J.jatupum	–	–	–	–	–	–	–
2	–	REVISE DETAIL FOR CT3 AND ADD CT7	S.thinnakorm	–	–	–	–	–	–	–

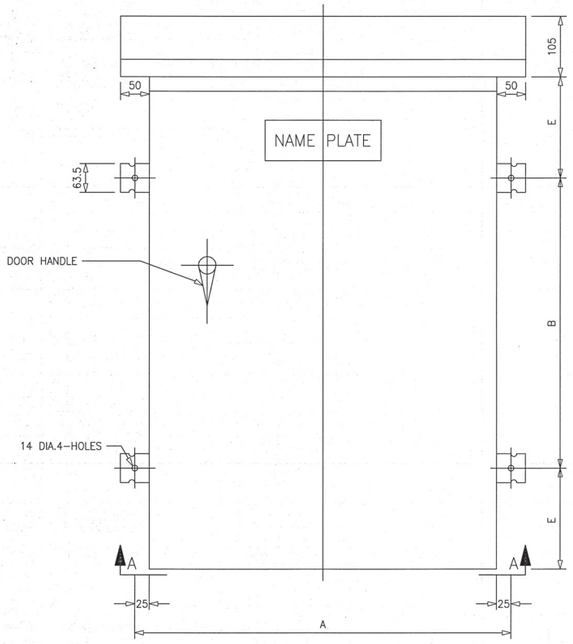
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$Date
$$$$$$$$$$$$Name

ELECTRICITY GENERATING AUTHORITY OF THAILAND

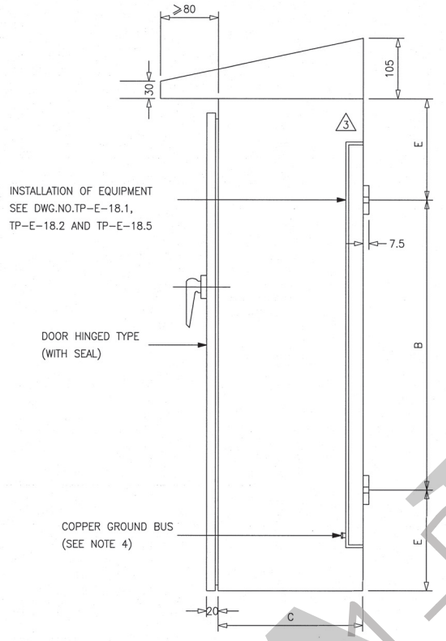
DRAWN	P.Sarinya	VALIDATED CHIEF, CONTROL & PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL CT.JUNCTION BOXS
DESIGNED	P.Sarinya	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: CT.JUNCTION BOX TYPICAL CONSTRUCTION
VERIFIED	H. KANAPOT	CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED	ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT	DATE 3/5/19	

JOB NO.	REPLACING DWG.NO.	DWG.NO.	REV.
–		TP – E – 18.2	– / 6

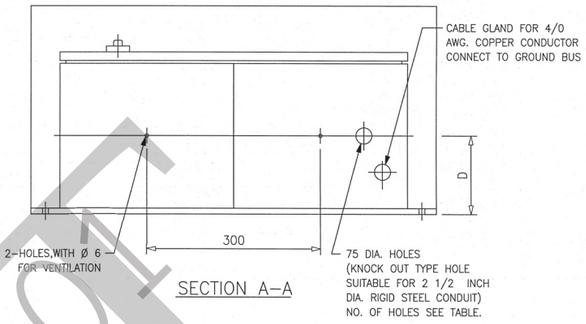
REV.	DWG.NO.
–	TP-E-18.4
–	11



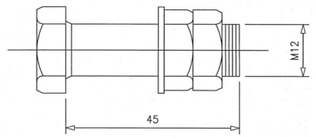
FRONT VIEW



SIDE VIEW



SECTION A–A



FIXING BOLT FOR JUNCTION BOXES
STAINLESS STEEL
4 PCS. FOR 1 SET

SIZE & DIMENSION OF JUNCTION BOXES

TYPE OF JUNCTION BOX	SYMBOL & DIMENSIONS IN MILLIMETERS					NUMBER OF HOLES (KNOCK OUT TYPE)	REFERENCE DWG.	
	A	B	C	D	E		DWG.NO.	SHEET
PT1	1100	900	250	125	150	6	TP-E-18.1	1
PT3	650	500	250	125	150	3	TP-E-18.1	1
PT4	450	500	250	125	150	2	TP-E-18.1	2
PT5	650	500	250	125	150	3	TP-E-18.1	2
PT6	650	500	250	125	150	3	TP-E-18.1	2
PT7	850	600	250	125	150	6	TP-E-18.5	1
PT8	450	500	250	125	150	2	TP-E-18.5	1
PT9	750	500	250	125	150	3	TP-E-18.1	2
PT11	650	500	250	125	150	3	TP-E-18.1	2
PT13	450	500	250	125	150	2	TP-E-18.1	4
PT14	850	600	250	125	150	6	TP-E-18.1	4
PT15	450	500	250	125	150	2	TP-E-18.1	4

SIZE & DIMENSION OF JUNCTION BOXES

TYPE OF JUNCTION BOX	SYMBOL & DIMENSIONS IN MILLIMETERS					NUMBER OF HOLES (KNOCK OUT TYPE)	REFERENCE DWG.NO.
	A	B	C	D	E		
CT1	850	300	250	125	150	6	TP-E-18.2
CT2	450	300	250	125	150	3	TP-E-18.2
CT3	450	300	250	125	150	3	TP-E-18.2
CT4	850	300	250	125	150	6	TP-E-18.2
CT6	1000	700	250	125	150	12	TP-E-18.2
CT7	650	300	250	125	150	4	TP-E-18.2

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DRAFT
Bid NOBBA-DSS-01

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETER.
2. THE DEGREE OF PROTECTION SHALL BE IP43 AS PER IEC 60529.
3. MATERIAL – STAINLESS STEEL SHEET WITH 2 mm THICK AND PAINT FINISHED AFTER FABRICATION AS INDICATED IN SPECIFICATION
4. THE COPPER GROUND BUS SIZE SHALL BE 6 mm THICK, 25 mm WIDTH AND THE LENGTH SHALL BE NOT LESS THAN 40 PERCENT OF DIMENSION "A" OF EACH JUNCTION BOX.
5. THE DIMENSION OF JUNCTION BOX SHALL BE AS SHOWN IN THE TABLE HERE IN. HOWEVER THE DIMENSION "B" MAY BE ADJUSTED TO SUIT THE SIZE OF TERMINAL BLOCK PROVIDED.

REFERENCE DRAWINGS

TYPICAL PT & CCVT JUNCTION BOXES.....DWG.NO.TP-E-18.1 SHEET 1, 2 & 4, TP-E-18.5 SHEET 1

TYPICAL CT JUNCTION BOXES.....DWG.NO.TP-E-18.2

CABINET NO W1
RUN NO 4030

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
11	–	ADD PT14 & PT15, REMOVE PT10 & PT12 AND REVISE PT4	P. Rakneung	–	–	–	–	–	–	–
10	–	REVISE TO CONFORM WITH CONTROL AND PROTECTION'S STANDARD 2015	R.RUHARN	–	–	–	–	–	–	–
9	–	REVISE ALL DIMENSIONS OF JUNCTION BOXES, ADD PT6	S.Jirapa	–	–	–	–	–	–	–
8	–	REVISE ALL DIMENSIONS OF JUNCTION BOXES AND ADD PT12	J.Surapong	–	–	–	–	–	–	–

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$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$Date

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN P. RAKNEUNG	VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED P. RAKNEUNG	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	PT AND CT JUNCTION BOX TYPICAL CONSTRUCTION
VERIFIED	CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		
APPROVED ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT	DATE 28 June 2021	JOB NO. –	REPLACING DWG.NO. TP-E-18.4 REV.10 / DWG.NO. TP-E-18.4 / REV. – 11

DWG.NO.	REV.
TP-E-20.2	1
	2
	–

BAY CONTROL UNIT (BCU)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Switch controller (Name: CSWI)
Interlocking (Name: CILO)
Generic process I/O (Name: GGIO)
Circuit breaker (Name: XCBR)
Circuit switch (Name: XSWI)
Protection scheme (Name: PSCH) *see note1
Metering (Name: MMTR)
Measurement (Name: MMXU)
Breaker failure (Name: RBRF) *see note2
Auto-reclosing (Name: RREC) *see note2
Synchronism-check (Name: RSYN) *see note2

TRANSFORMER PROTECTION (87K)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Differential (Name: PDIF)
Harmonic restraint (Name: PHAR)
Time overcurrent (Name: PTOC)
Instantaneous overcurrent (Name: PIOC)
Protection trip conditioning (Name: PTRC)
Volts per Hz (Name: PVPH)
Thermal overload (Name: PTTR)
Instantaneous overcurrent (Name: PIOC)
Disturbance recorder function (Name: RDRE)

DIRECTION EARTH FAULT RELAY (67N)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH) *see note3
Instantaneous overcurrent (Name: PIOC)
Time overcurrent (Name: PTOC)
Sensitive directional earthfault (Name: PSDE)
Teleprotection communication interfaces (Name: ITPC)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

RESIDUAL OVERVOLTAGE PROTECTION (59N)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH)
Overvoltage (Name: PTOV)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

BUS BAR PROTECTION (87B)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Differential (Name: PDIF)
Time overcurrent (Name: PTOC)
Protection trip conditioning (Name: PTRC)
Overvoltage (Name: PTOV)
Undervoltage (Name: PTUV)
Overfrequency (Name: PTOF)
Underfrequency (Name: PTUF)
Disturbance recorder function (Name: RDRE)

LINE DIFFERENTIAL PROTECTION (87L)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Differential (Name: PDIF)
Distance (Name: PDIS)
Protection scheme (Name: PSCH) *see note3
Instantaneous overcurrent (Name: PIOC)
Time overcurrent (Name: PTOC)
Sensitive directional earthfault (Name: PSDE)
Teleprotection communication interfaces (Name: ITPC)
Power swing detection/blocking (Name: RPSB)
Switch onto fault (Name: ----)
Protection trip conditioning (Name: PTRC)
Fault locator (Name: RFLO)
Disturbance recorder function (Name: RDRE)

DIRECTIONAL AND NON-DIRECTIONAL PHASE OVERCURRENT RELAY (67/67N, 51/51G, 51T/51TG, 51C/51CG)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH)
Instantaneous overcurrent (Name: PIOC)
Time overcurrent (Name: PTOC)
Directional comparison (Name: PDIR)
Sensitive directional earthfault (Name: PSDE)
Teleprotection communication interfaces (Name: ITPC)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

CURRENT UNBALANCE RELAY FOR CAPACITOR BANK PROTECTION (60C)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH)
Instantaneous overcurrent (Name: PIOC)
Current Unbalance (Name: ---)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

CT CIRCUIT SUPERVISION (95B)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Overvoltage (Name: PTOV)

DISTANCE PROTECTION (21P, 21BU)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Distance (Name: PDIS)
Protection scheme (Name: PSCH) *see note3
Instantaneous overcurrent (Name: PIOC)
Time overcurrent (Name: PTOC)
Sensitive directional earthfault (Name: PSDE)
Teleprotection communication interfaces (Name: ITPC)
Power swing detection/blocking (Name: RPSB)
Switch Onto Fault (Name: ----)
Protection trip conditioning (Name: PTRC)
Fault locator (Name: RFLO)
Disturbance recorder function (Name: RDRE)

OVERCURRENT GROUND BACKUP PROTECTION (51GB1, 51GB2)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH)
Instantaneous overcurrent (Name: PIOC)
Time overcurrent (Name: PTOC)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

VOLTAGE UNBALANCE RELAY FOR CAPACITOR BANK PROTECTION (60CL&60CH)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH)
Overvoltage (Name: PTOV)
Current Unbalance (Name: ---)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

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NOTES
1. THIS LOGICAL NODE USE FOR DIRECT TRANSFER TRIP & LOCKOUT AND OTHER
2. THIS LOGICAL NODE COULD BE LOCATED IN A DEDICATE IED
3. THIS LOGICAL NODE USED FOR WEI, SOTF AND OTHERS

CABINET NO W1
RUN NO 1625

BIDDING DRAFT

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
–	–	–	–	–	–	–	–	–	–	–

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$Name

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN S.KANATHIP	VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED S.KANATHIP	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	DIGITAL SUBSTATION SYSTEM LOGICAL NODES
VERIFIED	CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		
APPROVED ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT	DATE 22/10/19	JOB NO. –	REPLACING DWG.NO. –

DWG.NO. TP-E-20.2 REV. 1 2

DWG.NO.	TP-E-20.2
REV.	2
	–

OVERVOLTAGE RELAY FOR CAPACITOR BANK PROTECTION (59C)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH)
Overvoltage (Name: PTOV)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

SYNCHRO-CHECK RELAY (25)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Synchronism-check (Name: RSYN)
Overvoltage (Name: PTOV)
Undervoltage (Name: PTUV)

BREAKER FAILURE RELAY (50BF)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Breaker failure (Name: RBRF)
Protection scheme (Name: PSCH)
Teleprotection communication interfaces (Name: ITPC)

UNDERVOLTAGE RELAY FOR CAPACITOR BANK PROTECTION (27C)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Protection scheme (Name: PSCH)
Undervoltage (Name: PTUV)
Protection trip conditioning (Name: PTRC)
Disturbance recorder function (Name: RDRE)

UNDER-FREQUENCY RELAY (81U)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Underfrequency (Name: PTUF)
Protection scheme (Name: PSCH)

AUTOMATIC VOLTAGE TRANSFER RELAYS (27VTS)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Undervoltage (Name: PTUV)

AUTOMATIC RECLOSING RELAY (79)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Autoreclosing (Name: RREC)

GENERATOR/LOAD SHEDDING UNDERVOLTAGE RELAY (27SD)
Logical node zero (Name: LLN0)
Physical device information (Name: LPHD)
Generic process I/O (Name: GGIO)
Measurement (Name: MMXU)
Undervoltage (Name: PTUV)
Protection scheme (Name: PSCH)

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NOTES
1. THIS LOGICAL NODE USE FOR DIRECT TRANSFER TRIP & LOCKOUT AND OTHER
2. THIS LOGICAL NODE COULD BE LOCATED IN A DEDICATE IED
3. THIS LOGICAL NODE USED FOR WEI, SOTF AND OTHERS

CABINET NO. W1
RUN NO. 168.6

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
–	–	–	–	–	–	–	–	–	–	–

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$$None

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	S.KANATHIP	VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	S.KANATHIP	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: DIGITAL SUBSTATION SYSTEM LOGICAL NODES
VERIFIED		CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED		DATE 22/10/19 ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT	JOB NO. – / REPLACING DWG.NO. – / DWG.NO. TP-E-20.2 / REV. 2 –

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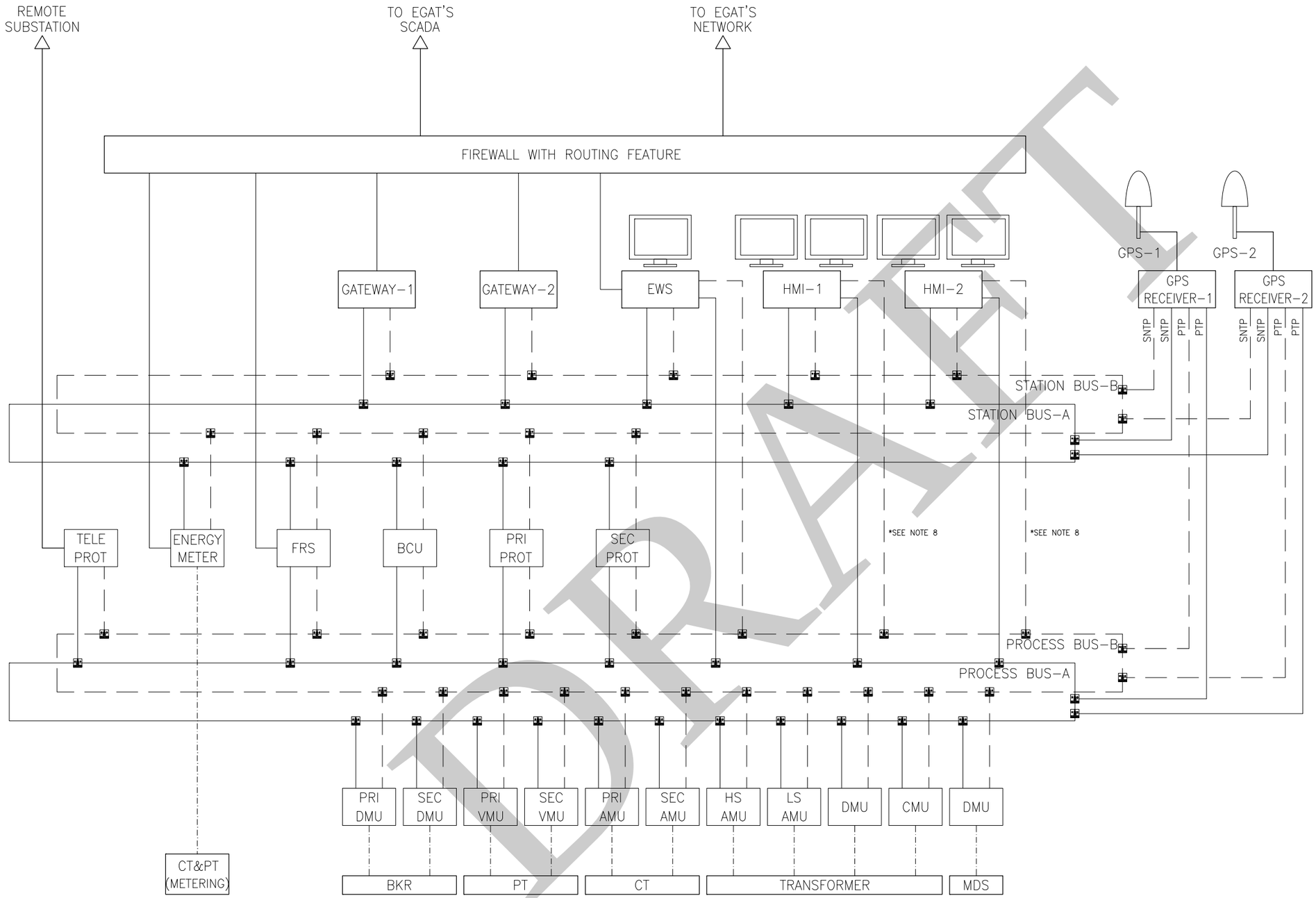
DWG.NO.	REV.
TP-E-20.3	1 2 4



LEGEND	DESCRIPTION
HMI	HUMAN MACHINE INTERFACE
EWS	ENGINEERING WORKSTATION
SNTP	SIMPLE NETWORK TIME PROTOCOL
PTP	PRECISION TIME PROTOCOL
RSTP	RAPID SPANNING TREE PROTOCOL
PRP	PARALLEL REDUNDANCY PROTOCOL
BCU	BAY CONTROL UNIT
PRI	PRIMARY
SEC	SECONDARY
PROT	PROTECTION
FRS	FAULT RECORDING SYSTEM
GPS	GLOBAL POSITIONING SYSTEM
ECP	EMERGENCY CONTROL PANEL
DMU	DIGITAL MERGING UNIT
AMU	CURRENT MERGING UNIT
VMU	VOLTAGE MERGING UNIT
CMU	CONDITION MONITORING UNIT
HS	HIGH SIDE
LS	LOW SIDE
BKR	POWER CIRCUIT BREAKER
MDS	MOTOR-OPERATED DISCONNECTING SWITCH
Tx	TRANSFORMER
OLTC	ON LOAD TAP CHANGER
CT	CURRENT TRANSFORMER
PT	POTENTIAL TRANSFORMER
■■	PORT OF ETHERNET SWITCH
———	LAN A (OPTICAL FIBER CABLE)
- - -	LAN B (OPTICAL FIBER CABLE)
-·-·-	COPPER WIRE
———	REMOTE ACCESS

NOTES

1. RSTP/MRP IS APPLIED FOR ETHERNET SWITCH NETWORK
2. PRP IS APPLIED FOR CONNECTION OF IEDs
3. ETHENET SWITCH SHALL SUPPORT PTP CONFORMING TO IEC/IEEE 61850-9-3
4. STATION BUS SHALL SUPPORT THE COMMUNICATION AS DESCRIBED IN IEC 61850-8-1
5. PROCESS BUS SHALL SUPPORT THE COMMUNICATION AS DESCRIBED IN IEC 61850-8-1 AND IEC 61850-9-2
6. QUANTITY OF DEVICES IN EACH PANEL SHOWN IN PRICE SCHEDULE REGARDING THE DESIGNED SUBSTATION.
7. DETAILS OF EQUIPMENT ARE DESCRIBED IN SPECIFICATION NOS.1003 AND 1008.
8. PROVIDED FOR MONITORING PROCESS BUS'S ETHERNET SWITCH
9. ALL ETHERNET SWITCHES SHALL SUPPORT MMS REPORT CONFORMING TO IEC 61850-7-2.

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ได้ตรวจสอบแล้ว
ลงชื่อ.....
(นายรุหาญ รุจิธัญธาร)
วันที่..... 29 Jul 2025
กองวิศวกรรมระบบควบคุมและป้องกัน

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
4	–	ADDED NOTE FOR ETHERNET SWITCH	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
3	–	SPECIFY COLOR FOR EACH TYPE OF CABLE	C.KANITHA	C.KANITHA	–	–	–	–	–	–
2	–	ADDED REMOTE ACCESS AND NETWORK MONITORING	C.KANITHA	C.KANITHA	–	–	–	–	–	–
1	–	REVISED NETWORK DIAGRAM	S.KANATHIP	S.KANATTHIP	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–

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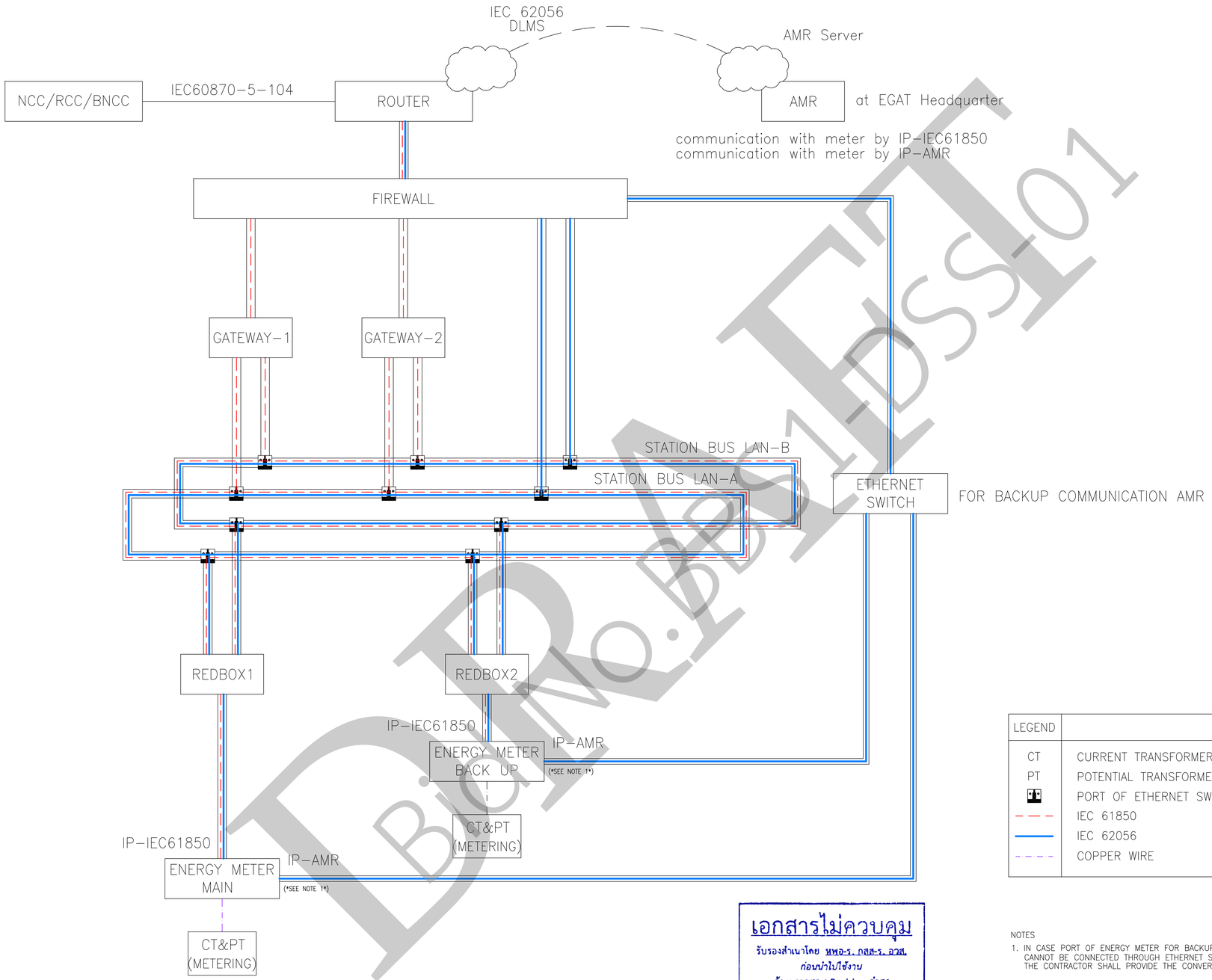
DRAWN C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	DIGITAL SUBSTATION SYSTEM NETWORK TOPOLOGY
VERIFIED			
APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO. / REPLACING DWG.NO. / DWG.NO.	TP-E-20.3
		REV.	1 2 4

DWG.NO.	TP-E-20.3	2	REV.
		2	-



LEGEND	DESCRIPTION
CT	CURRENT TRANSFORMER
PT	POTENTIAL TRANSFORMER
	PORT OF ETHERNET SWITCH
	IEC 61850
	IEC 62056
	COPPER WIRE

NOTES
1. IN CASE PORT OF ENERGY METER FOR BACKUP COMM. AMR CANNOT BE CONNECTED THROUGH ETHERNET SWITCH VIA RJ45 PORT, THE CONTRACTOR SHALL PROVIDE THE CONVERTER.

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	-	S.PHATHARAPON	K.NAPAT	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	S.PHATHARAPON	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	K.NAPAT	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING DIGITAL SUBSTATION SYSTEM METERING TOPOLOGY
VERIFIED	K.NAPAT	APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.3 / REV. 2 -

DWG.NO.	TP-E-20.4	–
REV.	–	2

230 kV AND BELOW BREAKER CONTROL SCHEMATIC DIAGRAM

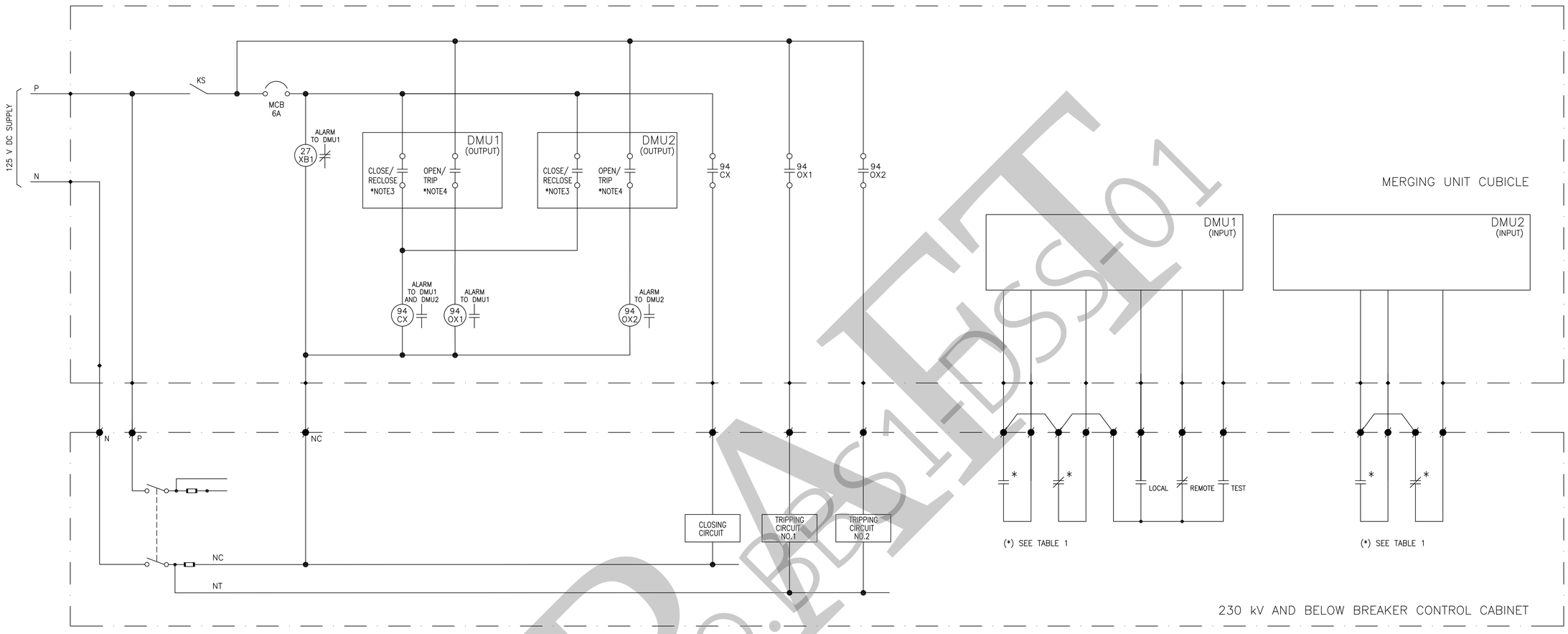

TABLE 1

EQUIPMENT	DESCRIPTION					
DMU1	52a	52b	LOW GAS ALARM	LOW GAS LOCKOUT	SPRING CHARGE FAILURE	SPRING CHARGE MOTOR DC FAILURE
DMU2	52a	52b	LOW GAS LOCKOUT	SPRING CHARGE FAILURE		

NOTES

1. PLEASE REFER TO MANUFACTURER'S DRAWINGS FOR THE ACTUAL CONTROL SCHEMATICS OF CIRCUIT BREAKERS AND OTHER SUBSTATION EQUIPMENT.
2. THE SIZE OF TERMINAL BLOCKS IN MERGING UNIT CABINET FOR DC SUPPLY, CT CIRCUIT, PT CIRCUIT, CONTROL CIRCUIT AND ALARM IS AS DESCRIBED IN SPECIFICATION 1008.
3. INCLUDING 86A BLOCK CLOSE LOGIC CIRCUIT.
4. INCLUDING 86A TRIP LOGIC CIRCUIT.
5. EACH 125 VDC SUPPLY CIRCUIT SHALL BE USED FOR ALL MERGING UNIT CABINETS IN EACH DIAMETER WITH THE SUITABLE RATING MCB OF DPP.
6. 94CX, 940X1 AND 940X2 SHALL BE HIGH BURDEN TYPE.
7. MCB SHALL BE 6A, CURVE K TYPE AND KS SHALL BE 32A.

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LEGEND	DESCRIPTION
MU	MERGING UNIT
AMU	ANALOG MERGING UNIT
DMU	DIGITAL MERGING UNIT
CMU	CONDITION MERGING UNIT
94	AUXILIARY TRIPPING RELAY
27X	DC UNDERVOLTAGE RELAY
KS	KNIFE SWITCH
	MINIATURE CIRCUIT BREAKER

LEGEND :

1. ◇ TERMINAL AT RELAY PANEL
2. ⌀ TERMINAL AT CONTROL PANEL
3. ⌀ TERMINAL AT SWITCHYARD EQUIPMENT
4. ◆ TERMINAL AT MARSHALLING/JUNCTION BOX/MU CABINET (OUTDOOR)
5. ■ TERMINAL AT MASHALLING PANEL (INDOOR)
6. □ TERMINAL AT TRANSDUCER PANEL
7. ⌀ TERMINAL AT INTERPOSING RELAY PANEL
8. ○ TERMINAL AT RTU PANEL
9. ⊠ KNIFE SWITCH TERMINAL

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
2	–	REMOVED DETAILS OF 125 VDC DISTRIBUTION BOARD–MERGING UNIT CABINET SCHEMATIC DIAGRAM	C.KANITHA	C.KANITHA	–	–	–	–	–	–
1	–	REVISED CLOSING & TRIPPING SCHEME AND REMOVED ECP	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–
–	–	–	S.KANATHIP	S.KANATHIP	–	–	–	–	–	–

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION–1	DESCRIPTION OF DETAIL DRAWING DIGITAL SUBSTATION SYSTEM (AIS) 230 kV AND BELOW BREAKER CONTROL SCHEMATIC DIAGRAM
VERIFIED	S.RAPAT		
APPROVED	DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568	JOB NO. – / REPLACING DWG.NO. – / DWG.NO. TP–E–20.4 / REV. – 2

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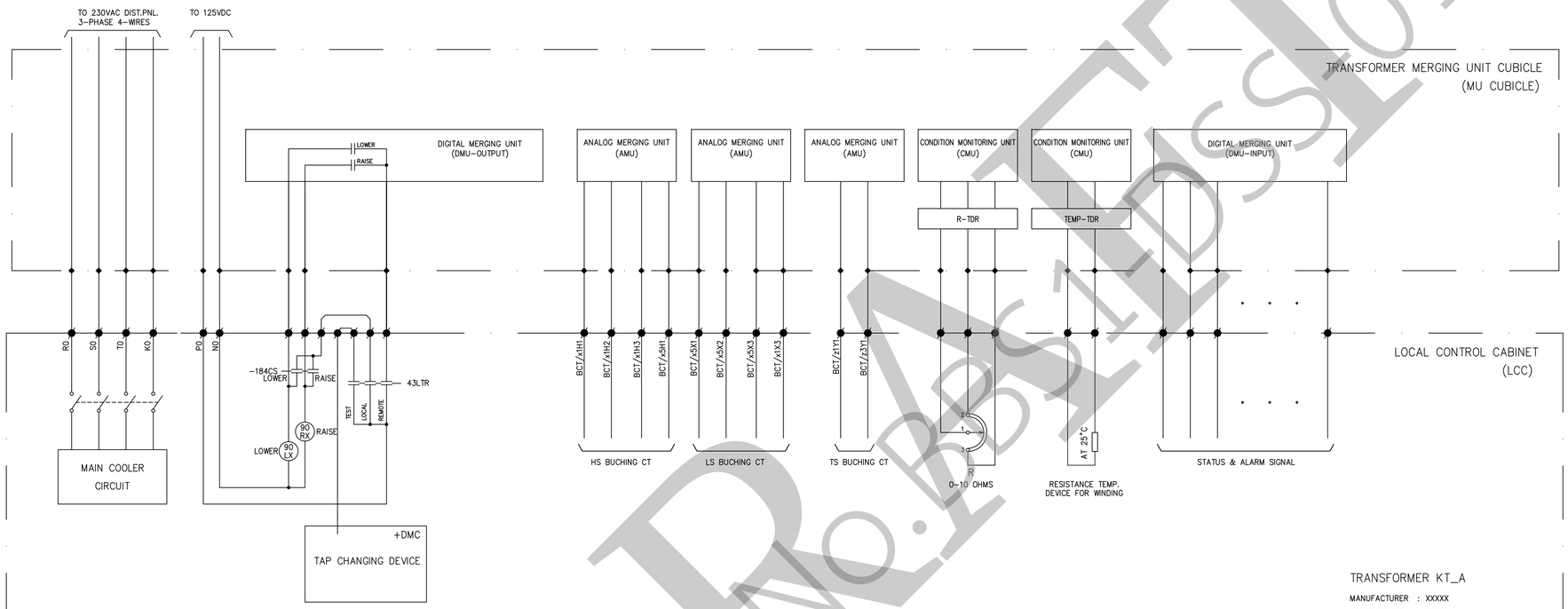

TRANSFORMER KT_A

MANUFACTURER : XXXXX
CONTRACT NO. : XXXXX
REFERENCE DWG. : XXXXX

LIST OF STATUS & ALARM SIGNALS
86A KT_A LOCKOUT RELAY STATUS --NO CONTACT
86A KT_A LOCKOUT RELAY STATUS --NC CONTACT
KT_A BUCHHOLZ RELAY ALARM
KT_A WINDING TEMPERATURE ALARM STAGE 1
KT_A WINDING TEMPERATURE ALARM STAGE 2
KT_A RUBBERBAG RUPTURE ALARM
KT_A MAIN TANK OIL LEVEL LOW
KT_A LTC OIL LEVEL LOW
KT_A MAIN TANK OIL LEVEL HI
KT_A LTC OIL LEVEL HI
KT_A LOSS OF AC SUPPLY
KT_A LOSS OF AC CONTROL POWER HEATER & OUTLET
KT_A LTC DRIVE MOTOR BREAKER TRIP
KT_A TAP CHANGE INCOMPLETE
KT_A GROUP 1 FAN MOTOR BREAKER TRIP
KT_A GROUP 2 FAN MOTOR BREAKER TRIP
KT_A GROUP 1 FAN MOTOR OVERLOAD
KT_A GROUP 2 FAN MOTOR OVERLOAD
KT_A BUCHHOLZ RELAY TRIP
KT_A MAIN TANK PRESSURE RELIEF ALARM
KT_A SUDDEN PRESSURE TRIP
KT_A LTC PRESSURE RELAY TRIP
KT_A LTC DRIVE SW. PRESSURE RELIEF ALARM
KT_A MAIN TANK OIL TEMP. HI
KT_A LOSS OF DC SUPPLY
KT_A LOSS OF DC CONTROL POWER
KT_A OVERCURRENT DURING TAP CHANGE
KT_A PHASE TAP DISCREPANCY
KT_A PARALLEL TAP DISCREPANCY
KT_A SELECTOR SW LTR POSITION -LOCAL
KT_A SELECTOR SW LTR POSITION -TEST
KT_A SELECTOR SW LTR POSITION -REMOTE
...
ETC.

LEGEND :
1. ◇ TERMINAL AT RELAY PANEL
2. ⌀ TERMINAL AT CONTROL PANEL
3. ◪ TERMINAL AT SWITCHYARD EQUIPMENT
4. ◆ TERMINAL AT MARSHALLING/JUNCTION BOX (OUTDOOR)
5. ■ TERMINAL AT MASHALLING PANEL (INDOOR)
6. □ TERMINAL AT TRANSDUCER PANEL
7. ⌀ TERMINAL AT INTERPOSING RELAY PANEL
8. ○ TERMINAL AT RTU PANEL
9. ⊠ KNIFE SWITCH TERMINAL

NOTES

1. THE SIZE OF TERMINAL BLOCKS IN MERGING UNIT PANEL FOR DC SUPPLY, CT CIRCUIT, PT CIRCUIT, CONTROL CIRCUIT AND ALARM IS AS DESCRIBED IN SPECIFICATION 1008.
2. TERMINAL BLOCKS FOR AC SUPPLY IN MERGING UNIT PANEL SHALL BE SUITABLE FOR TERMINAL LUG FOR COPPER CABLE SIZE UP TO 1x25 sq.mm.

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1	–	ADDED TRANSFORMER TAP POSITION TRANSDUCER AND TEMPERATURE TRANSDUCER	C.KANITHA	C.KANITHA	–	–	–	–	–	–
–	–	–	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–

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DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	
VERIFIED	SIRAPAT	CONCURRED	DESCRIPTION OF DETAIL DRAWING: DIGITAL SUBSTATION SYSTEM 115/22 kV TRANSFORMER OPERATION SCHEMATIC DIAGRAM
APPROVED		ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	
		DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568.

JOB NO.	REPLACING DWG.NO.	DWG.NO.	REV.
		TP-E-20.5	1
			5
			1

DWG.NO.	REV.
TP-E-20.5	2
	5
	-

MERGING UNIT CUBICLE2

LOWER — RAISE — DMU1 (OUTPUT)

MERGING UNIT CUBICLE1

LOWER — RAISE — DMU1 (OUTPUT)

TO 125 VDC SUPPLY FOR PARALLEL TAP CHECK

SEE SHEET 1

MCB1

43SP

IND M234 M234 M234

M123 M124 M134 M1234

TO DMU 27 XT

MARSHALLING CUBICLE FOR TRANSF.(KT1A)

MARSHALLING CUBICLE FOR TRANSF.(KT2A)

TAP CHECK (33PT)

43LTR-1

TEST — LOCAL — REMOTE

184CS-1 LOWER — RAISE

184CS-2 LOWER — RAISE

LOWER 90 LX — 90 RX RAISE

(+)

(-)

NO. 1 2 3 4

33P

33 PX

33 PT

90 LX 90 RX

PB — LOWER RAISE

DMC-DRIVING MOTOR CABINET KT1A

DMC-DRIVING MOTOR CABINET KT2A

0-10 OHMS R

RESISTANCE TEMP. DEVICE FOR WINDING AT 25 ℃

TCC-TRANSFORMER CONTROL CUBUCLE (KT1A)

TCC-TRANSFORMER CONTROL CUBUCLE (KT2A)

HS BUCHING CT — LS BUCHING CT — TS BUCHING CT

TRANSF.KT1A CUBICLE FOR MARSHALLING

TRANSF.KT2A CUBICLE FOR MARSHALLING

RTU

R-TDR

TEMP-TDR

380 VAC, 50 Hz. AC SUPPLY 3ø 4 W

125 VDC DC SUPPLY

ANALOG MERGING UNIT (AMU)

CONDITION MONITORING UNIT (CMU)

MERGING UNIT CUBICLE1

MERGING UNIT CUBICLE2

REMARK : THE DESIGN ON THIS DRAWING IS ONLY A GUIDELINE.

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-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED — CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED — ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: TYPICAL DIGITAL SUBSTATION SCHEMATIC DIAGRAM FOR FOUR-TRANSFORMER PARALLEL OPERATION
VERIFIED	SIRAPAT		
APPROVED	DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.5 / REV. 2, 5

DWG.NO.	REV.
TP-E-20.5	3
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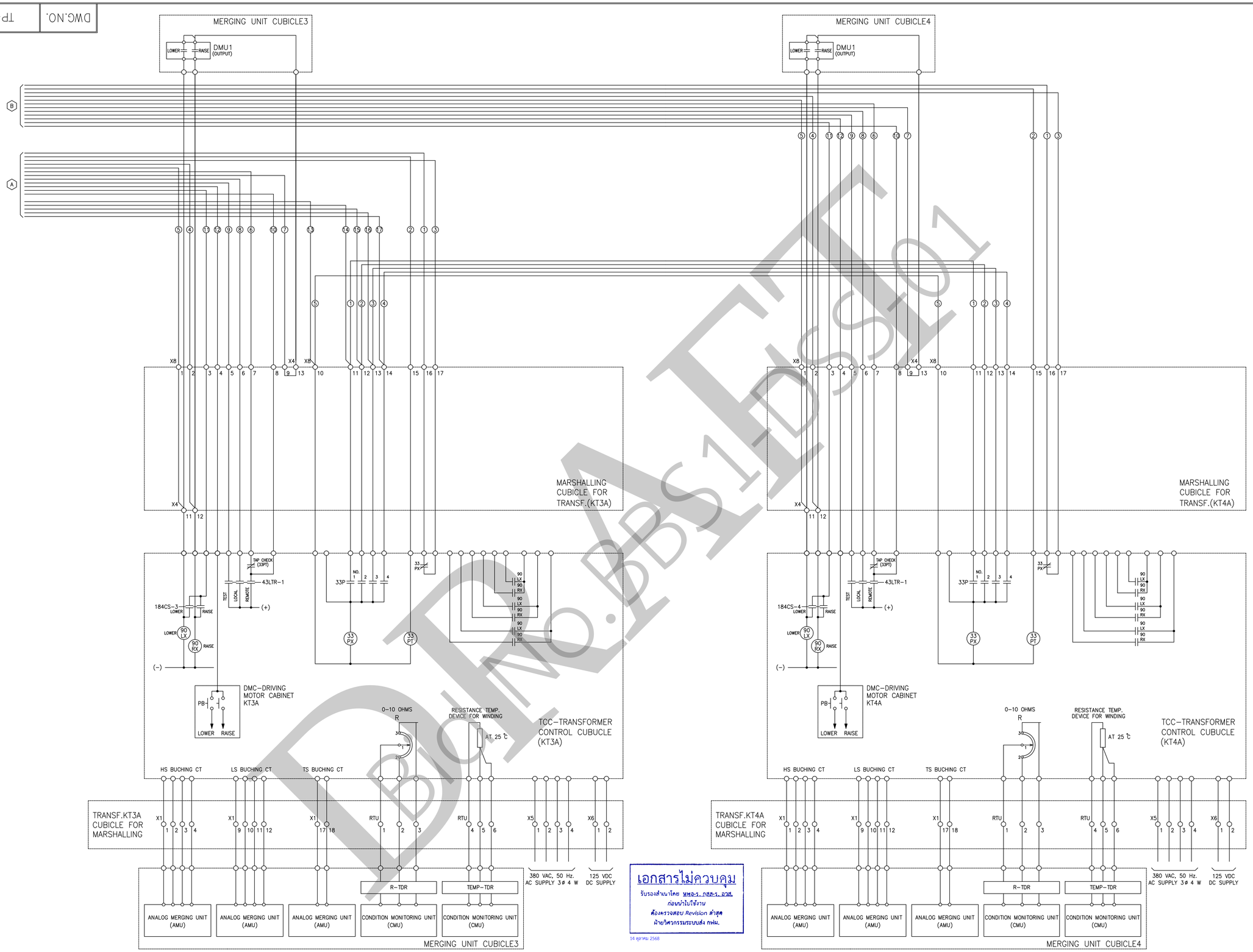

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–	–	–	C.KANITHA	C.KANITHA	–	–	–	–	–	–

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED	DRAWING NAME
DESIGNED	C.KANITHA	CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	TYPICAL DRAWING
VERIFIED	S.TRAPAT	CONCURRED	DESCRIPTION OF DETAIL DRAWING
APPROVED		ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION–1	TYPICAL DIGITAL SUBSTATION SCHEMATIC DIAGRAM FOR FOUR–TRANSFORMER PARALLEL OPERATION
		DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE 23/3/2568.	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP–E–20.5 / REV. 3, 5

DWG.NO. TP - E - 20.5

REV. 4 5 - 1

*SEE NOTE 2 THIS DWG SH.5

*SEE NOTE 6 THIS DWG SH.5

TERMINAL X1			PRIMARY MERGING UNIT DIGITAL INPUT MODULE (DMU1)	
	+	INDEX	DESCRIPTION	
71		36	KTxA OIL TEMP ALARM	CONTACT35
72				
73		37	KTxA WINDING TEMPERATURE ALARM STAGE1	CONTACT36
74				
75		38	KTxA WINDING TEMPERATURE ALARM STAGE2	CONTACT37
76				
77		39	KTxA TAP DIFF ALARM	CONTACT38
78				
79		40	KTxA TAP DIFF DC FAIL	CONTACT39
80				
81		41	KTxA 43LTR POSITION LOCAL	CONTACT40
82				
83		42	KTxA 43LTR POSITION TEST	CONTACT41
84				
85		43	KTxA 43LTR POSITION REMOTE	CONTACT42
86				
87		44	43SP SELECTOR SW M134	43SP
88				
89		45	43SP SELECTOR SW M124	43SP
90				
91		46	43SP SELECTOR SW M123	43SP
92				
93		47	43SP SELECTOR SW IND	43SP
94				
95		48	43SP SELECTOR SW M1234	43SP
96				
97		49	43SP SELECTOR SW M234	43SP
98				
99		50	PARALLEL CIRCUIT DC FAIL	CONTACT43
100				
101		51	PARALLEL CIRCUIT MCB TRIP	CONTACT44
102				
103		52	43SP SELECTOR SW IND	CONTACT45
104				
105		53	43SP SELECTOR SW PARALLEL	CONTACT46
106				
107		54	43SP SELECTOR SW MASTER1	CONTACT47
108				
109		55	43SP SELECTOR SW MASTER2	CONTACT48
110				
111		56	PROPRIETARY MANUFACTURER'S ALARM A	CONTACT49
112				
113		57	PROPRIETARY MANUFACTURER'S ALARM B	CONTACT50
114				
115		58	PROPRIETARY MANUFACTURER'S ALARM C	CONTACT51
116				
117		59	PROPRIETARY MANUFACTURER'S ALARM D	CONTACT52
118				
119		60	PROPRIETARY MANUFACTURER'S ALARM E	CONTACT53
120				

MP-TX

ได้ตรวจสอบแล้ว
ลงชื่อ.....
(นายรุหาญ รุจิธัญธาร)
วันที่..... 29 Jul 2025
กองวิศวกรรมระบบควบคุมและป้องกัน

TERMINAL X1			PRIMARY MERGING UNIT DIGITAL INPUT MODULE (DMU1)	
	+	INDEX	DESCRIPTION	
1		1	SECONDARY MERGING UNIT FAIL	DMU2
2				DMU2
3		2	STATUS 86A	MP-TX
4				CONTACT1 (86A)
5		3	STATUS 86A	CONTACT2 (86A)
6				
7		4	KTxA AC CONTROL FAIL	CONTACT3
8				
9		5	KTxA AC REGULATING FAIL	CONTACT4
10				
11		6	KTxA AC FAIL	CONTACT5
12				
13		7	KTxA BUCHHOLZ ALARM	CONTACT6
14				
15		8	KTxA BUCHHOLZ TRIP	CONTACT7
16				
17		9	KTxA DC CONTROL FAIL	CONTACT8
18				
19		10	KTxA DC FAIL	CONTACT9
20				
21		11	KTxA DC TRIP CIRCUIT FAIL	CONTACT10
22				
23		12	KTxA DIAPHRAGM RUPTURE	CONTACT11
24				
25		13	KTxA RUBBER BAG RUPTURE	CONTACT12
26				
27		14	KTxA GAS DETECTOR	CONTACT13
28				
29		15	KTxA OFF LTC MISC ALARM	CONTACT14
30				
31		16	KTxA 86A CUTOFF SWITCH	CONTACT15
32				
33		17	KTxA FAN STAGE MCB TRIP	CONTACT16
34				
35		18	KTxA FAN THERMAL STAGE1	CONTACT17
36				
37		19	KTxA FAN THERMAL STAGE2	CONTACT18
38				
39		20	KTxA FAN BREAKER GROUP1	CONTACT19
40				
41		21	KTxA FAN BREAKER GROUP2	CONTACT20
42				
43		22	KTxA FAN THERMAL GROUP1	CONTACT21
44				
45		23	KTxA FAN THERMAL GROUP2	CONTACT22
46				
47		24	KTxA HOT OIL FILTER TROUBLE	CONTACT23
48				
49		25	KTxA HOT OIL FILTER OVER PRESSURE	CONTACT24
50				
51		26	KTxA OLTC OIL LEVEL LOW	CONTACT25
52				
53		27	KTxA OLTC PRESSURE RELIEF DEVICE	CONTACT26
54				
55		28	KTxA OLTC OIL FLOW RELAY TRIP	CONTACT27
56				
57		29	KTxA OLTC DRIVE MOTOR MCB TRIP	CONTACT28
58				
59		30	KTxA OLTC OVERCURRENT DURING TAP CHANGE	CONTACT29
60				
61		31	KTxA OLTC PRESSURE RELAY TRIP	CONTACT30
62				
63		32	KTxA OIL TEMPERATURE HIGH	CONTACT31
64				
65		33	KTxA SUDDEN PRESSURE RELAY ALARM	CONTACT32
66				
67		34	KTxA SUDDEN PRESSURE RELAY TRIP	CONTACT33
68				
69		35	KTxA TAP CHANGE DELAY ALARM	CONTACT34
70				

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	-	IMPROVE ALARM POINT OF TRANSFORMER	S.PHATHARAPON	S.PHATHARAPON	-	-	-	-	-	-
-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

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ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: 230/115 KV TRANSFROMER STATUS AND ALARM DIGITAL SUBSTATION
VERIFIED	.....		
APPROVED	..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.5 / 4 5 / REV. 1

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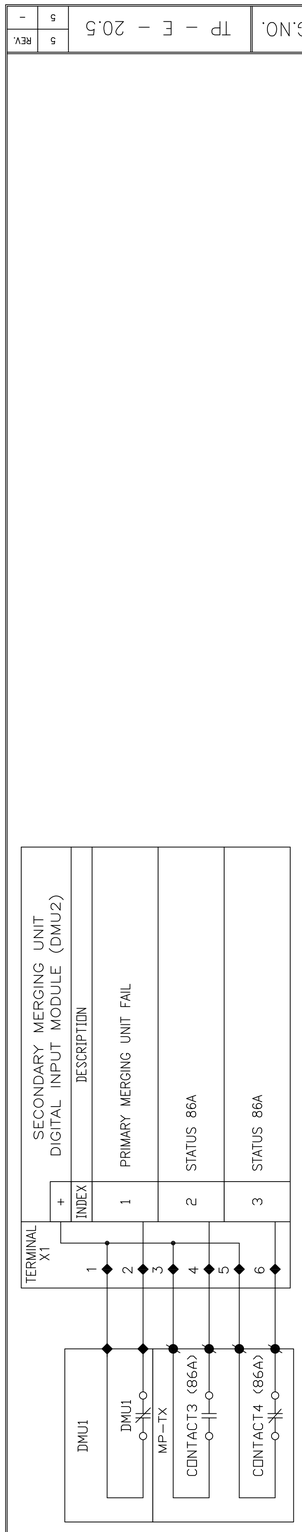
NOTES

1. SCHEMATIC REPRESENTATION IS FOR EACH TRANSFORMER IN NORMAL CONDITION.
2. ALARM CONTACTS REGARDING PARALLEL CIRCUIT ARE REQUIRED ONLY FROM FIRST TRANSFROMER MARSHALLING.
3. EVERY CONTACTS OF 86A(6) AND 86A(b) FOR PROTECTION FUNCTION, INTERLOCKING CIRCUIT, AND FRS SHALL BE PURE CONTACT. EVERY TRANSFORMERS ALARM AND STATUS CONTACTS WHICH CONNECT TO DMU1 AND DMU2 SHALL BE INDIVIDUAL CONTACT EXCEPTED KT4A 43LTR POSITION LOCAL KT1A 43LTR POSITION TEST, AND KT1A 43LTR POSITION REMOTE SHOULD BE COMMON.
5. DMU1 SHALL BE CONNECTED WITH CONTACTS OF PROTECTION, STATUS, ALARM AND FRS. DMU2 SHALL BE CONNECTED WITH CONTACTS OF PROTECTION ONLY.
6. CONTRACTOR SHALL PROVIDE SUFFICIENT QUANTITY OF DMU1'S I/O PORTS FOR PROPRIETARY MANUFACTURER'S ALARM CONTACTS.

LEGEND :

1. ◇ TERMINAL AT RELAY PANEL
2. ⊠ TERMINAL AT CONTROL PANEL
3. ◩ TERMINAL AT SWITCHYARD EQUIPMENT
4. ◆ TERMINAL AT MARSHALLING/JUNCTION BOX/MU CABINET (OUTDOOR)
5. ■ TERMINAL AT MASHALLING PANEL (INDOOR)
6. □ TERMINAL AT TRANSDUCER PANEL
7. ⊗ TERMINAL AT INTERPOSING RELAY PANEL
8. ○ TERMINAL AT RTU PANEL
9. ⊠ KNIFE SWITCH TERMINAL



เอกสารไม่ควบคุม
รับรองสำเนาโดย หพอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

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Bid No.: PBS1-DSS01

DWG.NO.	REV.
TP – E – 20.5	5
	–

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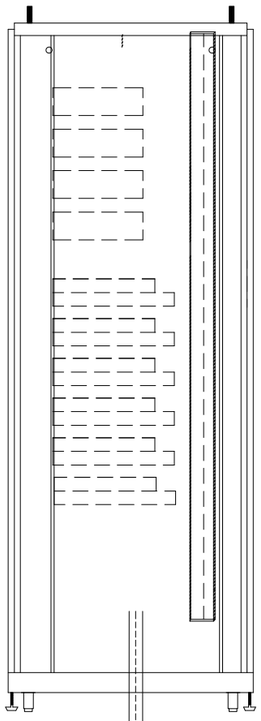
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
–	–	–	C.KANITHA	C.KANITHA	–	–	–	–	–	–

ELECTRICITY GENERATING AUTHORITY OF THAILAND

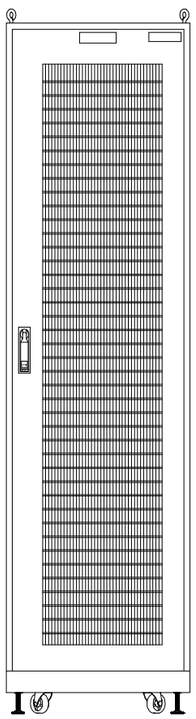
DRAWN C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING	
DESIGNED C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING 230/115 KV TRANSFROMER STATUS AND ALARM DIGITAL SUBSTATION	
VERIFIED S.T.RAPAT			
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568	JOB NO. / REPLACING DWG.NO.	DWG.NO. TP–E–20.5 REV. 5 / –

REV.	DWG.NO.
3	TP-E-20.6
2	
1	

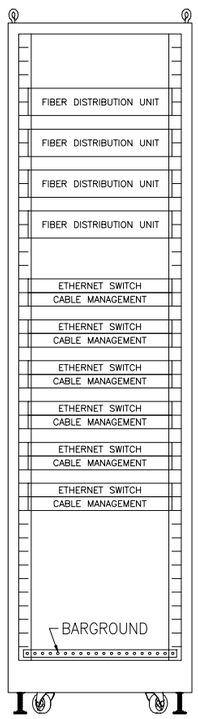
PROCESS BUS ETHERNET SWITCH PANEL



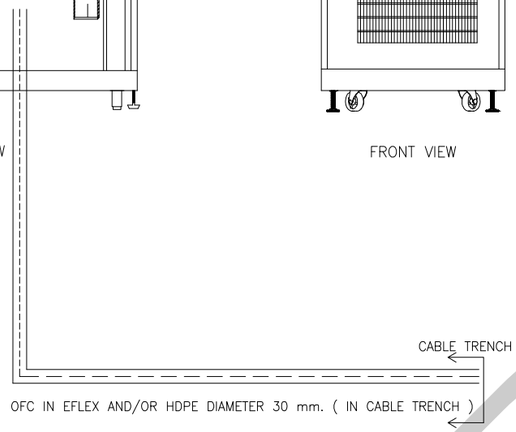
SIDE VIEW



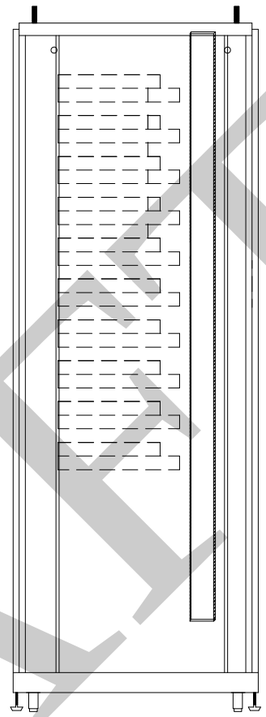
FRONT VIEW



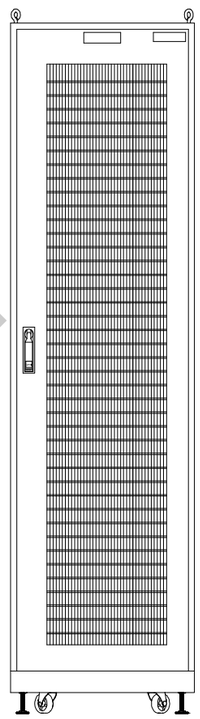
FRONT VIEW WITH OUT DOOR



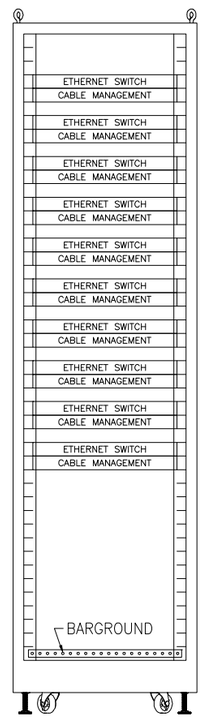
STATION BUS ETHERNET SWITCH PANEL



SIDE VIEW



FRONT VIEW



FRONT VIEW WITH OUT DOOR

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LEGEND

1. ----- OPTICAL FIBER CABLE
2. ═══ EFLEX AND/OR HDPE CONDUIT

NOTES

1. PANEL SHOWN IN THIS DRAWING 19" RACK PANEL AS SHOWN IN DWG. TP-E-10.19
2. ETHERNET SWITCHES AND FIBER DISTRIBUTION UNITS (FDU) SHALL BE PROVIDED SUFFICIENTLY FOR ALL DEVICES IN THE NETWORK.
3. HIGH DENSITY POLYETHYLENE CONDUIT (HDPE) SHALL BE MADE OF HIGH-DENSITY POLYETHYLENE WHICH IS NON-CORROSIVE, FLEXIBLE, AND SUITABLE FOR INSTALLATION IN CABLE TRENCH, ABOVE GROUND OR DIRECT BURIAL.
4. THE EFLEX SHALL BE MADE OF HIGH-DENSITY POLYETHYLENE WITH SPIRAL CORRUGATED PIPE SHAPE WHICH IS HIGHLY CORROSION, WEATHER RESISTANT, FLEXIBLE, MECHANICALLY STRONG AND SUITABLE FOR INSTALLATION IN CABLE TRENCH, ABOVE GROUND OR DIRECT BURIAL.
5. ALL ETHERNET SWITCHE SHALL BE COMPLETELY INSTALLED WITH NETWORK MODULE.
6. ALL ETHERNET SWITCHE PORT SHALL BE FULLY INSTALLED WITH SFP MODULES.
7. AT LEAST 5% OF TOTAL PORTS IN EACH ESW PANEL SHALL BE PROVIDED AS A SPARE PORT.
8. EACH FDU SHALL BE CONTAINED 48 PORTS FOR SPICING AND HEIGHT 2U.

ได้ตรวจสอบแล้ว
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(นายรุหาญ รุจิธัญธาร)
วันที่ 29 Jul 2025
กองวิศวกรรมระบบควบคุมและป้องกัน

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
2	–	ADDITONAL NOTE FOR FDU	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
1	–	ADDITONAL DETAILS AND MODIFY PANEL LAYOUT	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–
–	–	DIGITAL SUBSTATION SYSTEM DETAIL OF PANEL CONSTRUCTION ETHERNET SWITCH PANEL	P.PIYAWAT	K.NAPAT	–	–	–	–	–	–

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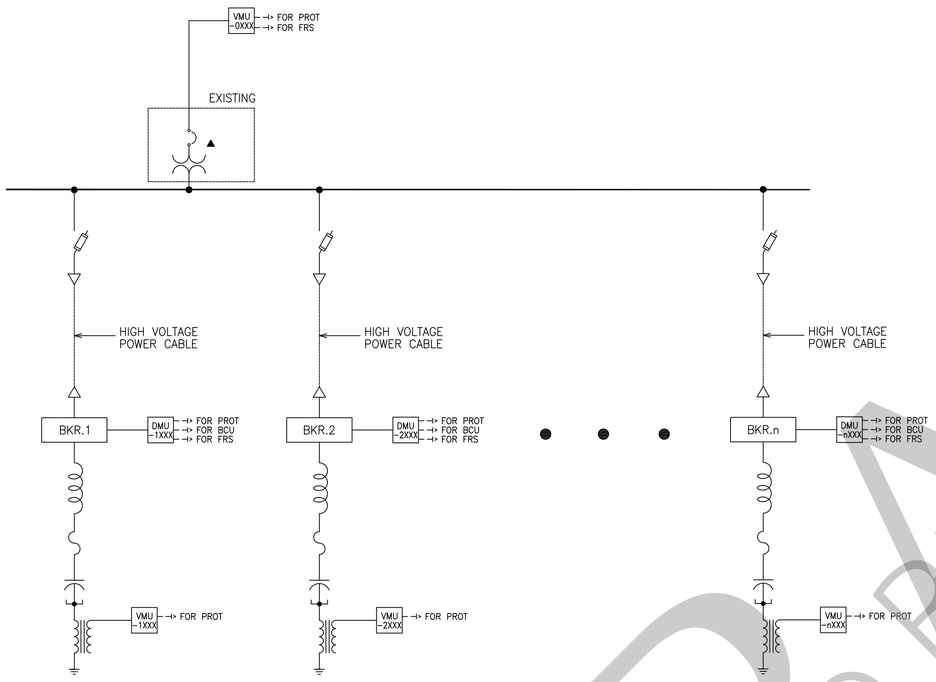
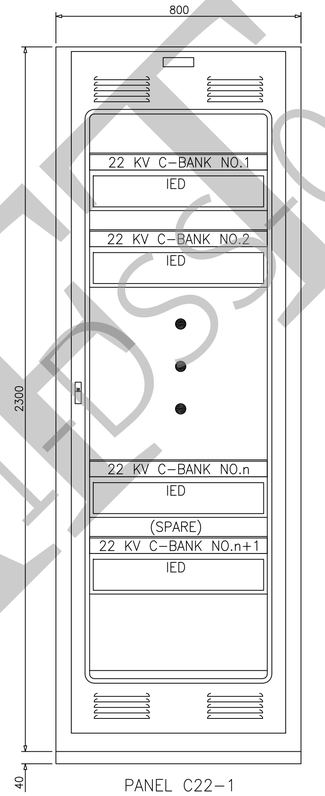
DWG.NO.	TP-E-20.6
REV.	2
	3
	2



SINGLE LINE DIAGRAM



PANEL C22-1
22 kV CAPACITOR BANK
PANEL

NOTES

1. PANELS SHOWN IN THIS DRAWING ARE SWING RACK TYPE SWITCHBOARD AS SHOWN IN DWG.NO. TP-E-20.14
2. QUANTITY OF IEDs INSTALLED IN PANEL SHALL NOT BE MORE THAN SIX(6) IEDs/PANEL.
3. n IS NUMBER OF ACTUAL CAPACITOR BANK IN SUBSTATION.

เอกสารไม่ควบคุม
รับรองสำเนาโดย หผอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

Bid No.PBS1DS01

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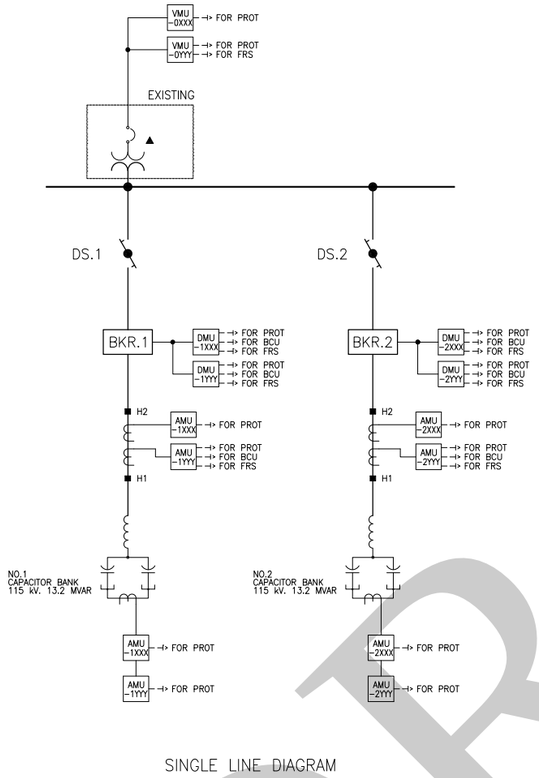
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
2	–	REVISED 22 KV AND 33 KV CAPACITOR BANK CONTROL & PROTECTION DESIGN CRITERIA	C.KANITHA	C.KANITHA	–	–	–	–	–	–
1	–	REVISED 22 KV AND 33 KV CAPACITOR BANK CONTROL & PROTECTION DESIGN CRITERIA	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–
–	–	DIGITAL SUBSTATION SYSTEM DETAIL OF PANEL CONSTRUCTION 22 KV AND 33 KV CAPACITOR BANK SINGLE LINE DIAGRAM	P.PIYAWAT	K.NAPAT	–	–	–	–	–	–

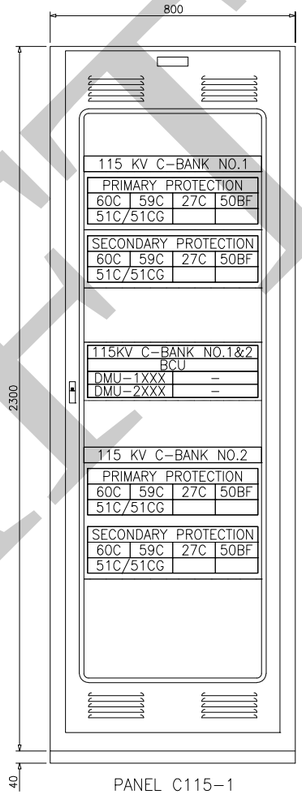
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING DIGITAL SUBSTATION SYSTEM DETAIL OF PANEL CONSTRUCTION 22 KV AND 33 KV CAPACITOR BANK SINGLE LINE DIAGRAM
VERIFIED	S.TRAPAT		
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.6 / REV. 2, 3

DWG.NO.	TP-E-20.6	REV.
		3



SINGLE LINE DIAGRAM



PANEL C115-1
115 kV CAPACITOR BANK
LINE NO.1 & LINE NO.2

NOTES
1. PANELS SHOWN IN THIS DRAWING ARE SWING RACK TYPE SWITCHBOARD AS SHOWN IN DWG.NO. TP-E-20.14

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ลงชื่อ.....
(นายรุหาญ รุจิชัญชาร)
วันที่ 29 Jul 2025
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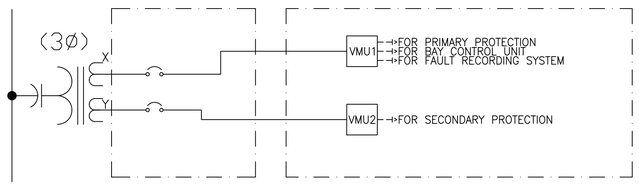
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
3	–	ADDITIONAL SECONDARY MERGING UNIT FOR UNBALANCE CT	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
2	–	REMOVED FUNCTION OF 69 KV AND 115 KV CAPACITOR BANK PROTECTION TABLE	C.KANITHA	C.KANITHA	–	–	–	–	–	–
1	–	REDESIGN DETAIL OF PANEL CONSTRUCTION 69 KV AND 115 KV CAPACITOR BANK BY REMOVED CUTOFF SWITCH OUT	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–
–	–	DIGITAL SUBSTATION SYSTEM DETAIL OF PANEL CONSTRUCTION 69 KV AND 115 KV CAPACITOR BANK SINGLE LINE DIAGRAM	P.PIYAWAT	K.NAPAT	–	–	–	–	–	–

ELECTRICITY GENERATING AUTHORITY OF THAILAND

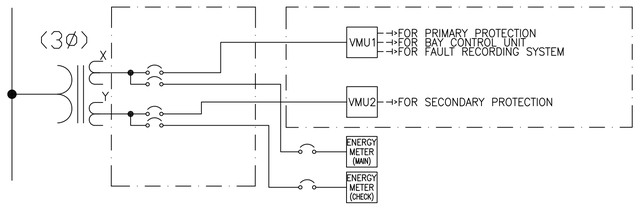
DRAWN C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-2	DESCRIPTION OF DETAIL DRAWING	DIGITAL SUBSTATION SYSTEM DETAIL OF PANEL CONSTRUCTION 69 KV AND 115 KV CAPACITOR BANK SINGLE LINE DIAGRAM
VERIFIED	APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE	JOB NO.	REPLACING DWG.NO. / DWG.NO. TP-E-20.6 / REV. 3 3

PT-D1 MERGING UNIT CUBICLE



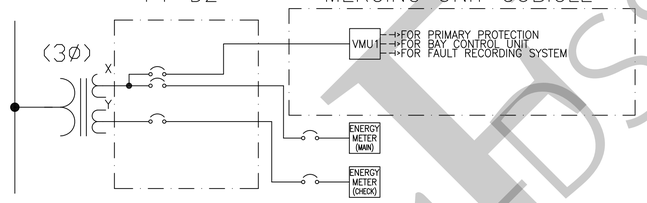
PT BUS AND PT LINE TO EGAT

PT-D2* MERGING UNIT CUBICLE



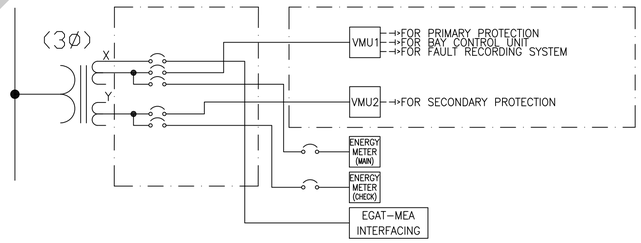
LINE TO PEA AND MEA

PT-D2* MERGING UNIT CUBICLE



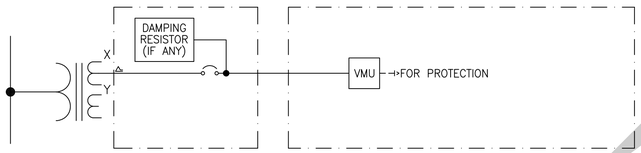
22 kV LOW SIDE TRANSFORMER AND SWITCHGEAR

PT-D2** MERGING UNIT CUBICLE



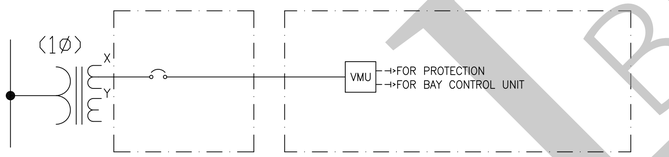
LINE TO MEA (ADJACENT FENCES)

PT-D3 MERGING UNIT CUBICLE



TRANSFORMER TERTIARY WINDING

PT-D4 MERGING UNIT CUBICLE



HIGH SIDE AND LOW SIDE TIE TRANSFORMER

SYMBOL	LEGEND
	MINIATURE CIRCUIT BREAKER
	PT SECONDARY WINDING HALF TAP
	PT SECONDARY WINDING FULL TAP
PT-D1	JUNCTION BOX OF PT BUS (IN MAIN AND TRANSFER BUS, BREAKER AND A HALF BUS, AND DOUBLE BUS SINGLE BREAKER ARRANGEMENT) AND PT LINE TO EGAT
PT-D2	JUNCTION BOX OF INDUCTIVE PT USED FOR 22kV LOW SIDE TRANSFORMER AND SWITCHGEAR, LINE TO PEA AND MEA AND LINE TO MEA (ADJACENT)
PT-D3	JUNCTION BOX OF PT USED FOR TRANSFORMER TERTIARY WINDING
PT-D4	JUNCTION BOX OF PT USED FOR HIGH-SIDED AND LOW SIDE TIE TRANSFORMER

NOTES

1. (*) HALF TAP PT FOR LINE TO PEA AND MEA AND 22kV LOW SIDE TRANSFORMER AND SWITCHGEAR.
2. (**) FULL TAP PT FOR EGAT-MEA INTERFACING
3. IN CASE OF GIS SUBSTATION, CONTRACTOR SHALL SUPPLY ADDITIONAL 2 MCBs FOR SYNCHRONIZATION AND METERING OF LCC.

REFERENCES

1. SPECIFICATION NO.1008

เอกสารไม่ควบคุม
รับรองสำเนาโดย หพอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

DRAFT Bid No.PBS1 ISSUE

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	ADDED JUNCTION BOX OF 230KV LINE TO MEA (ADJACENT FENCES) AND REVISED CRITERIA 22 kV LOW SIDE TRANSFORMER AND SWITCHGEAR JUNCTION BOX.	C.KANITHA	C.KANITHA	–	–	–	–	–	–
–	–	DIGITAL SUBSTATION SYSTEM DETAIL OF PT. & CCVT. JUNCTION BOX	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–

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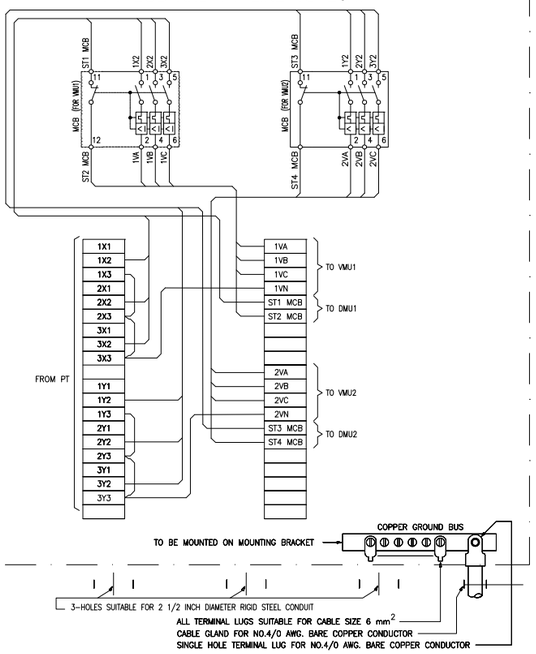
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-2	DESCRIPTION OF DETAIL DRAWING PT. JUNCTION BOX APPLICATIONS FOR DIGITAL SUBSTATION SYSTEM
VERIFIED	S.T.RAPAT		
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.7 / REV. 3 1

REV.	DWG.NO.
2	TP-E-20.7
3	
2	

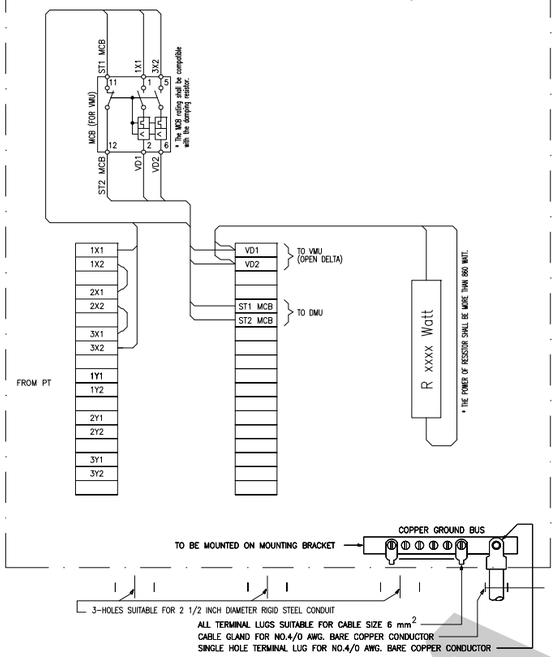
TYPICAL JUNCTION BOX TYPE PT-D1

PT BUS AND PT LINE TO EGAT



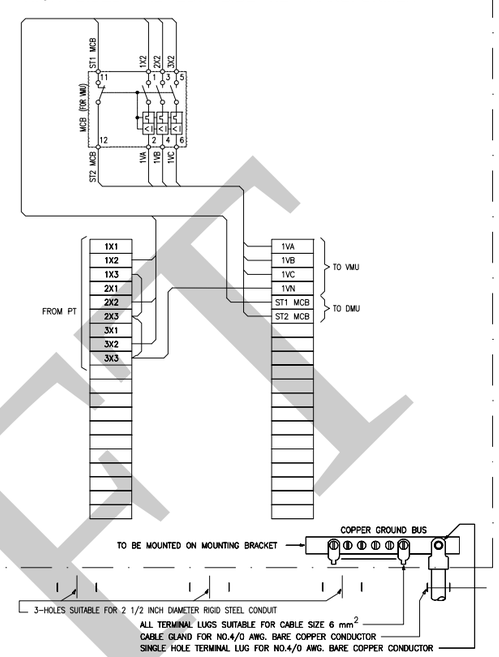
TYPICAL JUNCTION BOX TYPE PT-D3

TRANSFORMER TERTIARY WINDING



TYPICAL JUNCTION BOX TYPE PT-D4

HIGH-SIDED AND LOW SIDE TIE TRANSFORMER

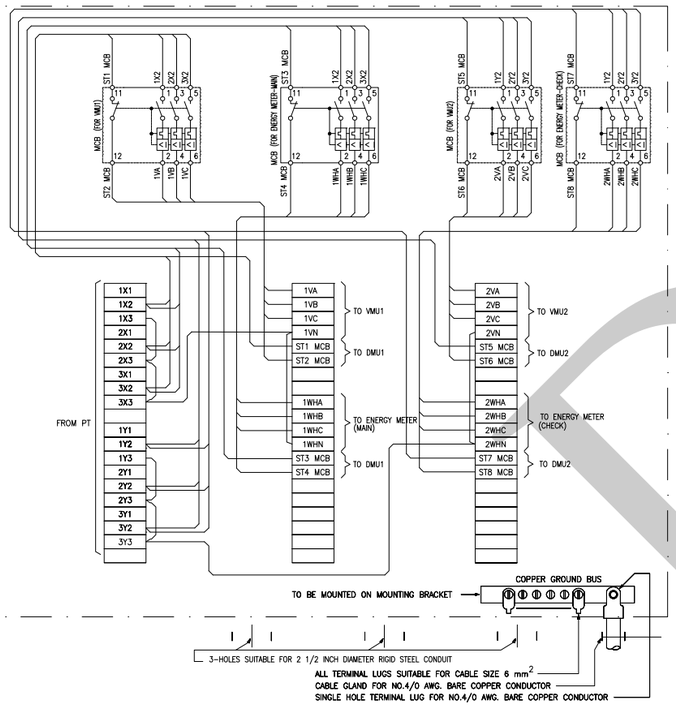


NOTES

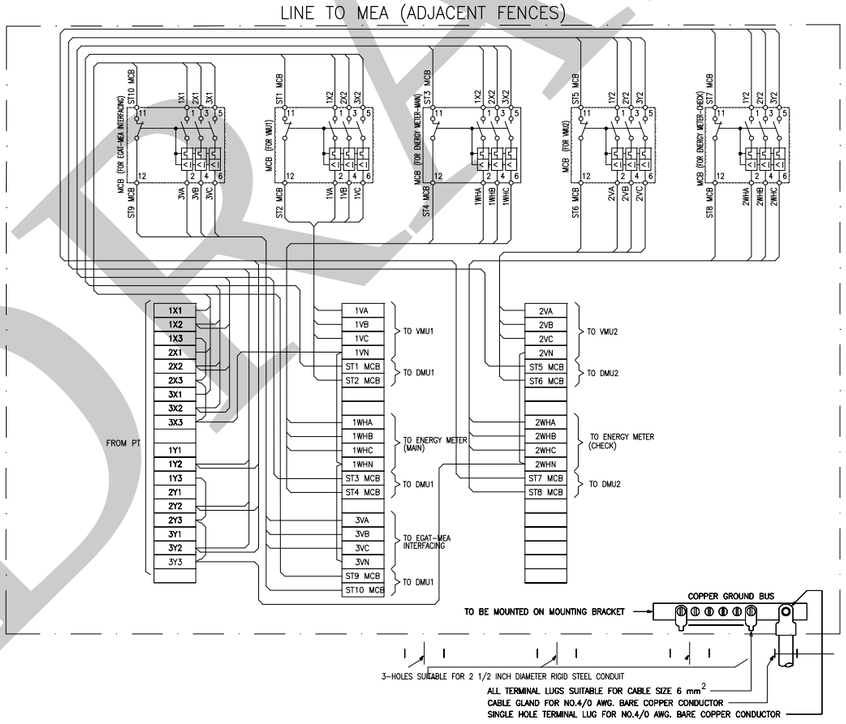
- THE FOLLOWING ACCESSORIES AND WIRING CONNECTION SHALL BE PROVIDED BY THE CONTRACTOR
  1. TERMINAL BLOCKS WITH DESIGNATION LABEL SUITABLE FOR RING TONGUE TYPE TERMINAL LUG FOR COPPER CABLE SIZES UP TO 2x6 Sq.mm.. THESE TERMINAL BLOCKS SHALL BE OF 600 V MOLDED NONFLAMABLE THERMOSETTING MATERIAL TYPE WITH INSULATING BARRIER BETWEEN ADJACENT TERMINALS AND SHALL BE SUITABLE FOR USE IN AN OUTDOOR CUBICLE.
  2. WIRING CONNECTION INDICATED BY SOLID LINE SHALL BE 4 Sq.mm. COPPER CABLE.
  3. COPPER GROUND BUS COMPLETE WITH :-
     A. SCREWS 4 mm. DIAMETER AND TERMINAL LUGS AS SHOWN ON THIS DRAWING
     B. SINGLE HOLE TERMINAL LUG SUITABLE FOR BARE COPPER CONDUCTOR NO.4/0 AWG.
     C. STUD BOLT FOR FIXING WITH COPPER GROUND BUS
     D. CABLE GLAND SUITABLE FOR NO.4/0 AWG. BARE COPPER CONDUCTOR
  4. NAMEPLATE INDICATING TYPE OF JUNCTION BOX (AT THE FRONT OF THE BOX).
  5. MCBS WITH DESIGNATION LABEL SPECIFIED THE DESTINATION EQUIPMENT EX. VMU, METER AND ETC.
- THE FOLLOWING ACCESSORIES AND WIRING CONNECTION SHALL BE PROVIDED BY EGAT (FOR SUPPLY EQUIPMENT) OR BY CONTRACTOR (FOR TURN-KEY PROJECT)
  1. NO.4/0 AWG. BARE COPPER CONDUCTOR
  2. RIGID STEEL CONDUIT
  3. ALL SHIELD OF CONTROL CABLE SHALL BE SOLDERED TO 6 Sq.mm. INSULATED COPPER WIRE, AND THEN CONNECTED TO COPPER GROUND BUS.
- THE DETAILS OF PT. JUNCTION BOX CONSTRUCTION ARE SHOWN ON DWG.NO.TP-E-18.4
- THE MINIATURE CIRCUIT BREAKER SHALL HAVE TRIPPING CHARACTERISTIC C PER IEC 60898, RATED VOLTAGE 400 V.
- WHEN THE MCB IS MANUALLY OPEN, THE "NC" AUXILIARY CONTACTS SHALL BE CLOSED AUTOMATICALLY.
- FOR 0.5 A MCB, THE OPERATING TIME OF THE "21-22" CONTACT SHALL BE LESS THAN 20 ms.
- IN CASE OF GIS SUBSTATION, CONTRACTOR SHALL SUPPLY ADDITIONAL 2 MCBs FOR SYNCHRONIZATION AND METERING OF LCC.

TYPICAL JUNCTION BOX TYPE PT-D2

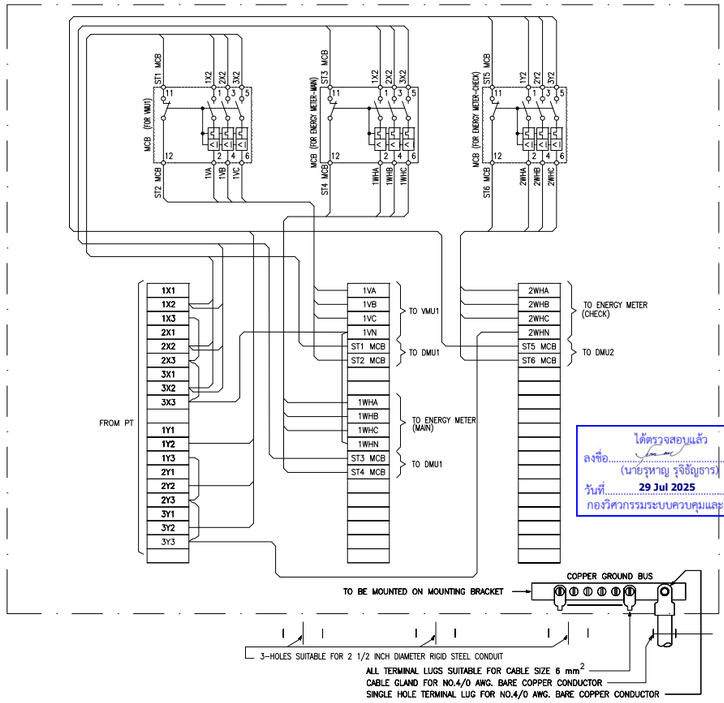
LINE TO PEA AND MEA



LINE TO MEA (ADJACENT FENCES)



22 kV LOW SIDE TRANSFORMER AND SWITCHGEAR



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ลงชื่อ.....
(นายสุพาญ รุจิณัฐธาร)
วันที่..... 29 Jul 2025
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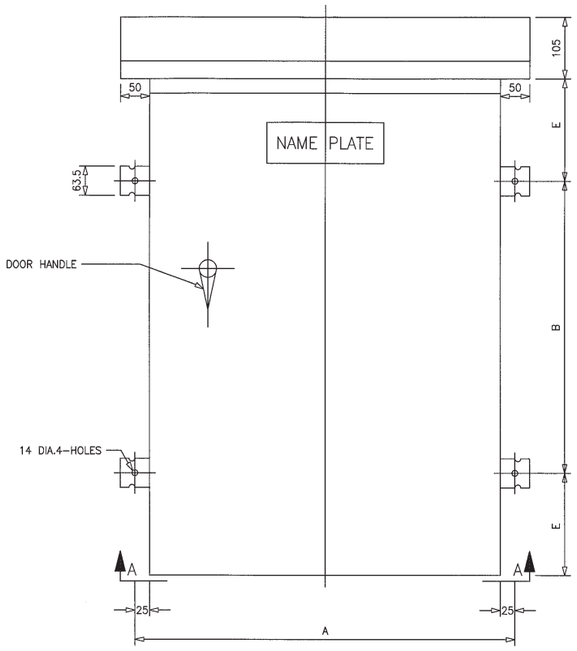
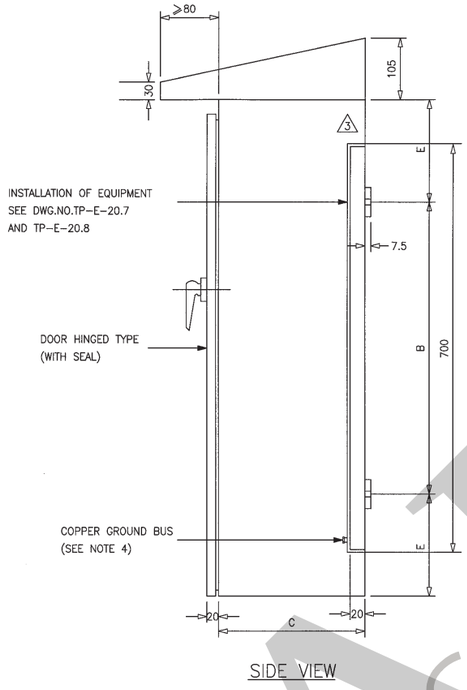
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
2	-	REVISE DESCRIPTION OF DETAIL DRAWING	S.PHATHARAPON	S.PHATHARAPON	-	-	-	-	-	-
1	-	ADDED JUNCTION BOX OF 230KV LINE TO MEA (ADJACENT FENCES) AND REVISED CRITERIA 22 kV LOW SIDE TRANSFORMER AND SWITCHGEAR JUNCTION BOX.	C.KANITHA	C.KANITHA	-	-	-	-	-	-
-	-	DIGITAL SUBSTATION SYSTEM DETAIL OF PT. & CCVT. JUNCTION BOX	P.ACHITAPOL	P.ACHITAPOL	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

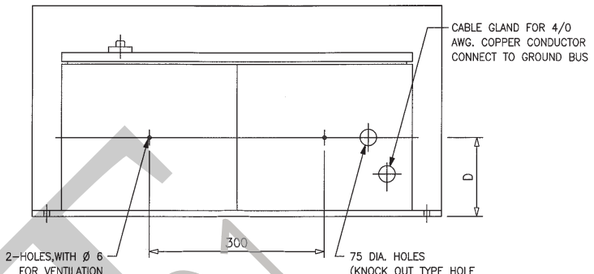
DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-2	DESCRIPTION OF DETAIL DRAWING: PT JUNCTION BOX FOR DIGITAL SUBSTATION SYSTEM TYPE PT-D1, PT-D2, PT-D3 AND PT-D4 LAY-OUT
VERIFIED	.....		
APPROVED	DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.7 / REV. 2, 3



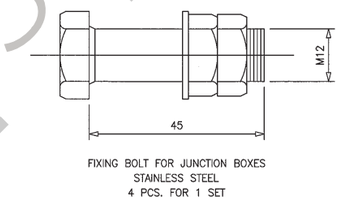
FRONT VIEW



SIDE VIEW



SECTION A–A



FIXING BOLT FOR JUNCTION BOXES
STAINLESS STEEL
4 PCS. FOR 1 SET

SIZE & DIMENSION OF JUNCTION BOXES

TYPE OF JUNCTION BOX	SYMBOL & DIMENSIONS IN MILLIMETERS					NUMBER OF HOLES (KNOCK OUT TYPE)	REFERENCE DWG.	
	A	B	C	D	E		DWG.NO.	SHEET
PT–D1	650	500	250	125	150	3	TP–E–20.7	1
PT–D2	650	500	250	125	150	3	TP–E–20.7	1
PT–D3	650	500	250	125	150	3	TP–E–20.7	1

เอกสารไม่ควบคุม
รับรองสำเนาโดย หหอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

DRAFT Bid No. PBS-01

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETER.
2. THE DEGREE OF PROTECTION SHALL BE IP43 AS PER IEC 60529.
3. MATERIAL – STAINLESS STEEL SHEET WITH 2 mm THICK AND PAINT FINISHED AFTER FABRICATION AS INDICATED IN SPECIFICATION
4. THE COPPER GROUND BUS SIZE SHALL BE 6 mm THICK, 25 mm WIDTH AND THE LENGTH SHALL BE NOT LESS THAN 40 PERCENT OF DIMENSION "A" OF EACH JUNCTION BOX.
5. THE DIMENSION OF JUNCTION BOX SHALL BE AS SHOWN IN THE TABLE HERE IN. HOWEVER THE DIMENSION "B" MAY BE ADJUSTED TO SUIT THE SIZE OF TERMINAL BLOCK PROVIDED.

REFERENCE DRAWINGS

TYPICAL PT & CCVT JUNCTION BOXES.....DWG.NO.TP–E–20.7

CABINET NO. IN1
RUN NO. 0029

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
–	–	DIMENSIONS OF JUNCTION BOXES FOR DIGITAL SUBSTATION SYSTEM	P.ACHITAPOL	P.ACHITAPOL	–	–	–	–	–	–

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN P.ACHITAPOL	VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED P.ACHITAPOL	RECOMMENDED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	PT JUNCTION BOX FOR DIGITAL SUBSTATION SYSTEM TYPICAL CONSTRUCTION
VERIFIED	CONCURRED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		
APPROVED W. TEERAWAT ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT	DATE 08 ธ.ค. 2565	JOB NO. –	REPLACING DWG.NO. –
		DWG.NO. TP – E – 20.7	REV. 3 –

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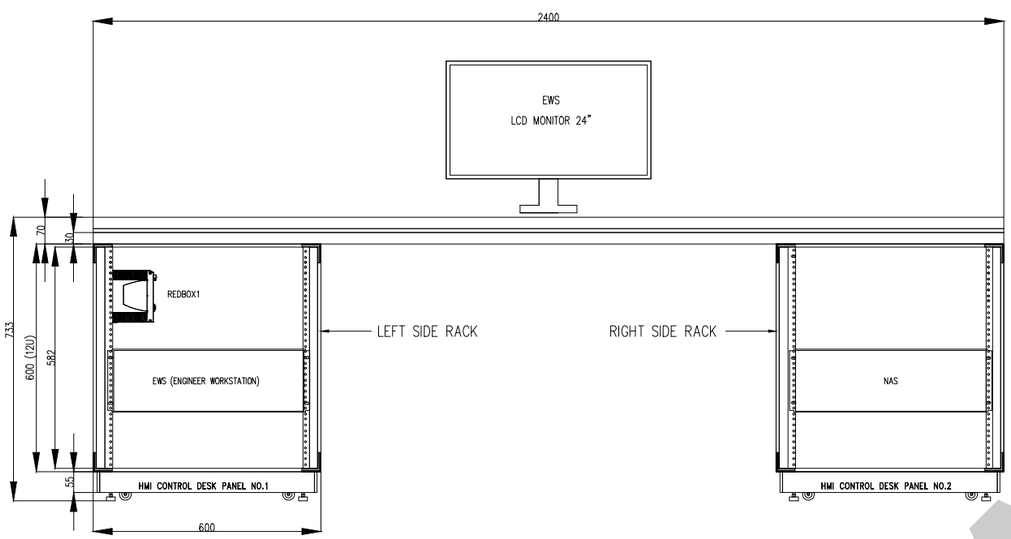
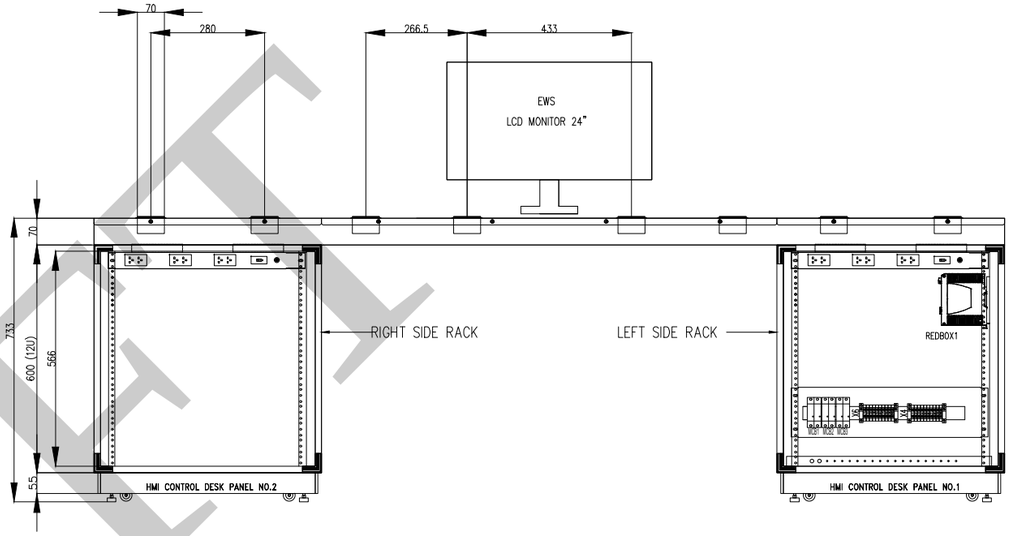
$$$

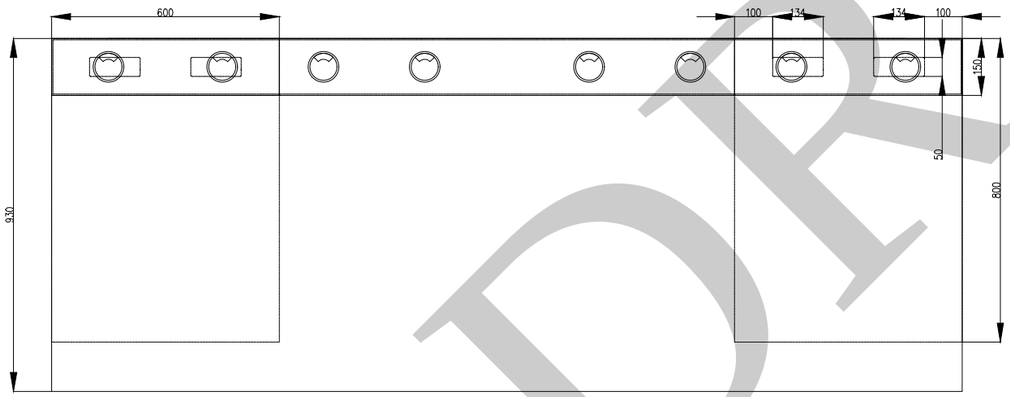
HMI OPERATOR CONSOLE DESK NO.1 LAYOUT



FRONT VIEW WITHOUT DOOR



REAR VIEW WITHOUT DOOR



TOP VIEW

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(นายรุหาญ รุจิธัญธาร)
วันที่..... 29 Jul 2025
กองวิศวกรรมระบบควบคุมและป้องกัน

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	DIGITAL SUBSTATION SYSTEM HMI OPERATOR CONSOLE DESK LAYOUT WITHOUT DOOR	P.ACHITAPOL	P.ACHITAPOL	-	-	-	-	-	-

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$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$Filename
$$$$$$$$$$$$$$$Date
$$$$$$$$$$$$$$$Name

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	P.ACHITAPOL	VALIDATED: CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	P.ACHITAPOL	RECOMMENDED: ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: DIGITAL SUBSTATION SYSTEM HMI OPERATOR CONSOLE DESK LAYOUT WITHOUT DOOR
VERIFIED		CONCURRED: DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	
APPROVED		DATE ..... ASSISTANT GOVERNOR – TRANSMISSION SYSTEM DEVELOPMENT	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.8 / REV. - 1

DWG.NO.	REV.
TP-E-20.9	1
	5
	-

LEGEND	DESCRIPTION
MUC1	MERGING UNIT CUBICLE TYPE 1 FOR PT BUS IN BREAKER AND A HALF BUS & DOUBLE MAIN AND TRANSFER ARRANGEMENT
MUC2	MERGING UNIT CUBICLE TYPE 2 FOR PT BUS IN BREAKER AND A HALF ARRANGEMENT
MUC3	MERGING UNIT CUBICLE TYPE 3 FOR PT BUS AND BUS COUPLE IN DOUBLE BUS SINGLE BREAKER
MUC4	MERGING UNIT CUBICLE TYPE 4 FOR PT BUS AND TIE BREAKER IN MAIN AND TRANSFER ARRANGEMENT
MUC5	MERGING UNIT CUBICLE TYPE 5 FOR LINE TO EGAT, LINE TO PEA AND LINE FOR C-BANK FEEDER
MUC6	MERGING UNIT CUBICLE TYPE 6 FOR HIGH-SIDED AND LOW SIDED TIE TRANSFORMER, HIGH-SIDED LOADING TRANSFORMER TO SWITCHGEAR
MUC7	MERGING UNIT CUBICLE TYPE 7 FOR MIDDLE BREAKER IN BREAKER AND HALF ARRANGEMENT , HIGH-SIDED LOADING TRANSFORMER
MUC8	MERGING UNIT CUBICLE TYPE 8 FOR LOW-SIDED LOADING TRANSFORMER
MUC9	MERGING UNIT CUBICLE TYPE 9 FOR TIE TRANSFORMER
MUC10	MERGING UNIT CUBICLE TYPE 10 FOR LOADING TRANSFORMER
MUC11	MERGING UNIT CUBICLE TYPE 11 FOR 230,115 KV C-BANK
MUC12	MERGING UNIT CUBICLE TYPE 12 FOR 3*22 KV C-BANK
MUC13	MERGING UNIT CUBICLE TYPE 13 FOR SWITCHGEAR

MERGING UNIT CUBICLE TYPE CRITERIA

MUC TYPE / POINT TYPE		MUC1		MUC2		MUC3(AIS)		MUC3(GIS)		MUC4		MUC5(AIS)		MUC5(GIS)		MUC6(AIS)		MUC6(GIS)	
		PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY
ANALOG INPUT*	PT	4	4	8	8	8	8	8	8	4	4	4	4	4	4	4	0	4	0
	CT	0	0	0	0	4	4	4	4	0	0	4	4	4	4	4	4	4	4
BINARY INPUT		10	10	10	10	40	20	130	50	40	20	40	20	130	50	30	10	130	50
BINARY OUTPUT		0	0	0	0	4	3	10	3	4	3	4	3	10	3	4	3	10	3
MILLIAMP INPUT (MI)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

MUC TYPE / POINT TYPE		MUC7(AIS)		MUC7(GIS)		MUC8(AIS)		MUC8(GIS)		MUC9		MUC10		MUC11		MUC12		MUC13	
		PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY	PRIMARY	SECONDARY
ANALOG INPUT*	PT	0	0	0	0	4	0	4	0	4	4	0	0	0	0	12	–	4	0
	CT	4	4	4	4	8	4	8	4	16	12	8	0	8	8	0	–	20	12
BINARY INPUT		30	10	130	50	30	10	130	50	60	10	50	10	30	10	40	–	60	0
BINARY OUTPUT		4	3	10	3	4	3	10	3	15	15	3	0	4	3	10	–	15	0
MILLIAMP INPUT (MI)		0	0	0	0	0	0	0	0	6	0	2	0	0	0	0	–	0	0

NOTES

1. * : SIGNALS FROM PHASE A, B, C, N ARE ALREADY INCLUDED ON THE TABLE ABOVE.
2. MUC6 TO MUC12 CAN BE APPLIED WITH ALL BUS ARRANGEMENTS.

DRAFT

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
–	–	IMPROVE MERGING UNIT TYPE DETAIL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–

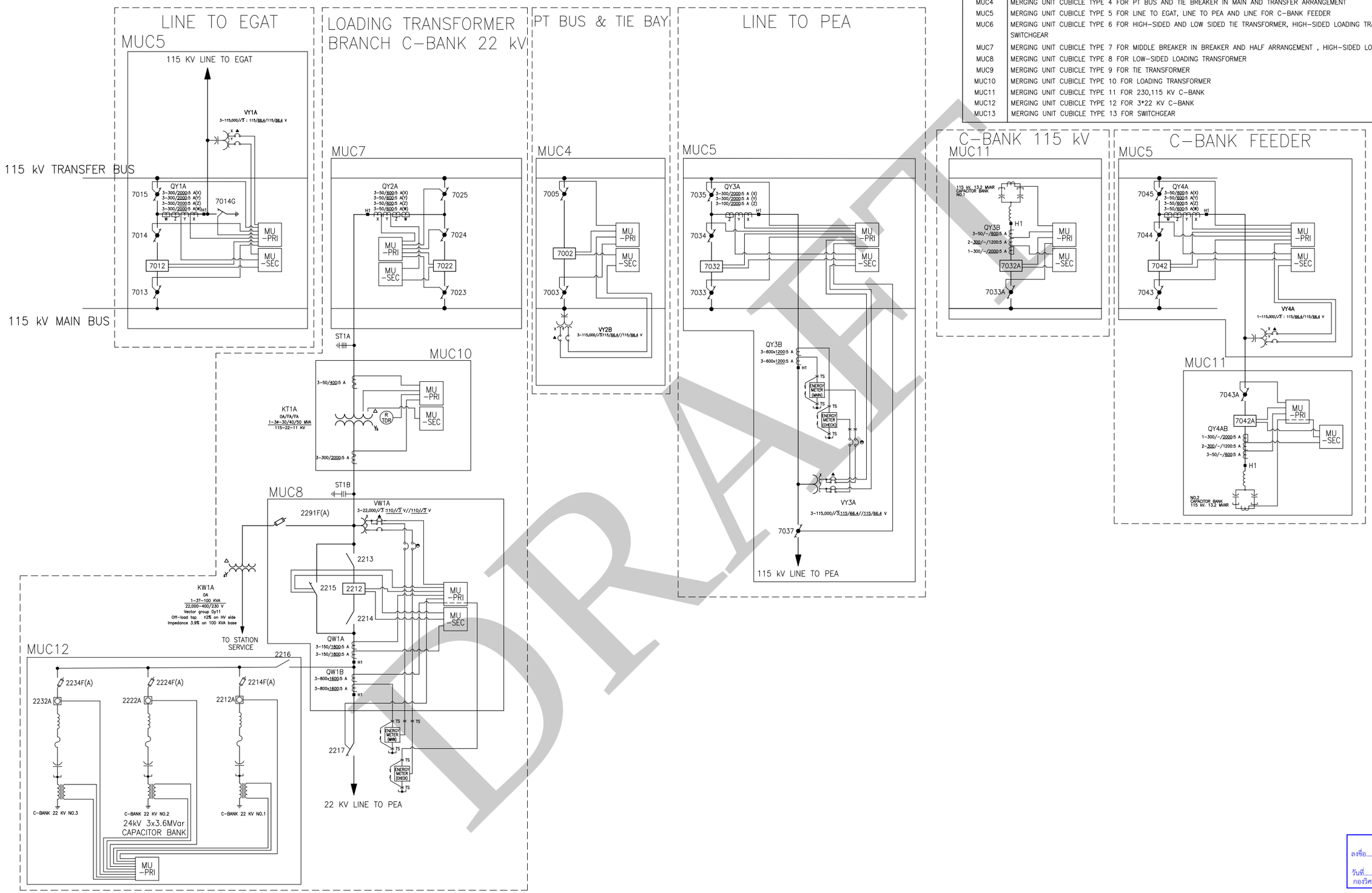
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: MERGING UNIT CUBICLE TYPE CRITERIA
VERIFIED	.....	APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE	JOB NO. – / REPLACING DWG.NO. – / DWG.NO. TP-E-20.9 / REV. 1 5 –

DWG.NO.	REV.
TP-E-20.9	2
	5
	1

AIS SUBSTATION

LEGEND	DESCRIPTION
MUC1	MERGING UNIT CUBICLE TYPE 1 FOR PT BUS IN BREAKER AND A HALF BUS & DOUBLE MAIN AND TRANSFER ARRANGEMENT
MUC2	MERGING UNIT CUBICLE TYPE 2 FOR PT BUS IN BREAKER AND A HALF ARRANGEMENT
MUC3	MERGING UNIT CUBICLE TYPE 3 FOR PT BUS AND BUS COUPLE IN DOUBLE BUS SINGLE BREAKER
MUC4	MERGING UNIT CUBICLE TYPE 4 FOR PT BUS AND TIE BREAKER IN MAIN AND TRANSFER ARRANGEMENT
MUC5	MERGING UNIT CUBICLE TYPE 5 FOR LINE TO EGAT, LINE TO PEA AND LINE FOR C-BANK FEEDER
MUC6	MERGING UNIT CUBICLE TYPE 6 FOR HIGH-SIDED AND LOW SIDED TIE TRANSFORMER, HIGH-SIDED LOADING TRANSFORMER TO SWITCHGEAR
MUC7	MERGING UNIT CUBICLE TYPE 7 FOR MIDDLE BREAKER IN BREAKER AND HALF ARRANGEMENT , HIGH-SIDED LOADING TRANSFORMER
MUC8	MERGING UNIT CUBICLE TYPE 8 FOR LOW-SIDED LOADING TRANSFORMER
MUC9	MERGING UNIT CUBICLE TYPE 9 FOR TIE TRANSFORMER
MUC10	MERGING UNIT CUBICLE TYPE 10 FOR LOADING TRANSFORMER
MUC11	MERGING UNIT CUBICLE TYPE 11 FOR 230,115 KV C-BANK
MUC12	MERGING UNIT CUBICLE TYPE 12 FOR 3*22 KV C-BANK
MUC13	MERGING UNIT CUBICLE TYPE 13 FOR SWITCHGEAR



DRAFT

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ลงชื่อ.....
(นายรุหาญ รุจิธัญธาร)
วันที่ 29 Jul 2025
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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	IMPROVE MERGING UNIT TYPE DETAIL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
–	–	MERGING UNIT CUBICLE TYPE FOR EACH BUS ARRANGEMENT	C.KANITHA	C.KANITHA	–	–	–	–	–	–

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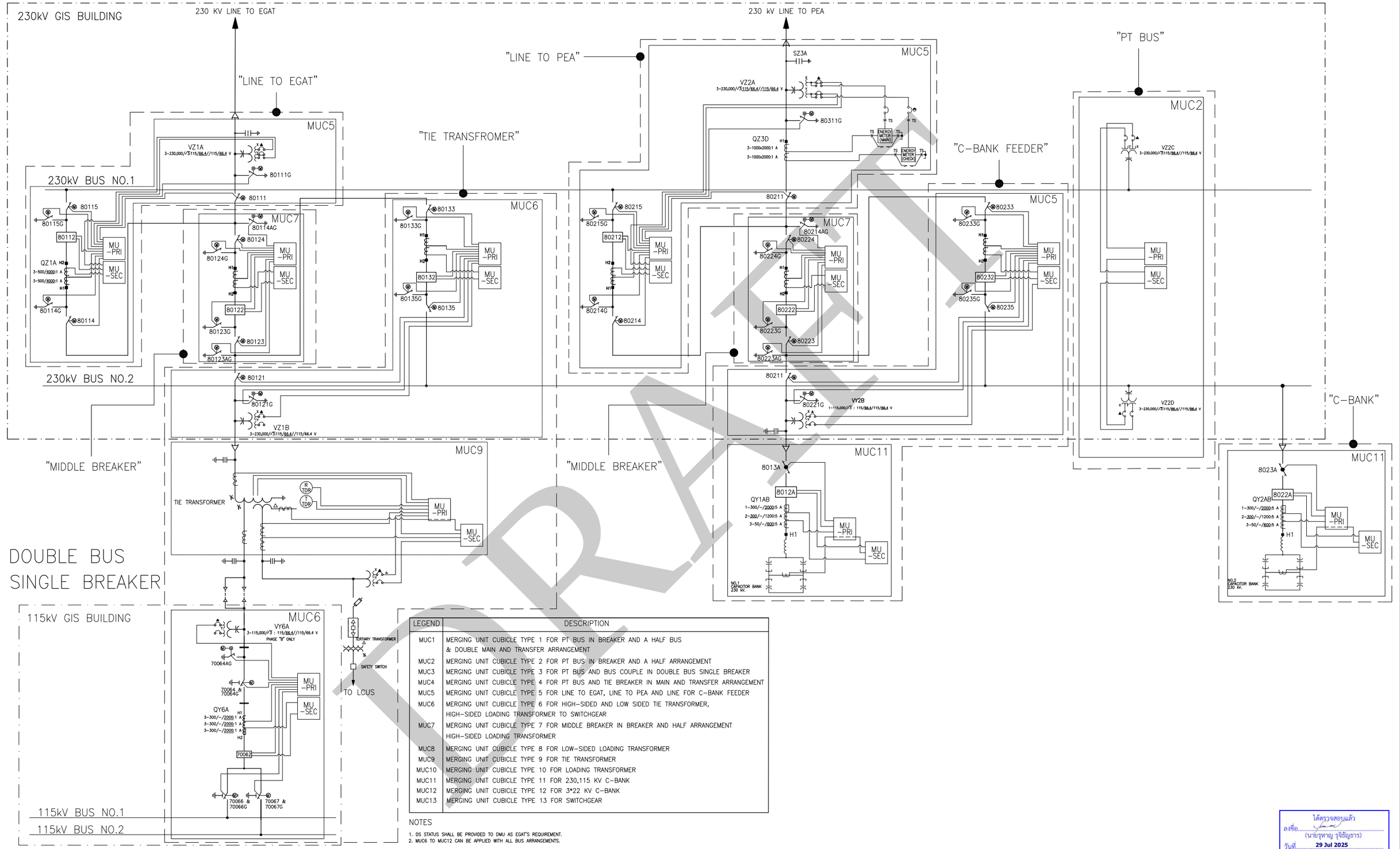
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	MERGING UNIT CUBICLE TYPE FOR AIS MAIN & TRANSFER BUS ARRANGEMENT
VERIFIED	APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE	JOB NO. –	REPLACING DWG.NO. –
		DWG.NO. TP-E-20.9	REV. 2 5 1

BREAKER AND A HALF ARRANGEMENT GIS SUBSTATION



LEGEND	DESCRIPTION
MUC1	MERGING UNIT CUBICLE TYPE 1 FOR PT BUS IN BREAKER AND A HALF BUS & DOUBLE MAIN AND TRANSFER ARRANGEMENT
MUC2	MERGING UNIT CUBICLE TYPE 2 FOR PT BUS IN BREAKER AND A HALF ARRANGEMENT
MUC3	MERGING UNIT CUBICLE TYPE 3 FOR PT BUS AND BUS COUPLE IN DOUBLE BUS SINGLE BREAKER
MUC4	MERGING UNIT CUBICLE TYPE 4 FOR PT BUS AND TIE BREAKER IN MAIN AND TRANSFER ARRANGEMENT
MUC5	MERGING UNIT CUBICLE TYPE 5 FOR LINE TO EGAT, LINE TO PEA AND LINE FOR C-BANK FEEDER
MUC6	MERGING UNIT CUBICLE TYPE 6 FOR HIGH-SIDED AND LOW SIDED TIE TRANSFORMER, HIGH-SIDED LOADING TRANSFORMER TO SWITCHGEAR
MUC7	MERGING UNIT CUBICLE TYPE 7 FOR MIDDLE BREAKER IN BREAKER AND HALF ARRANGEMENT HIGH-SIDED LOADING TRANSFORMER
MUC8	MERGING UNIT CUBICLE TYPE 8 FOR LOW-SIDED LOADING TRANSFORMER
MUC9	MERGING UNIT CUBICLE TYPE 9 FOR TIE TRANSFORMER
MUC10	MERGING UNIT CUBICLE TYPE 10 FOR LOADING TRANSFORMER
MUC11	MERGING UNIT CUBICLE TYPE 11 FOR 230,115 KV C-BANK
MUC12	MERGING UNIT CUBICLE TYPE 12 FOR 3*22 KV C-BANK
MUC13	MERGING UNIT CUBICLE TYPE 13 FOR SWITCHGEAR

NOTES

1. DS STATUS SHALL BE PROVIDED TO DMU AS EGAT'S REQUIREMENT.
2. MUC6 TO MUC12 CAN BE APPLIED WITH ALL BUS ARRANGEMENTS.

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วันที่ 29 Jul 2025
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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	IMPROVE MERGING UNIT TYPE DETAIL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
–	–	MERGING UNIT CUBICLE TYPE FOR EACH BUS ARRANGEMENT	C.KANITHA	C.KANITHA	–	–	–	–	–	–

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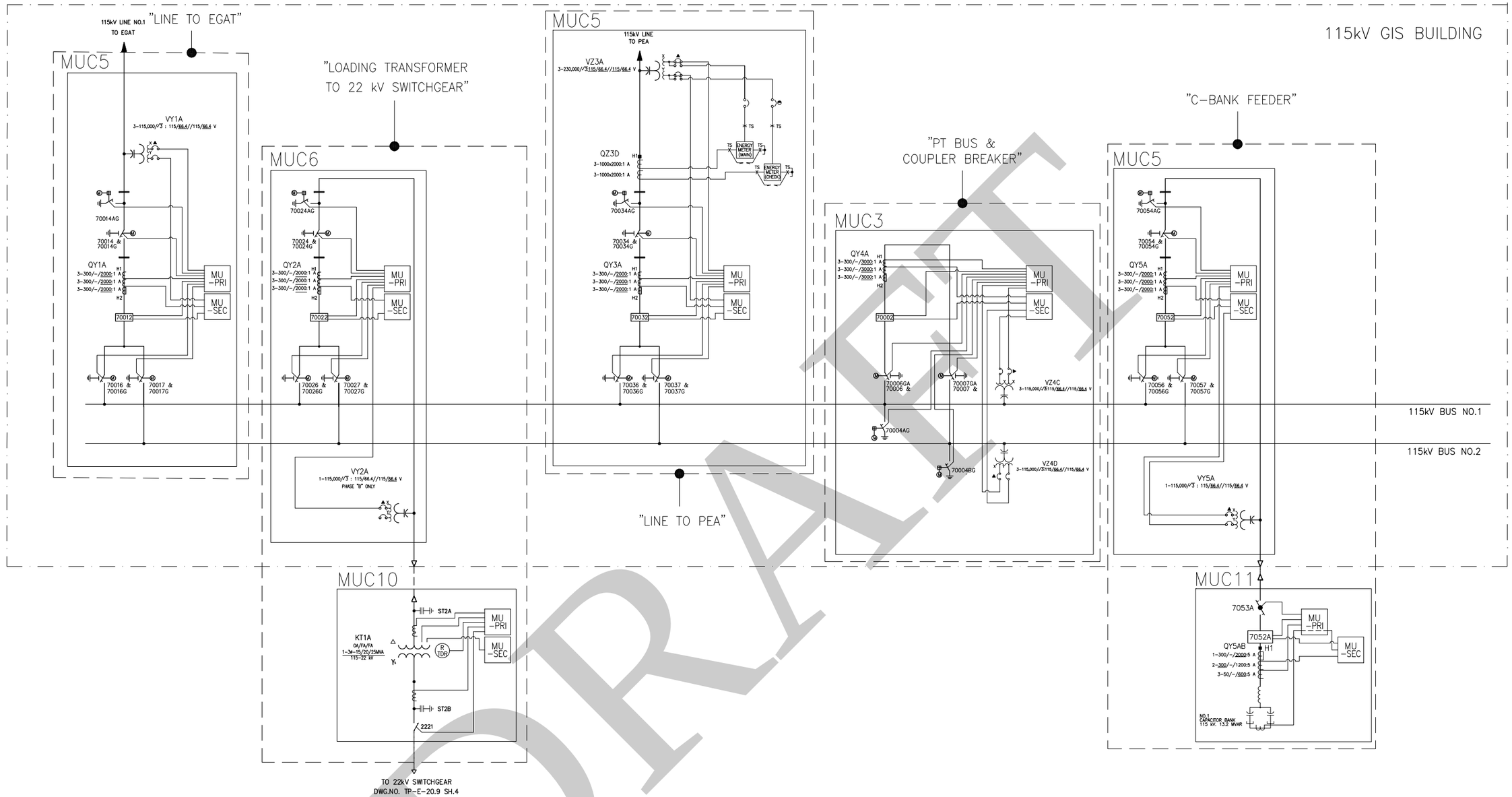
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	MERGING UNIT CUBICLE TYPE FOR GIS BREAKER AND A HALF BUS ARRANGEMENT
VERIFIED			
APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO. –	REPLACING DWG.NO. –
		DWG.NO. TP-E-20.9	3 REV. 5 1

DRAFT

DOUBLE BUS SINGLE BREAKER ARRANGEMENT GIS SUBSTATION



LEGEND	DESCRIPTION
MUC1	MERGING UNIT CUBICLE TYPE 1 FOR PT BUS IN BREAKER AND A HALF BUS & DOUBLE MAIN AND TRANSFER ARRANGEMENT
MUC2	MERGING UNIT CUBICLE TYPE 2 FOR PT BUS IN BREAKER AND A HALF ARRANGEMENT
MUC3	MERGING UNIT CUBICLE TYPE 3 FOR PT BUS AND BUS COUPLE IN DOUBLE BUS SINGLE BREAKER
MUC4	MERGING UNIT CUBICLE TYPE 4 FOR PT BUS AND TIE BREAKER IN MAIN AND TRANSFER ARRANGEMENT
MUC5	MERGING UNIT CUBICLE TYPE 5 FOR LINE TO EGAT, LINE TO PEA AND LINE FOR C-BANK FEEDER
MUC6	MERGING UNIT CUBICLE TYPE 6 FOR HIGH-SIDED AND LOW SIDED TIE TRANSFORMER, HIGH-SIDED LOADING TRANSFORMER TO SWITCHGEAR
MUC7	MERGING UNIT CUBICLE TYPE 7 FOR MIDDLE BREAKER IN BREAKER AND HALF ARRANGEMENT , HIGH-SIDED LOADING TRANSFORMER
MUC8	MERGING UNIT CUBICLE TYPE 8 FOR LOW-SIDED LOADING TRANSFORMER
MUC9	MERGING UNIT CUBICLE TYPE 9 FOR TIE TRANSFORMER
MUC10	MERGING UNIT CUBICLE TYPE 10 FOR LOADING TRANSFORMER
MUC11	MERGING UNIT CUBICLE TYPE 11 FOR 230,115 KV C-BANK
MUC12	MERGING UNIT CUBICLE TYPE 12 FOR 3*22 KV C-BANK
MUC13	MERGING UNIT CUBICLE TYPE 13 FOR SWITCHGEAR

NOTES

1. DS STATUS SHALL BE PROVIDED TO DMU AS EGAT'S REQUIREMENT.
2. MUC6 TO MUC12 CAN BE APPLIED WITH ALL BUS ARRANGEMENTS.

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	IMPROVE MERGING UNIT TYPE DETAIL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
–	–	MERGING UNIT CUBICLE TYPE FOR EACH BUS ARRANGEMENT	C.KANITHA	C.KANITHA	–	–	–	–	–	–

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ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: MERGING UNIT CUBICLE TYPE FOR GIS DOUBLE BUS SINGLE BREAKER ARRANGEMENT
VERIFIED	.....		
APPROVED	..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO. – / REPLACING DWG.NO. – / DWG.NO. TP-E-20.9 / REV. 4 5 1

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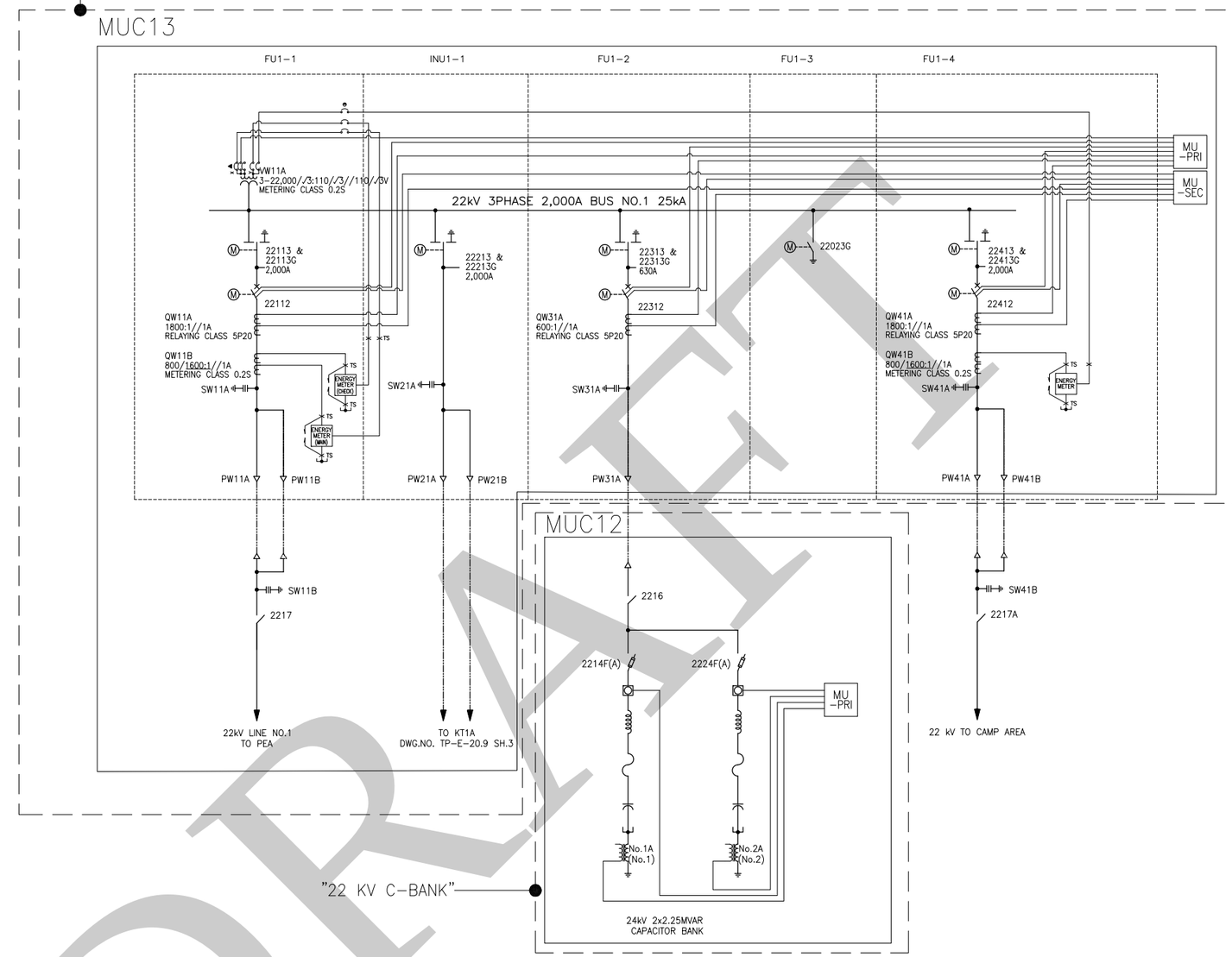
DWG.NO.	REV.
TP-E-20.9	5
	1

22 kV SWITCHGEAR



LEGEND	DESCRIPTION
MUC1	MERGING UNIT CUBICLE TYPE 1 FOR PT BUS IN BREAKER AND A HALF BUS & DOUBLE MAIN AND TRANSFER ARRANGEMENT
MUC2	MERGING UNIT CUBICLE TYPE 2 FOR PT BUS IN BREAKER AND A HALF ARRANGEMENT
MUC3	MERGING UNIT CUBICLE TYPE 3 FOR PT BUS AND BUS COUPLE IN DOUBLE BUS SINGLE BREAKER
MUC4	MERGING UNIT CUBICLE TYPE 4 FOR PT BUS AND TIE BREAKER IN MAIN AND TRANSFER ARRANGEMENT
MUC5	MERGING UNIT CUBICLE TYPE 5 FOR LINE TO EGAT, LINE TO PEA AND LINE FOR C-BANK FEEDER
MUC6	MERGING UNIT CUBICLE TYPE 6 FOR HIGH-SIDED AND LOW SIDED TIE TRANSFORMER, HIGH-SIDED LOADING TRANSFORMER TO SWITCHGEAR
MUC7	MERGING UNIT CUBICLE TYPE 7 FOR MIDDLE BREAKER IN BREAKER AND HALF ARRANGEMENT , HIGH-SIDED LOADING TRANSFORMER
MUC8	MERGING UNIT CUBICLE TYPE 8 FOR LOW-SIDED LOADING TRANSFORMER
MUC9	MERGING UNIT CUBICLE TYPE 9 FOR TIE TRANSFORMER
MUC10	MERGING UNIT CUBICLE TYPE 10 FOR LOADING TRANSFORMER
MUC11	MERGING UNIT CUBICLE TYPE 11 FOR 230,115 KV C-BANK
MUC12	MERGING UNIT CUBICLE TYPE 12 FOR 3*22 KV C-BANK
MUC13	MERGING UNIT CUBICLE TYPE 13 FOR SWITCHGEAR

NOTES

1. DS STATUS SHALL BE PROVIDED TO DMU AS EGAT'S REQUIREMENT.

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	IMPROVE MERGING UNIT TYPE DETAIL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
–	–	MERGING UNIT CUBICLE TYPE FOR EACH BUS ARRANGEMENT	C.KANITHA	C.KANITHA	–	–	–	–	–	–

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ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: MERGING UNIT CUBICLE TYPE FOR 22 kV SWITCHGEAR
VERIFIED	.....		
APPROVED	..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO. – / REPLACING DWG.NO. – / DWG.NO. TP-E-20.9 / REV. 5 1

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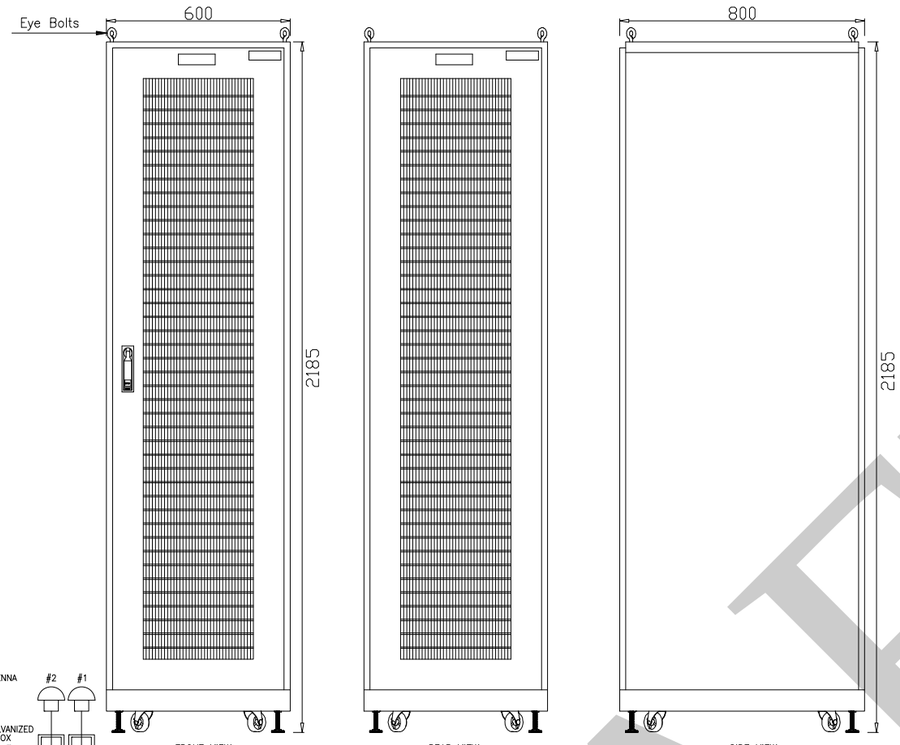
REV.	–	DWG.NO.	TP-E-20.10
1	–		



NOTES

1. PANEL SHOWN IN THIS DRAWING IS 19" RACK PANEL AS DEPICTED IN DWG. TP–E–10.19
2. GPS UNIT SHALL MEET SPECIFICATION NO.1008.
3. SURGE ARRESTER SHALL BE PROVIDED FOR COMPLETELY PROTECTIVE AND COMPATIBLE WITH GPS RECEIVER.

REFERENCES

1. SPECIFICATION NO.1008

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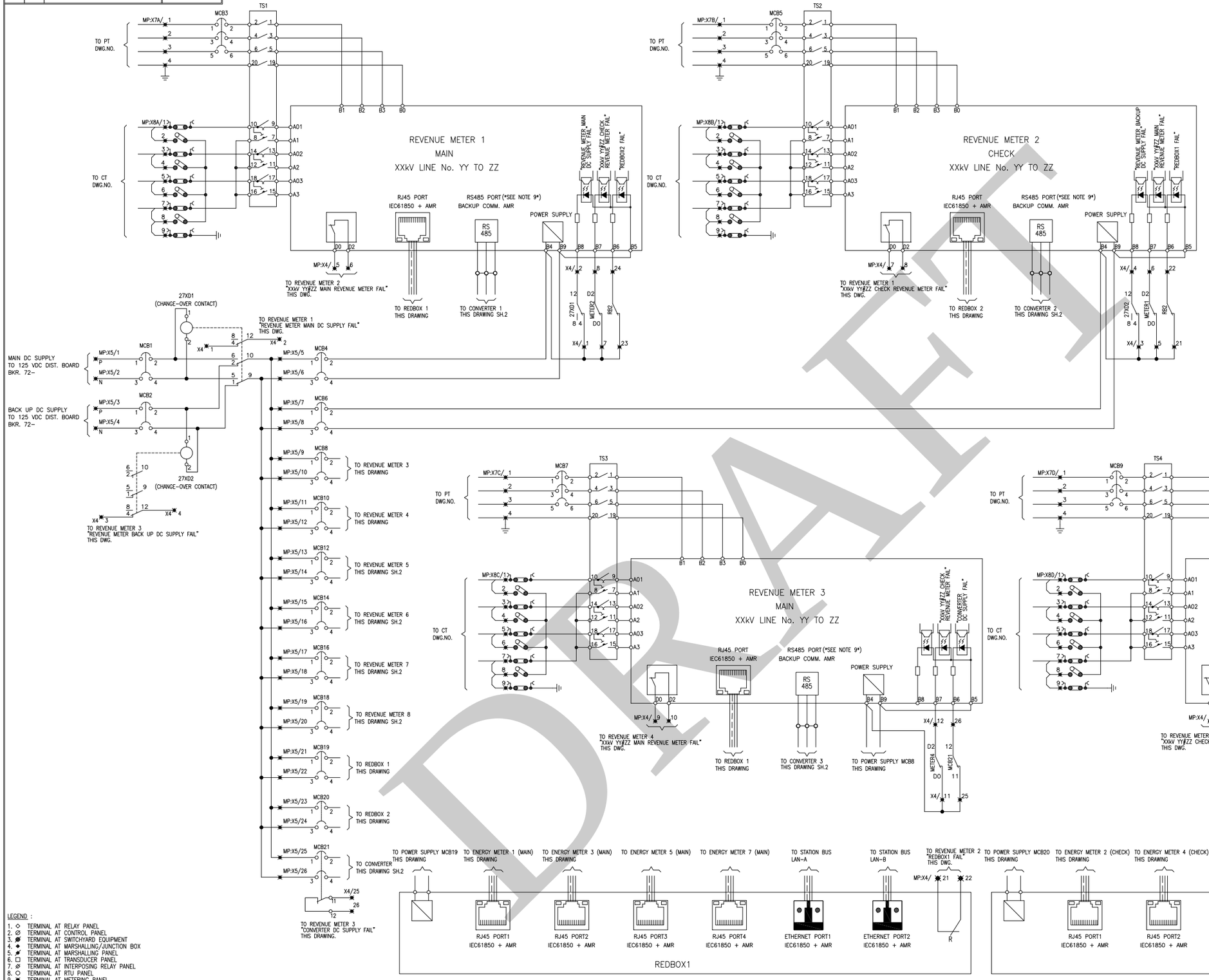
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	REMOVE GATEWAY FROM GPS AND GATEWAY PANEL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
–	–	GPS AND GATEWAY SWITCHBOARD PANEL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN S.PHATHARAPON	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED S.PHATHARAPON	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION–1	DESCRIPTION OF DETAIL DRAWING	GPS SWITCHBOARD PANEL
VERIFIED			
APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE	JOB NO.	REPLACING DWG.NO.	DWG.NO. TP–E–20.10 – REV. 1

DWG.NO.	REV.
TP-E-20.11	1
	2
	1



NOTES

1. 'XX' IS FOR VOLTAGE LEVELS

   EXAMPLE
   - 22 = 22 kV
   - 33 = 33 kV
   - 69 = 69 kV
   - 115 = 115 kV
   - 230 = 230 kV
   - 500 = 500 kV

2. 'YY' IS FOR LINE NO. OR FEEDER NO.

   EXAMPLE
   - 1 = LINE NO. 1
   - 2 = LINE NO. 2

3. 'ZZ' IS FOR CUSTOMER'S NAMES

   EXAMPLE
   - MEA = MEA
   - PEA = PEA
   - GENCO = GENCO

4. EACH 27XD SHALL HAVE AT LEAST 3 CHANGEOVER CONTACTS.
5. PRP IS APPLIED FOR CONNECTION OF ENERGY METER.
6. ENERGY METER SHALL SUPPORT IEC 62056(DLMS) AND IEC 61850.
7. DETAILS OF EQUIPMENT ARE DESCRIBED IN SPECIFICATION NOS.1008.
8. SIGNALS OF "BACKUP COMMUNICATION AMR" SHALL BE TRANSFERRED THROUGH RJ45 PORT OF ENERGY METER.
9. IN CASE PORT OF ENERGY METER FOR BACKUP COMM. AMR CAN BE CONNECTED THROUGH ETHERNET SWITCH DIRECTLY, NO NEED TO INSTALLE CONVERTER.

LEGEND	DESCRIPTION
CT	CURRENT TRANSFORMER
PT	POTENTIAL TRANSFORMER
	PORT OF ETHERNET SWITCH
- - - -	IEC 61850
———	IEC 62056

LEGEND :

1. ◇ TERMINAL AT RELAY PANEL
2. ⌀ TERMINAL AT CONTROL PANEL
3. ◪ TERMINAL AT SWITCHYARD EQUIPMENT
4. ◆ TERMINAL AT MARSHALLING/JUNCTION BOX
5. ◢ TERMINAL AT MARSHALLING PANEL
6. □ TERMINAL AT TRANSDUCER PANEL
7. ⊗ TERMINAL AT INTERPOSING RELAY PANEL
8. ○ TERMINAL AT RTU PANEL
9. ✱ TERMINAL AT METERING PANEL

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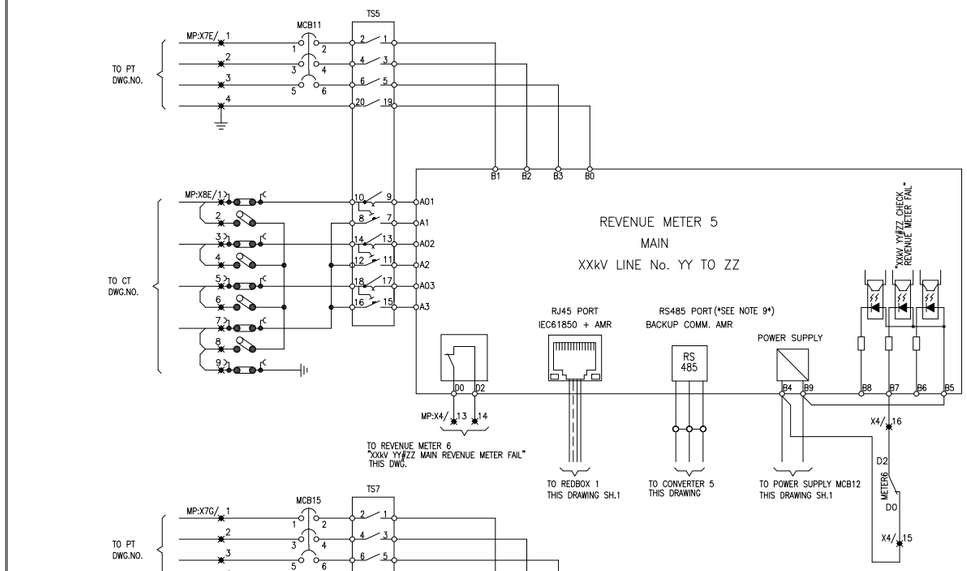
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
1	–	IMPROVE REVENUE METER AND ACCESSORIES DETAIL	S.PHATHARAPON	S.PHATHARAPON	–	–	–	–	–	–
–	–	METERING SYSTEM SCHEMATIC DIAGRAM	S.PHATHARAPON	K.NAPAT	–	–	–	–	–	–

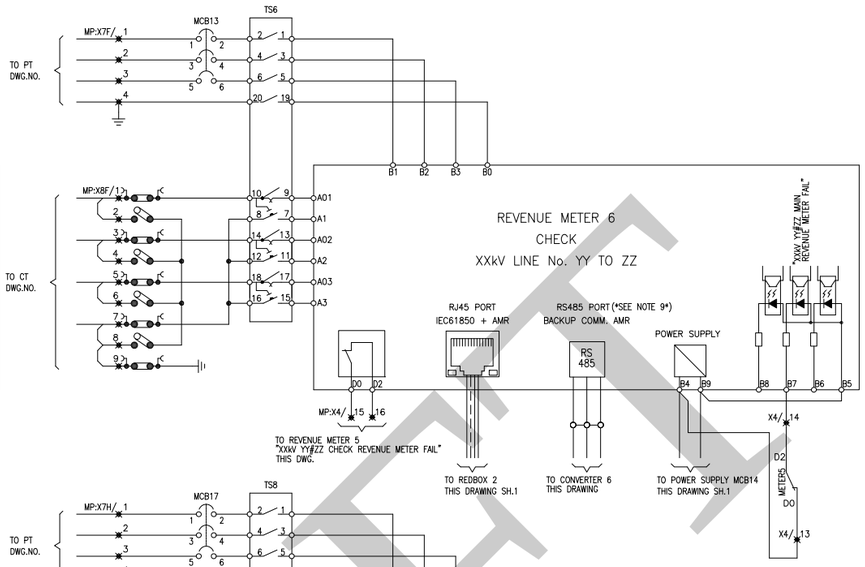
ELECTRICITY GENERATING AUTHORITY OF THAILAND

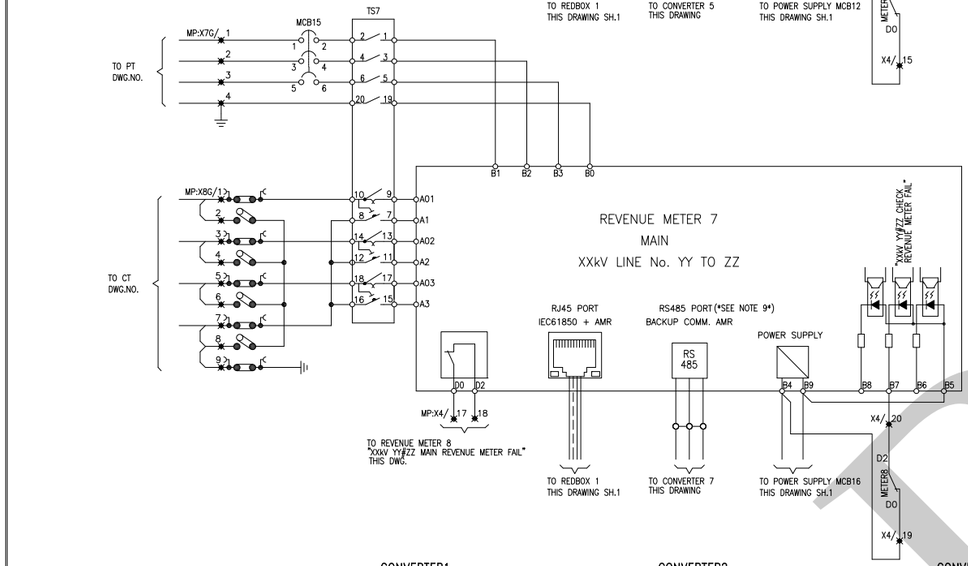
DRAWN	S.PHATHARAPON	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	K.NAPAT	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: DIGITAL SUBSTATION METERING SYSTEM SCHEMATIC DIAGRAM
VERIFIED	.....		
APPROVED	..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.11 / REV. 1 / 2

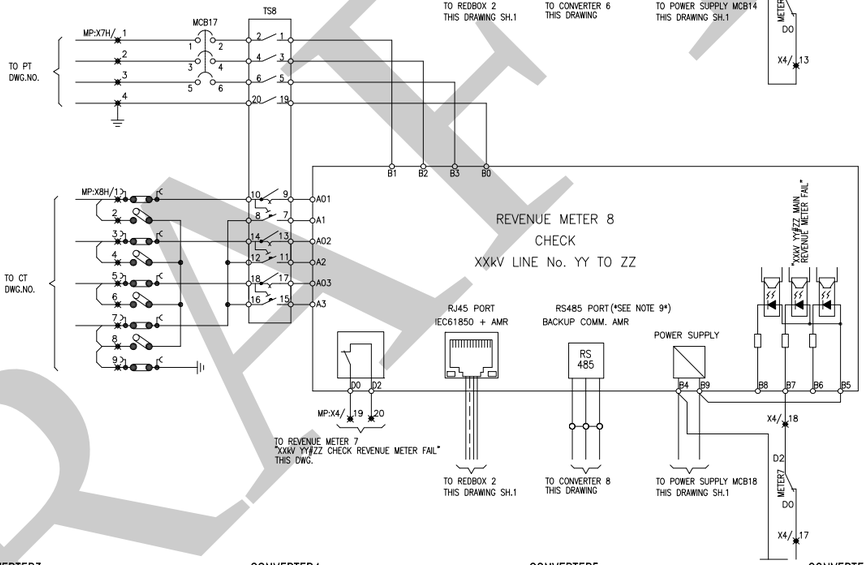
DRAFT

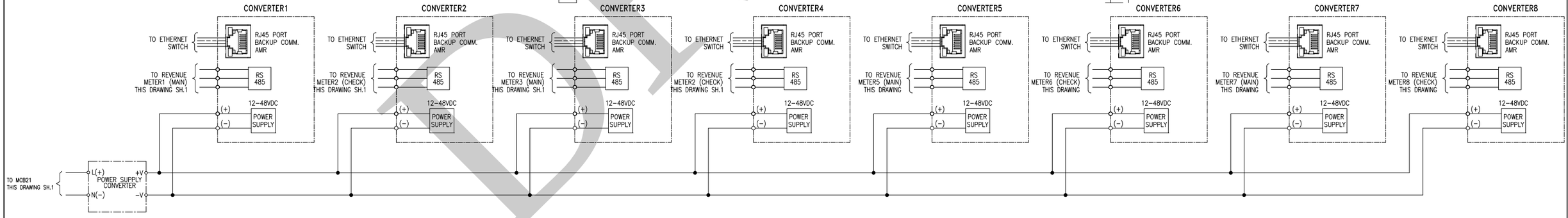
DWG.NO.	REV.
TP-E-20.11	2
	-











NOTES
1. 'XX' IS FOR VOLTAGE LEVELS

   EXAMPLE
   - 22 = 22 kV
   - 33 = 33 kV
   - 69 = 69 kV
   - 115 = 115 kV
   - 230 = 230 kV
   - 500 = 500 kV

2. 'YY' IS FOR LINE NO. OR FEEDER NO.

   EXAMPLE
   - 1 = LINE NO. 1
   - 2 = LINE NO. 2

3. 'ZZ' IS FOR CUSTOMER'S NAMES

   EXAMPLE
   - MEA = MEA
   - PEA = PEA
   - GENCO = GENCO

4. EACH 27XD SHALL HAVE AT LEAST 3 CHANGEOVER CONTACTS.
5. PRP IS APPLIED FOR CONNECTION OF ENERGY METER.
6. ENERGY METER SHALL SUPPORT IEC 62056(DLMS) AND IEC 61850.
7. DETAILS OF EQUIPMENT ARE DESCRIBED IN SPECIFICATION NOS.1008.
8. SIGNALS OF "BACKUP COMMUNICATION AMR" SHALL BE TRANSFERRED THROUGH RJ45 PORT OF ENERGY METER.
9. IN CASE PORT OF ENERGY METER FOR BACKUP COMM. AMR CAN BE CONNECTED THROUGH ETHERNET SWITCH DIRECTLY, NO NEED TO INSTALLE CONVERTER.

LEGEND	DESCRIPTION
CT	CURRENT TRANSFORMER
PT	POTENTIAL TRANSFORMER
	PORT OF ETHERNET SWITCH
- - - -	IEC 61850
———	IEC 62056

LEGEND :
1. ◇ TERMINAL AT RELAY PANEL
2. ∅ TERMINAL AT CONTROL PANEL
3. ⌀ TERMINAL AT SWITCHYARD EQUIPMENT
4. ◆ TERMINAL AT MARSHALLING/JUNCTION BOX
5. ⌀ TERMINAL AT MARSHALLING PANEL
6. □ TERMINAL AT TRANSDUCER PANEL
7. ⌀ TERMINAL AT INTERPOSING RELAY PANEL
8. ○ TERMINAL AT RTU PANEL
9. ✱ TERMINAL AT METERING PANEL

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	IMPROVE REVENUE METER AND ACCESSORIES DETAIL	S.PHATHARAPON	S.PHATHARAPON	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN S.PHATHARAPON	RECOMMENDED AND VALIDATED ..... CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED K.NAPAT	CONCURRED ..... ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING	DIGITAL SUBSTATION METERING SYSTEM SCHEMATIC DIAGRAM
VERIFIED			
APPROVED ..... DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE	JOB NO.	REPLACING DWG.NO. / DWG.NO. TP-E-20.11 / REV. 2 / 2

DRAFT

DWG.NO.	REV.
TP-E-20.12	1
	7
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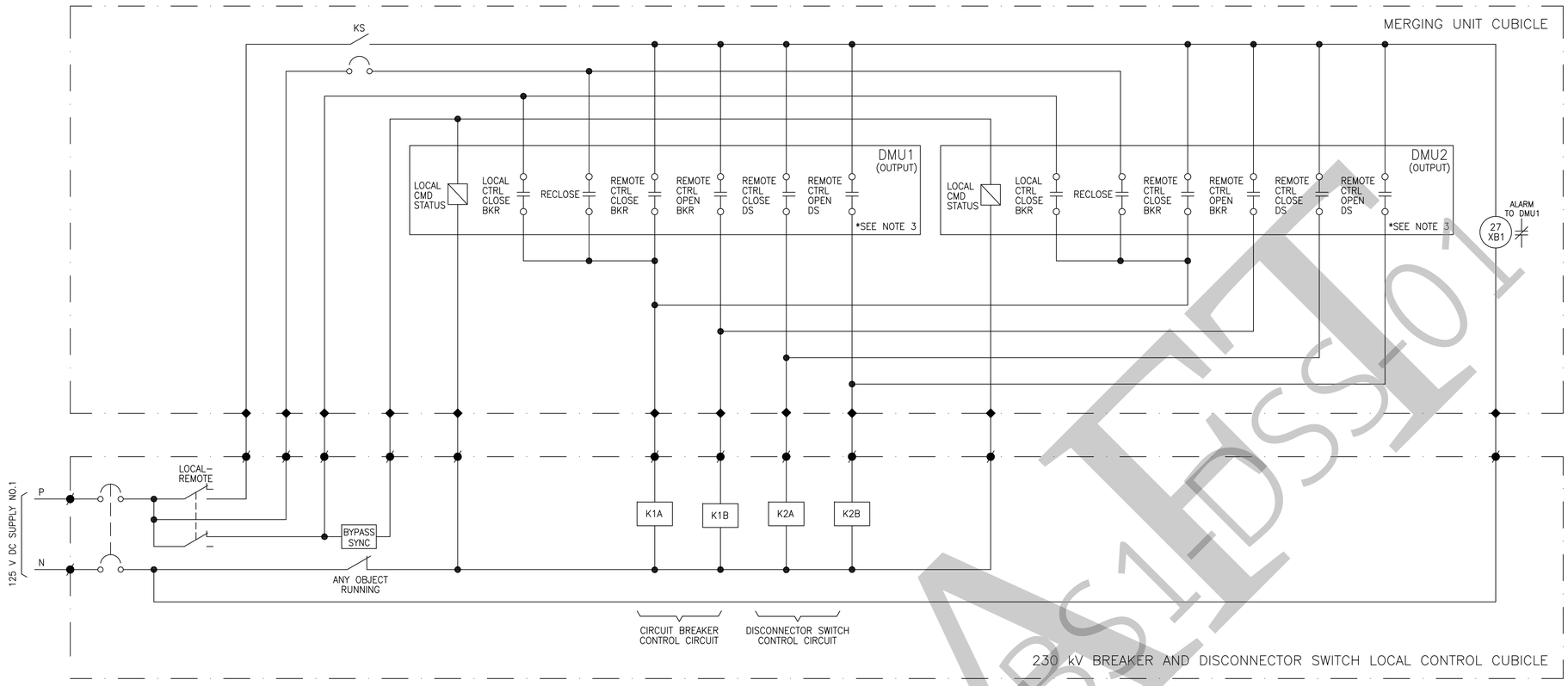
230 kV GIS BREAKER & DISCONNECTOR SWITCH CONTROL SCHEMATIC DIAGRAM



LEGEND	DESCRIPTION
MU	MERGING UNIT
DMU	DIGITAL MERGING UNIT
AMU	ANALOG MERGING UNIT
CMU	CONDITION MERGING UNIT
K1A	AUXILIARY RELAY FOR CLOSING CIRCUIT BREAKER
K1B	AUXILIARY RELAY FOR TRIPPING CIRCUIT BREAKER
K2A	AUXILIARY RELAY FOR CLOSING DISCONNECTOR SWITCH
K2B	AUXILIARY RELAY FOR TRIPPING DISCONNECTOR SWITCH
CTRL	CONTROL
BKR	CIRCUIT BREAKER
DS	DISCONNECTOR SWITCH
ES	EARTHING SWITCH
27X	DC UNDERVOLTAGE RELAY
KS	KNIFE SWITCH
	MINIATURE CIRCUIT BREAKER

NOTES

1. PLEASE REFER TO MANUFACTURER'S DRAWINGS FOR THE ACTUAL CONTROL SCHEMATICS OF CIRCUIT BREAKERS AND OTHER SUBSTATION EQUIPMENT.
2. THE SIZE OF TERMINAL BLOCKS IN MERGING UNIT CABINET FOR DC SUPPLY, CT CIRCUIT, PT CIRCUIT, CONTROL CIRCUIT AND ALARM IS AS DESCRIBED IN SPECIFICATION NO. 1008.
3. INCLUDING 86A BLOCK CLOSE LOGIC CIRCUIT.
4. INCLUDING 86A TRIP LOGIC CIRCUIT.
5. EACH 125 VDC SUPPLY CIRCUIT SHALL BE USED FOR ALL MERGING UNIT CABINETS IN EACH DIAMETER WITH THE SUITABLE RATING MCB OF DPP.
6. 125 VDC SUPPLY SHALL USE 125 VDC DISTRIBUTION BOARD AT GIS BUILDING.

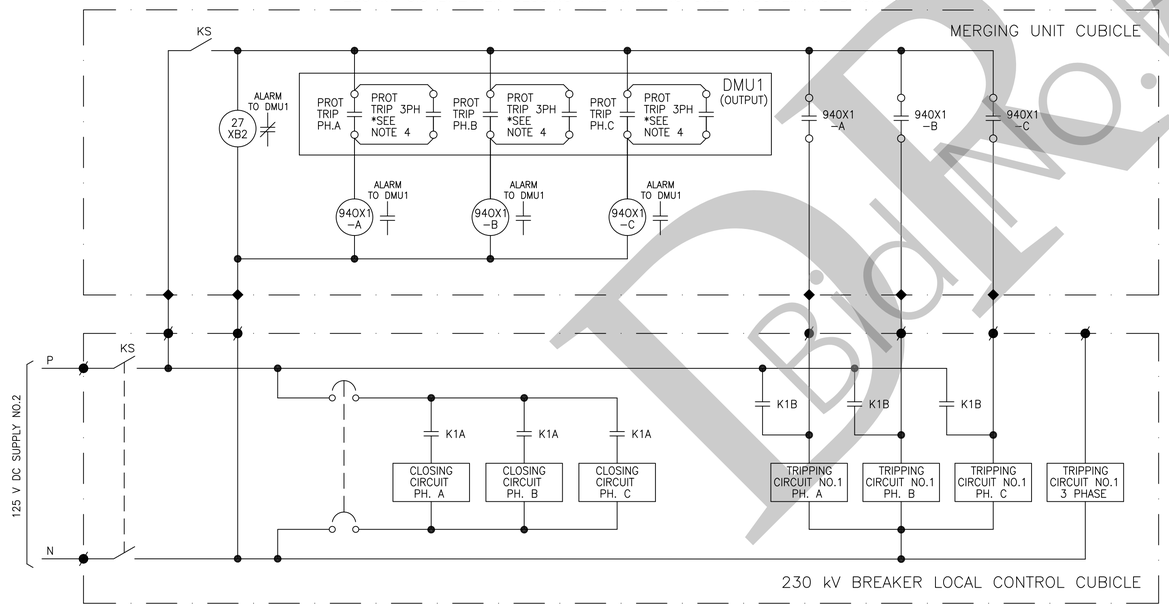
LEGEND

1. ✖ TERMINAL AT SWITCHYARD EQUIPMENT
2. • TERMINAL AT JUNCTION BOX/MU CUBICLE (OUTDOOR)
3. ✖ TERMINAL AT 125 VDC DISTRIBUTION BOARD

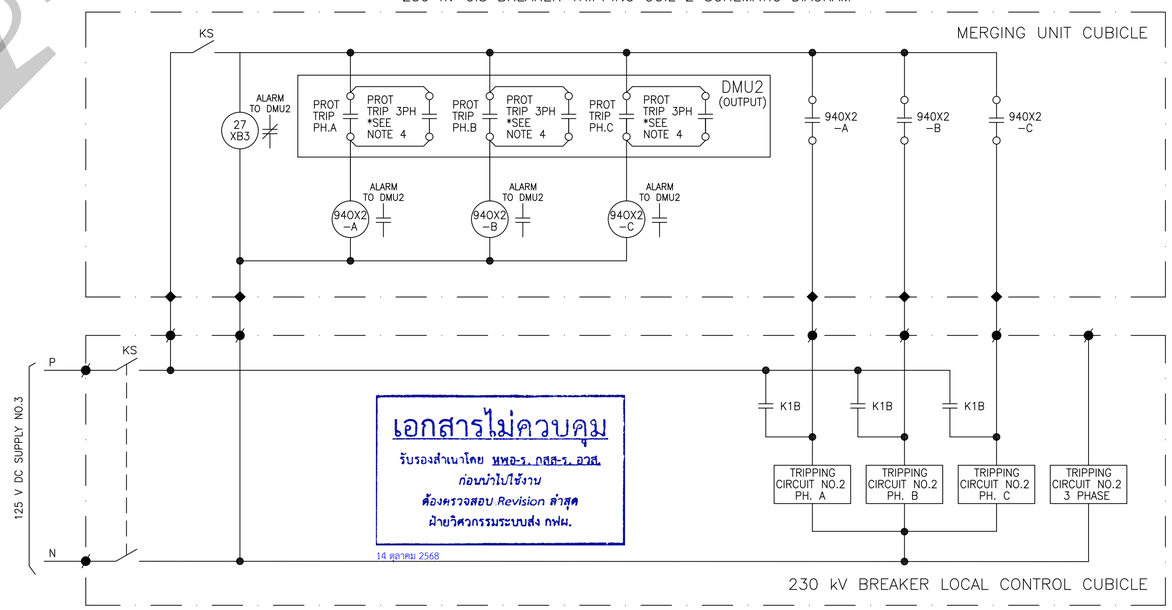
REFERENCE

1. SPECIFICATION NO. 1008.

230 kV GIS BREAKER CLOSING AND TRIPPING COIL 1 SCHEMATIC DIAGRAM



230 kV GIS BREAKER TRIPPING COIL 2 SCHEMATIC DIAGRAM



เอกสารไม่ควบคุม
รับรองสำเนาโดย หหอ-ร. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

DRAFT
BID NO. PBS1-DSS01

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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED: CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED: ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: DIGITAL SUBSTATION SYSTEM (GIS) 230 kV BREAKER CONTROL SCHEMATIC DIAGRAM
VERIFIED	SIRAPAT		
APPROVED	DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.12 / REV. 1, 7, -

REV.	DWG.NO.
2	TP-E-20.12
7	
-	

PRIMARY MERGING UNIT
DIGITAL INPUT MODULE (DMU1)

TERMINAL X1	+ INDEX	DESCRIPTION	
71	36	DS1(DS No.6) STATUS PH.B	
72		GIS 89a-B-1	
73			
74	37	DS1(DS No.6) STATUS PH.B	*SEE NOTE 5 THIS DWG SH.3
75		89b-B-1	
76	38	DS1(DS No.6) STATUS PH.C	
77		89a-C-1	
78	39	DS1(DS No.6) STATUS PH.C	
79		89b-C-1	
80	40	DS1(DS No.6) MOTOR OVERLOAD	
81		MOTOR OVERRUN-1	
82	41	DS1(DS No.6) MOTOR OVERRUN	
83		MOTOR OVERRUN-1	
84	42	ES1 STATUS PH.A	
85		89a-A-1	
86	43	ES1 STATUS PH.A	
87		89b-A-1	
88	44	ES1 STATUS PH.B	
89		89a-B-1	
90	45	ES1 STATUS PH.B	
91		89b-B-1	
92	46	ES1 STATUS PH.C	
93		89a-C-1	
94	47	ES1 STATUS PH.C	
95		89b-C-1	
96	48	ES1 MOTOR OVERLOAD	
97		MOTOR OVERRUN-1	
98	49	ES1 MOTOR OVERRUN	
99		MOTOR OVERRUN-1	
100	50	DS2(DS No.7) STATUS PH.A	
101		89a-A-1	
102	51	DS2(DS No.7) STATUS PH.A	
103		89b-A-1	
104	52	DS2(DS No.7) STATUS PH.B	*SEE NOTE 5 THIS DWG SH.3
105		89a-B-1	
106	53	DS2(DS No.7) STATUS PH.B	
107		89b-B-1	
108	54	DS2(DS No.7) STATUS PH.C	
109		89a-C-1	
110	55	DS2(DS No.7) STATUS PH.C	
111		89b-C-1	
112	56	DS2(DS No.7) MOTOR OVERLOAD	
113		MOTOR OVERRUN-1	
114	57	DS2(DS No.7) MOTOR OVERRUN	
115		MOTOR OVERRUN-1	
116	58	ES2 STATUS PH.A	
117		89a-A-1	
118	59	ES2 STATUS PH.A	
119		89b-A-1	
120	60	ES2 STATUS PH.B	
121		89a-B-1	
122	61	ES2 STATUS PH.B	
123		89b-B-1	
124	62	ES2 STATUS PH.C	
125		89a-B-1	
126	63	ES2 STATUS PH.C	
127		89b-B-1	
128	64	ES2 MOTOR OVERLOAD	
129		MOTOR OVERRUN-1	
130	65	ES2 MOTOR OVERRUN	
131		MOTOR OVERRUN-1	
132	66	DS3 STATUS PH.A	
133		89b-A-1	
134	67	DS3 STATUS PH.A	
135		89a-A-1	
136	68	DS3 STATUS PH.B	
137		89a-B-1	
138	69	DS3 STATUS PH.B	
139		89b-B-1	
140	70	DS3 STATUS PH.C	
		89a-C-1	

TO X1/71
DWG. TP-E-20.12 SH.3

PRIMARY MERGING UNIT
DIGITAL INPUT MODULE (DMU1)

TERMINAL X1	+ INDEX	DESCRIPTION	
1	1	SECONDARY MERGING UNIT FAIL	
2		DMU2 DMU2	
3	2	BKR LOW HYDRAULIC PRESSURE ALARM	
4		GIS HR(ST.1)-1	
5	3	BKR LOW HYDRAULIC PRESSURE LOCKOUT PH.A	
6		HR(ST.2)-A-1	
7	4	BKR LOW HYDRAULIC PRESSURE LOCKOUT PH.A	
8		HR(ST.2)-A-1	
9	5	BKR LOW HYDRAULIC PRESSURE LOCKOUT PH.B	
10		HR(ST.2)-B-1	
11	6	BKR LOW HYDRAULIC PRESSURE LOCKOUT PH.B	
12		HR(ST.2)-B-1	
13	7	BKR LOW HYDRAULIC PRESSURE LOCKOUT PH.C	
14		HR(ST.2)-C-1	
15	8	BKR LOW HYDRAULIC PRESSURE LOCKOUT PH.C	
16		HR(ST.2)-C-1	
17	9	BKR LOW GAS STAGE1 ALARM	
18		GR(ST.1)-1	
19	10	BKR LOW GAS STAGE2 LOCKOUT PH.A	
20		GR(ST.2)-A-1	
21	11	BKR LOW GAS STAGE2 LOCKOUT PH.A	
22		GR(ST.2)-A-1	
23	12	BKR LOW GAS STAGE2 LOCKOUT PH.B	
24		GR(ST.2)-B-1	
25	13	BKR LOW GAS STAGE2 LOCKOUT PH.B	
26		GR(ST.2)-B-1	
27	14	BKR LOW GAS STAGE2 LOCKOUT PH.C	
28		GR(ST.2)-C-1	
29	15	BKR LOW GAS STAGE2 LOCKOUT PH.C	
30		GR(ST.2)-C-1	
31	16	BKR SPRING CHARGE FAIL	
32		SL-FAIL-1	
33	17	BKR PH A SPRING BLOCKED	
34		SL-A-1	
35	18	BKR PH A SPRING BLOCKED	
36		SL-A-1	
37	19	BKR PH B SPRING BLOCKED	
38		SL-B-1	
39	20	BKR PH B SPRING BLOCKED	
40		SL-B-1	
41	21	BKR PH C SPRING BLOCKED	
42		SL-C-1	
43	22	BKR PH C SPRING BLOCKED	
44		SL-C-1	
45	23	BKR STATUS PH.A	
46		52a-A-1	
47	24	BKR STATUS PH.A	
48		52a-A-1	
49	25	BKR STATUS PH.B	
50		52a-B-1	
51	26	BKR STATUS PH.B	
52		52a-B-1	
53	27	BKR STATUS PH.C	
54		52a-C-1	
55	28	BKR STATUS PH.C	
56		52a-C-1	
57	29	BKR CLOSE COMMAND	
58		K1A-1	
59	30	BKR POLE DISAGREEMENT TRIP1 OPERATE	
60		62PD1-1	
61	31	BKR POLE DISAGREEMENT TRIP2 OPERATE	
62		62PD2-1	
63	32	BKR MOTOR OVERLOAD	
64		MOTOR OVERLOAD-1	
65	33	BKR MOTOR OVERRUN	
66		MOTOR OVERLOAD-1	
67	34	DS1(DS No.6) STATUS PH.A	*SEE NOTE 5 THIS DWG SH.3
68		89a-A-1	
69	35	DS1(DS No.6) STATUS PH.A	
70		89b-A-1	

เอกสารไม่ควรคัดลอก
รับรองสำเนาโดย นายอ.ว. แสงเดือน ลาวัลย์
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME: TYPICAL DRAWING	
DESIGNED C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING: DIGITAL SUBSTATION SYSTEM (GIS) 230KV EQUIPMENT STATUS AND ALARM	
VERIFIED SIRAPAT	APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE 23/3/2568	JOB NO.	REPLACING DWG.NO. / DWG.NO. TP-E-20.12 / REV. 2, 7

DWG.NO.	REV.
TP-E-20.12	3
	7
	-

NOTES

1. SCHEMATIC REPRESENTATION IS FOR GIS CONDITIONS AS FOLLOWS:
   - BKR, DS, AND ES IN OPEN POSITION
   - SPRING DISCHARGE/LOW HYDRAULIC PRESSURE
   - LOW GAS DENSITY
   - NO SUPPLY VOLTAGE
2. ANY CONTACTS OF 52a, 52b, 89a AND 89b FOR PROTECTION FUNCTION, INTERLOCKING CIRCUIT, AND FRS SHALL BE PURE CONTACT. ANY GIS EQUIPMENT CONTACTS WHICH CONNECT TO DMU1 AND DMU2 SHALL BE INDIVIDUAL CONTACT.
3. PROTECTION FUNCTION, INTERLOCKING CIRCUIT, AND FRS SHALL BE OF EARLY BREAK CONTACT TYPE. STATUS AND ALARM SHALL BE OF LATE MAKE CONTACT TYPE.
4. SHALL BE CONNECTED WITH CONTACTS OF PROTECTION, STATUS, ALARM AND FRS. DMU2 SHALL BE CONNECTED WITH CONTACTS OF PROTECTION ONLY.
5. STATUS CONTACTS OF DISCONNECTING SWITCH NUMBER 6 AND NUMBER 7 IN DOUBLE BUS SINGLE BREAKER ARRANGEMENT SHALL BE CONNECTED TO BOTH DMU1 AND DMU2.
6. CONTRACTOR SHALL PROVIDE SUFFICIENT QUANTITY OF DMU1'S I/O PORTS, ADDITIONALLY, FOR PROPRIETARY MANUFACTURER'S ALARM CONTACTS.

LEGEND

1. ▰ TERMINAL AT SWITCHYARD EQUIPMENT
2. • TERMINAL AT JUNCTION BOX/MU CUBICLE (OUTDOOR)

TERMINAL X1		PRIMARY MERGING UNIT DIGITAL INPUT MODULE (DMU1)			
	+	INDEX	DESCRIPTION		
141		71	DS3 STATUS PH.C	GIS	89a-C-1
142					
143		72	DS3 MOTOR OVERLOAD	MOTOR OVERLOAD-1	
144					
145		73	DS3 MOTOR OVERRUN	MOTOR OVERRUN-1	
146					
147		74	ES3 STATUS PH.A	89a-A-1	
148					
149		75	ES3 STATUS PH.A	89a-A-1	
150					
151		76	ES3 STATUS PH.B	89a-B-1	
152					
153		77	ES3 STATUS PH.B	89b-B-1	
154					
155		78	ES3 STATUS PH.C	89a-C-1	
156					
157		79	ES3 STATUS PH.C	89b-C-1	
158					
159		80	ES3 MOTOR OVERLOAD	MOTOR OVERLOAD-1	
160					
161		81	ES3 MOTOR OVERRUN	MOTOR OVERRUN-1	
162					
163		82	BKR 43LR POSITION LOCAL	43LR-LOCAL	
164					
165		83	BKR 43LR POSITION REMOTE	43LR-REMOTE	
166					
167		84	BKR 43TEST POSITION PH A	43TEST-PHA	
168					
169		85	BKR 43TEST POSITION PH B	43TEST-PHB	
170					
171		86	BKR 43TEST POSITION PH C	43TEST-PHC	
172					
173		87	BKR 43TEST POSITION 3 PH	43TEST-3PH	
174					
175		88	230KV LCC 43NM POSITION MAINTENANCE	43-MAINT	
176					
177		89	230KV LCC 43NM POSITION NORMAL	43-NOR	
178					
179		90	400/230VAC SUPPLY FAIL	27	
180					
181		91	125VDC CIRCUIT 1 SUPPLY FAIL	27XB1	
182					
183		92	125VDC CIRCUIT 2 SUPPLY FAIL	27XB2	
184					
185		93	125VDC CIRCUIT 3 SUPPLY FAIL	27XB3	
186					
187		94	125VDC CIRCUIT 4 SUPPLY FAIL	27XB4	
188					
189		95	PROPRIETARY MANUFACTURER'S ALARM A	ALARM A	
190					
191		96	PROPRIETARY MANUFACTURER'S ALARM A	ALARM A	
192					
193		97	PROPRIETARY MANUFACTURER'S ALARM B	ALARM B	
194					
195		98	PROPRIETARY MANUFACTURER'S ALARM B	ALARM B	
196					
197		99	PROPRIETARY MANUFACTURER'S ALARM C	ALARM C	
198					
		100	PROPRIETARY MANUFACTURER'S ALARM C	ALARM C	
		101			
		102	PROPRIETARY MANUFACTURER'S ALARM N	ALARM N	*SEE NOTE 6 THIS DWG
		103	PROPRIETARY MANUFACTURER'S ALARM N		

TO X1/70
DWG. TP-E-20.12 SH.2

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รับรองสำเนาถูกต้อง โดย หน.ฝ.ว. กสส-ร. อวส.
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
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14 ตุลาคม 2568

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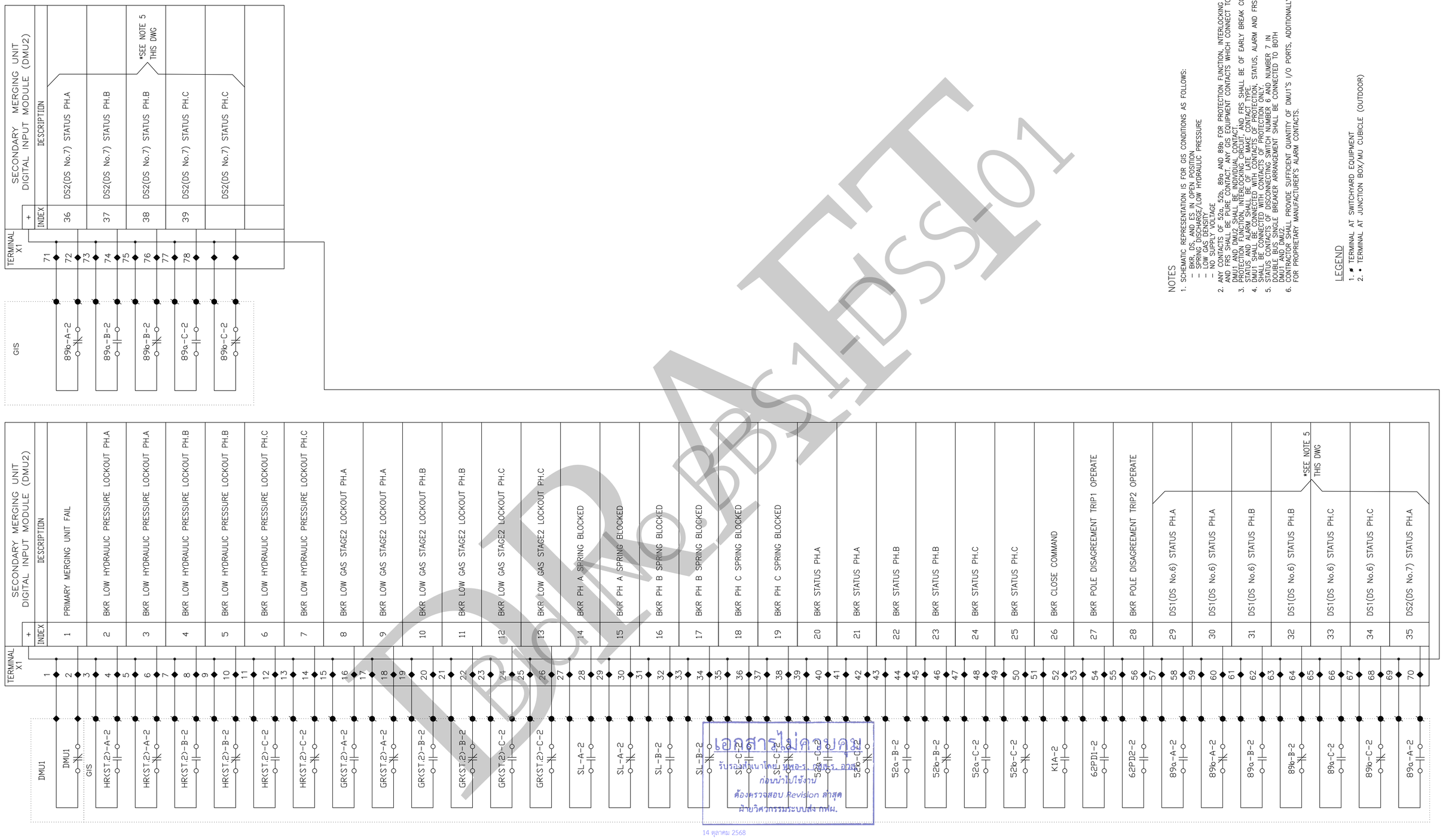
REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING DIGITAL SUBSTATION SYSTEM (GIS) 230KV EQUIPMENT STATUS AND ALARM
VERIFIED	SIRAPAT		
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.12 / REV. 3 / 7



NOTES

1. SCHEMATIC REPRESENTATION IS FOR GIS CONDITIONS AS FOLLOWS:
   - BKR, DS, AND ES IN OPEN POSITION
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6. STATUS CONTACTS OF DISCONNECTING SWITCH NUMBER 6 AND NUMBER 7 IN DOUBLE BUS SINGLE BREAKER ARRANGEMENT SHALL BE CONNECTED TO BOTH DMU1 AND DMU2.
7. CONTRACTOR SHALL PROVIDE SUFFICIENT QUANTITY OF DMU1'S I/O PORTS, ADDITIONALLY, FOR PROPRIETARY MANUFACTURER'S ALARM CONTACTS.

LEGEND

1. ▰ TERMINAL AT SWITCHYARD EQUIPMENT
2. ▪ TERMINAL AT JUNCTION BOX/MU CUBICLE (OUTDOOR)

เอกสารไม่ควบคุม
รับรองสำเนาโดย นายอ... ...สิทธิ์ ... ลาวัล
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
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REV.	DWG.NO.
4	TP-E-20.12
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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

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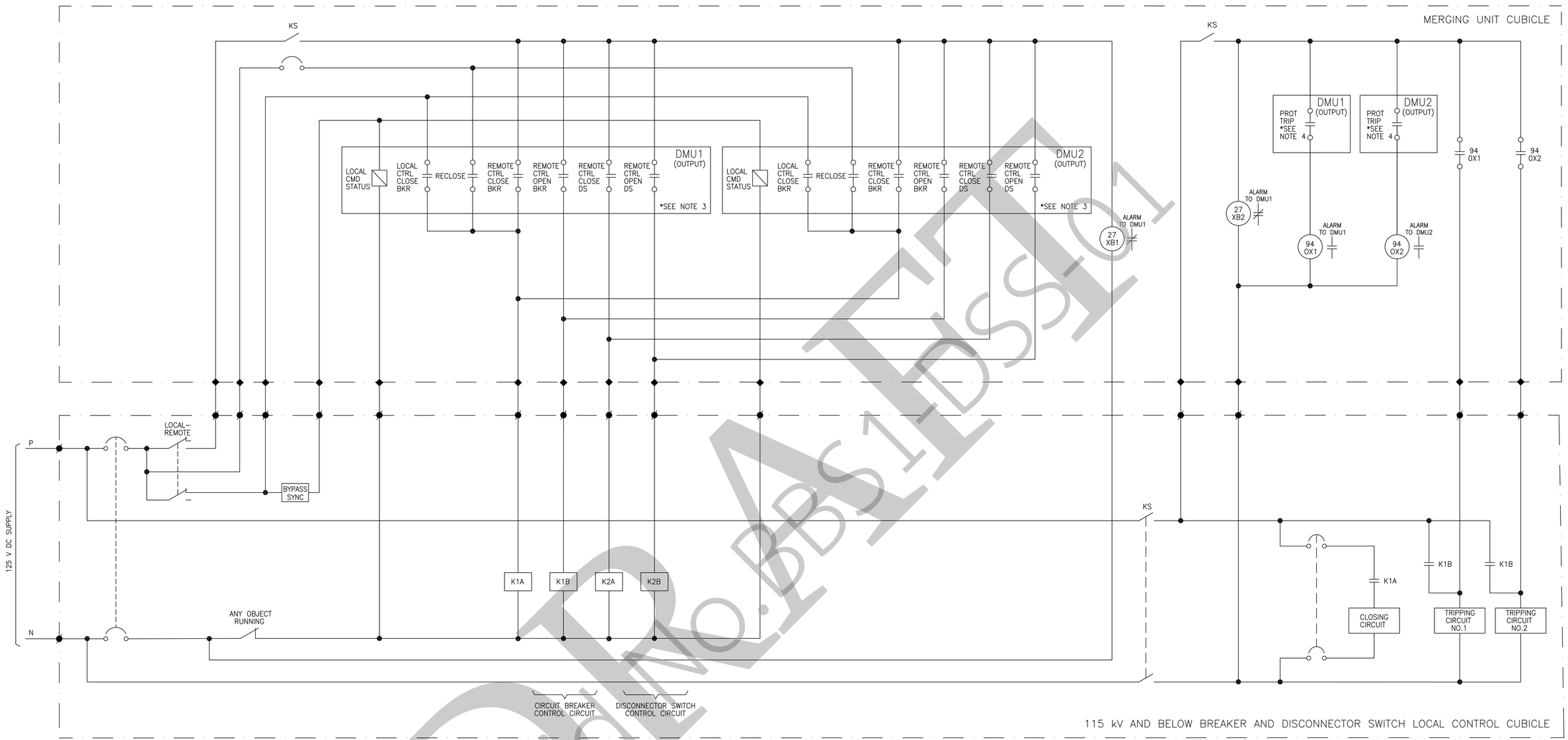
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING DIGITAL SUBSTATION SYSTEM (GIS) 230KV EQUIPMENT STATUS AND ALARM
VERIFIED	SIRAPAT		
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.12 / REV. 4, 7, -

115 kV AND BELOW GIS BREAKER & DISCONNECTOR SWITCH CONTROL SCHEMATIC DIAGRAM



LEGEND

1. ● TERMINAL AT SWITCHYARD EQUIPMENT
2. ◆ TERMINAL AT JUNCTION BOX/MU CUBICLE (OUTDOOR)
3. ■ TERMINAL AT 125 VDC DISTRIBUTION BOARD

REFERENCE

1. SPECIFICATION NO. 1008.

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รับรองสำเนาโดย หหอ-ร. กสธ-ร. อวส.
ก่อนนำไปใช้งาน
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ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

NOTES

1. PLEASE REFER TO MANUFACTURER'S DRAWINGS FOR THE ACTUAL CONTROL SCHEMATICS OF CIRCUIT BREAKERS AND OTHER SUBSTATION EQUIPMENT.
2. THE SIZE OF TERMINAL BLOCKS IN MERGING UNIT CABINET FOR DC SUPPLY, CT CIRCUIT, PT CIRCUIT, CONTROL CIRCUIT AND ALARM IS AS DESCRIBED IN SPECIFICATION NO. 1008.
3. INCLUDING 86A BLOCK CLOSE LOGIC CIRCUIT.
4. INCLUDING 86A TRIP LOGIC CIRCUIT.
5. EACH 125 VDC SUPPLY CIRCUIT SHALL BE USED FOR ALL MERGING UNIT CABINETS IN EACH DIAMETER WITH THE SUITABLE RATING MCB OF DPP.
6. 125 VDC SUPPLY SHALL USE 125 VDC DISTRIBUTION BOARD AT GIS BUILDING.

LEGEND	DESCRIPTION
MU	MERGING UNIT
DMU	DIGITAL MERGING UNIT
AMU	ANALOG MERGING UNIT
CMU	CONDITION MERGING UNIT
K1A	AUXILIARY RELAY FOR CLOSING CIRCUIT BREAKER
K1B	AUXILIARY RELAY FOR TRIPPING CIRCUIT BREAKER
K2A	AUXILIARY RELAY FOR CLOSING DISCONNECTOR SWITCH
K2B	AUXILIARY RELAY FOR TRIPPING DISCONNECTOR SWITCH
CTRL	CONTROL
BKR	CIRCUIT BREAKER
DS	DISCONNECTOR SWITCH
27X	DC UNDERVOLTAGE RELAY
KS	KNIFE SWITCH
–o o–	MINIATURE CIRCUIT BREAKER

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
–	–	–	C.KANITHA	C.KANITHA	–	–	–	–	–	–

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED	DRAWING NAME: TYPICAL DRAWING
DESIGNED	C.KANITHA	CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DESCRIPTION OF DETAIL DRAWING: DIGITAL SUBSTATION SYSTEM (GIS) 115 kV AND BELOW BREAKER CONTROL SCHEMATIC DIAGRAM
VERIFIED	SIRAPAT	CONCURRED: ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION–1	
APPROVED	DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP–E–20.12 / REV. 5 7 –

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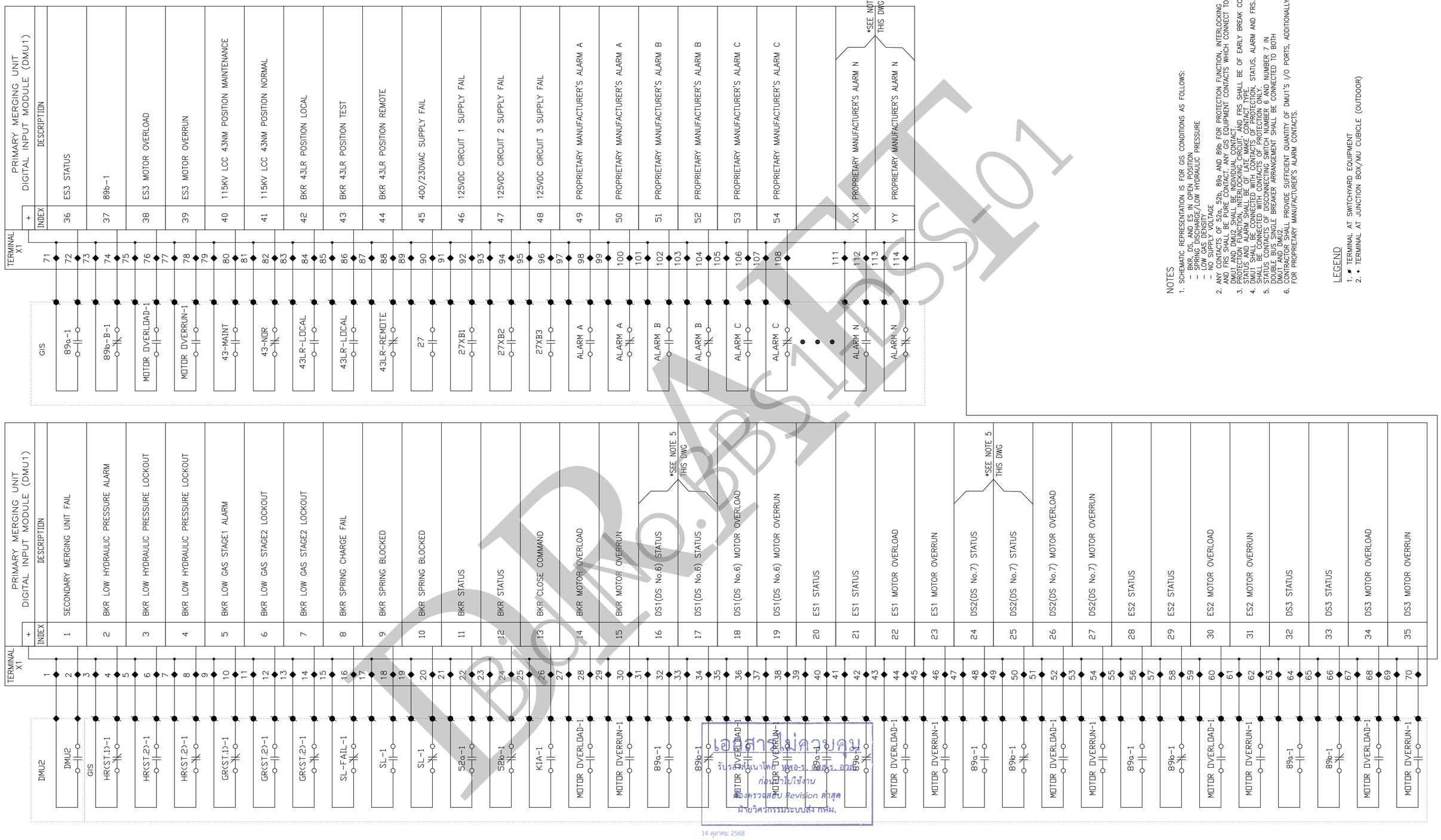

NOTES

1. SCHEMATIC REPRESENTATION IS FOR GIS CONDITIONS AS FOLLOWS:
   - BKR, DS, AND ES IN OPEN POSITION
   - SPRING DISCHARGE/LOW HYDRAULIC PRESSURE
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LEGEND

1. ▰ TERMINAL AT SWITCHYARD EQUIPMENT
2. • TERMINAL AT JUNCTION BOX/MU CUBICLE (OUTDOOR)

เอกสารไม่ควบคุม
รับรองว่าเป็นโครงการ กฟผ. ที่ได้รับ อนุมัติ
ก่อนนำไปใช้งาน
ต้องตรวจสอบ Revision ล่าสุด
ฝ่ายวิศวกรรมระบบส่ง กฟผ.
14 ตุลาคม 2568

REV.	DWG.NO.
6	TP-E-20.12
7	
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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

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ELECTRICITY GENERATING AUTHORITY OF THAILAND

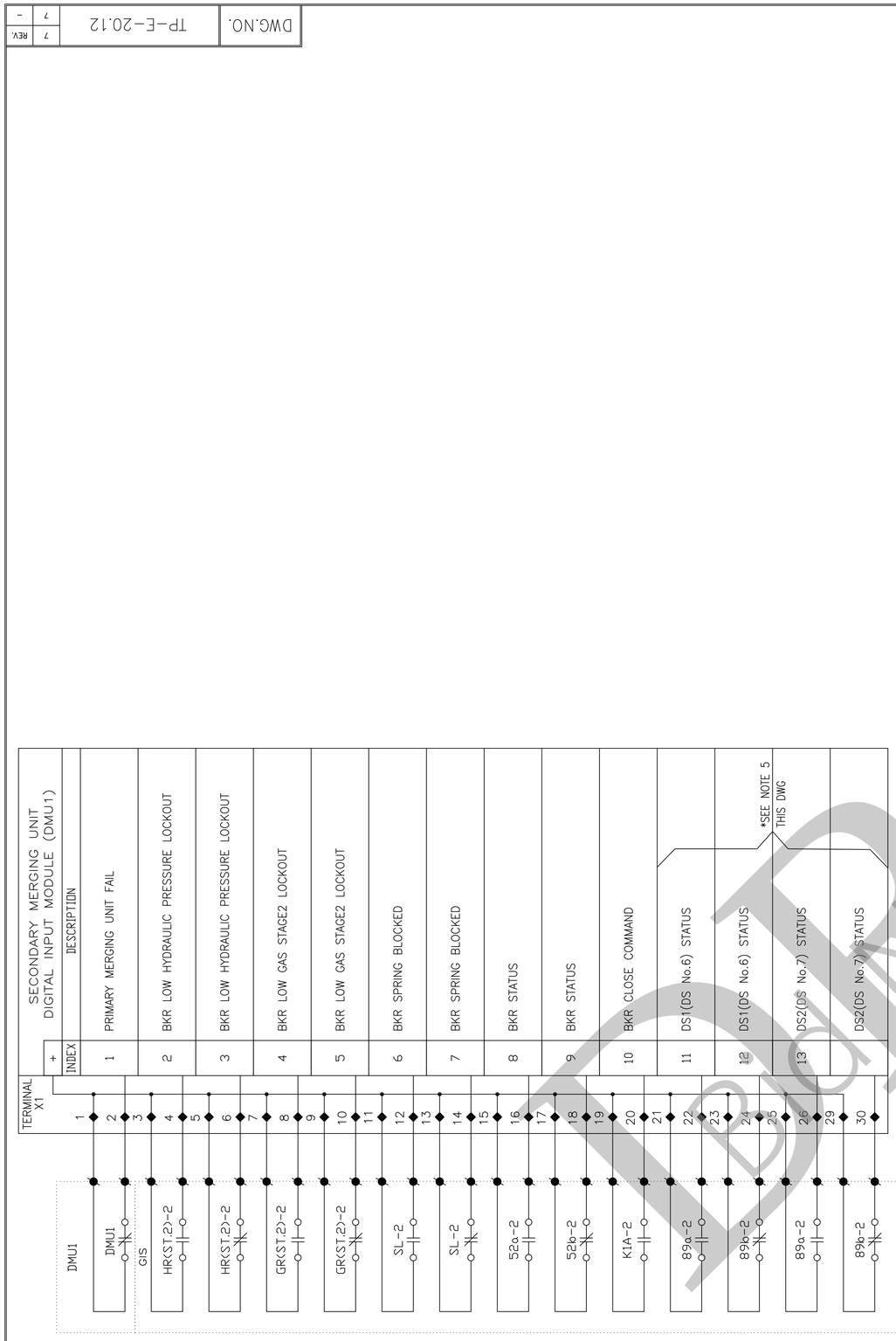
DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM-ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING DIGITAL SUBSTATION SYSTEM (GIS) 115 kV AND BELOW EQUIPMENT STATUS AND ALARM
VERIFIED	SIRAPAT		
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.12 / REV. 6, 7

NOTES

1. SCHEMATIC REPRESENTATION IS FOR GIS CONDITIONS AS FOLLOWS:
   - BKR, DS, AND ES IN OPEN POSITION
   - SPRING DISCHARGE/LOW HYDRAULIC PRESSURE
   - LOW GAS DENSITY
   - NO SUPPLY VOLTAGE
2. ANY CONTACTS OF 52a, 52b, 89a AND 89b FOR PROTECTION FUNCTION, INTERLOCKING CIRCUIT, AND FRS SHALL BE PURE CONTACT, ANY GIS EQUIPMENT CONTACTS WHICH CONNECT TO DMU1 AND DMU2 SHALL BE INDIVIDUAL CONTACT.
3. PROTECTION FUNCTION, INTERLOCKING CIRCUIT, AND FRS SHALL BE OF EARLY BREAK CONTACT TYPE.
4. STATUS AND ALARM SHALL BE OF LATE MAKE CONTACT TYPE.
5. DMU1 SHALL BE CONNECTED WITH CONTACTS OF PROTECTION, STATUS, ALARM AND FRS. DMU2 SHALL BE CONNECTED WITH CONTACTS OF PROTECTION ONLY.
6. STATUS CONTACTS OF DISCONNECTING SWITCH NUMBER 6 AND NUMBER 7 IN DOUBLE BUS SINGLE BREAKER ARRANGEMENT SHALL BE CONNECTED TO BOTH DMU1 AND DMU2.
7. CONTRACTOR SHALL PROVIDE SUFFICIENT QUANTITY OF DMU1'S I/O PORTS, ADDITIONALLY, FOR PROPRIETARY MANUFACTURER'S ALARM CONTACTS.

LEGEND

1. ■ TERMINAL AT SWITCHYARD EQUIPMENT
2. ● TERMINAL AT JUNCTION BOX/MU CUBICLE (OUTDOOR)



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REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	-	C.KANITHA	C.KANITHA	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME TYPICAL DRAWING
DESIGNED	C.KANITHA	CONCURRED ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	DESCRIPTION OF DETAIL DRAWING DIGITAL SUBSTATION SYSTEM (GIS) 115 kV AND BELOW EQUIPMENT STATUS AND ALARM
VERIFIED	SIRAPAT		
APPROVED DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION		DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.12 / REV. 7 / 7

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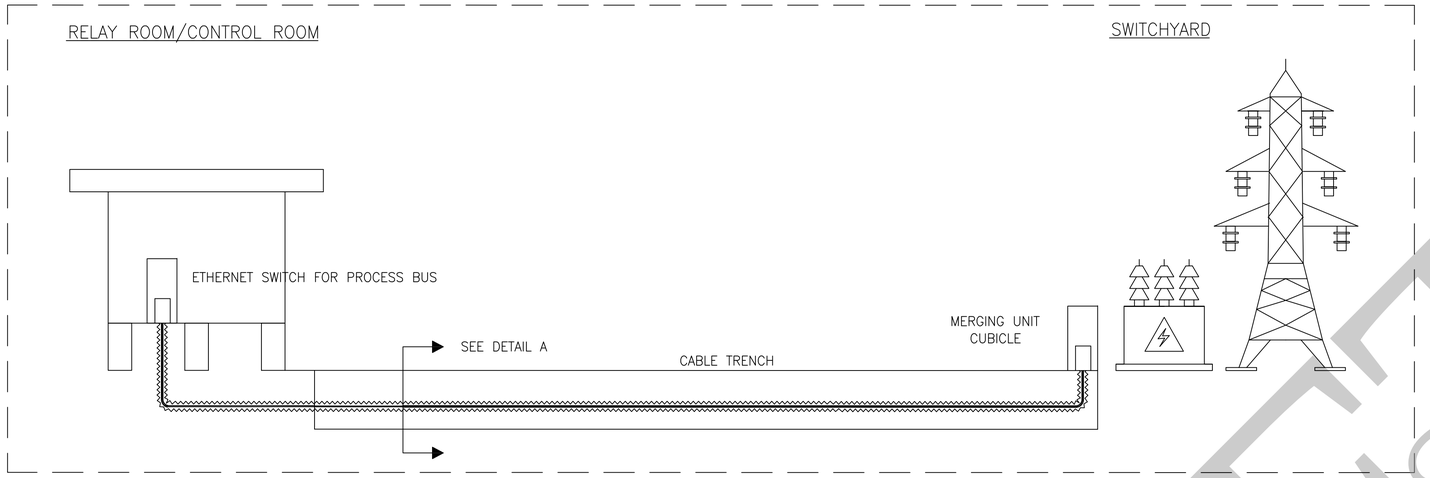
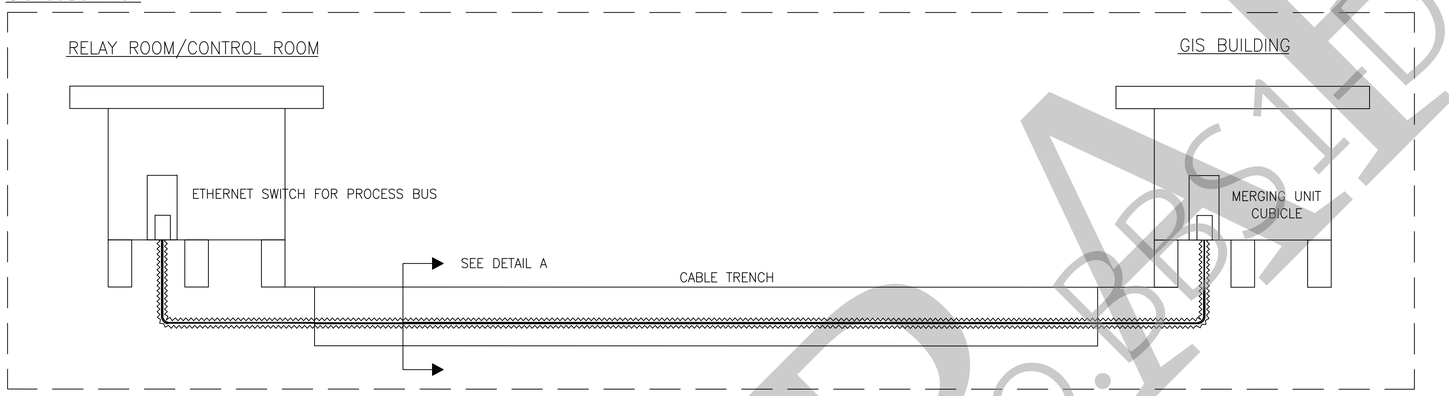
TP-E-20.13	-

AIS SUBSTATION



GIS SUBSTATION



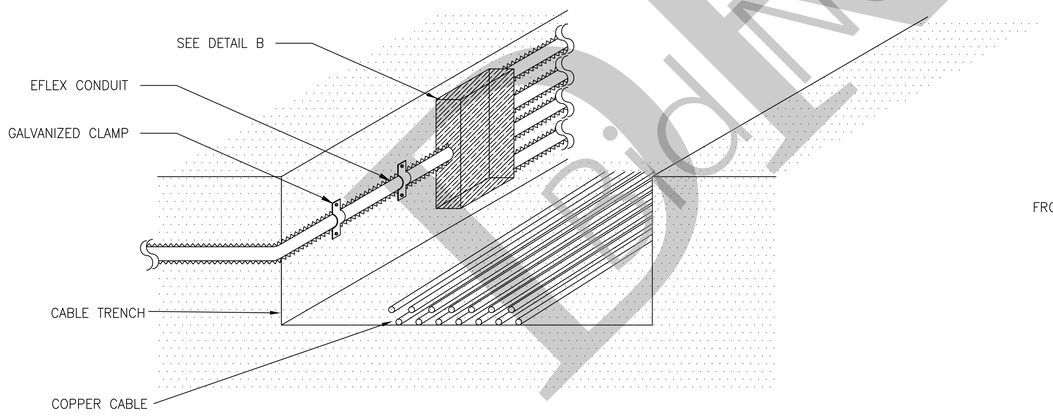
LEGEND	DESCRIPTION
~~	EFLEX CONDUIT
———	OPTIC FIBER CABLE

NOTES

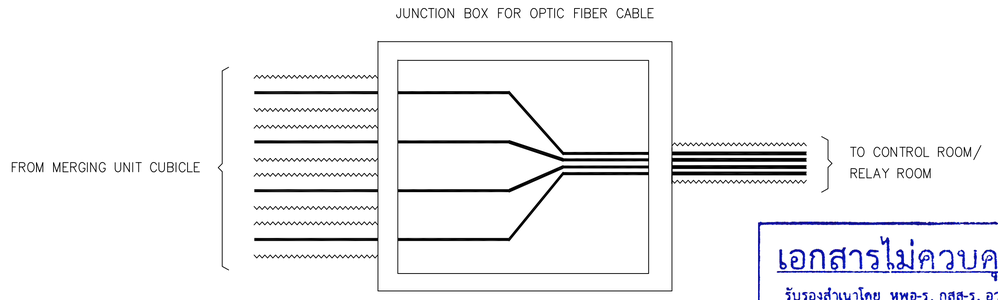
1. BENDING RADIUS SHALL BE 20 TIMES OF THE EXTERNAL DIAMETER OF OPTIC FIBER CABLE (OFC).
2. DIAMETER OF EFLEX CONDUIT IS 50 MILLIMETERS.
3. ONE (1) EFLEX CONDUIT SHALL CONTAIN ONLY OFC('S) FROM EACH LAN OF EACH MERGING UNIT CUBICLE.
4. ONE (1) EFLEX CONDUIT SHALL CONTAIN NOT MORE THAN FOUR (4) OFC'S.
5. EFLEX CONDUIT WHICH ARE CONNECTED TO ONE SIDE OF THE JUNCTION BOX SHALL HAVE NO MORE THAN FOUR (4).
6. THE EFLEX CONDUIT SHALL BE MADE OF HIGH-DENSITY POLYETHYLENE WITH SPIRAL CORRUGATED PIPE SHAPE WHICH IS HIGHLY CORROSION, WEATHER RESISTANT, FLEXIBLE, MECHANICALLY STRONG AND SUITABLE FOR INSTALLATION IN CABLE TRENCH.
7. JUNCTION BOX FOR OFC SHALL BE MADE OF WATER RESISTANCE, WEATHER RESISTANT AND SUFFICIENTLY RUGGED AND STURDY TO WITHSTAND OUTDOOR CLIMATIC AND ENVIRONMENT CONDITIONS.
8. THE COVER OF JUNCTION BOX FOR OFC SHALL BE SECURELY FASTENED TO THE CASE BY NON-LOOSENING FASTENERS. BOTH THE CASE AND THE COVER INCLUDING MOUNTING BRACKET AND ITS ACCESSORIES SHALL BE MADE OF METALLIC MATERIAL WITH SUFFICIENT GALVANIZED OR EQUIVALENT SUBSTANCE COATING IN ORDER TO PREVENT ANY CHEMICAL REACTIONS, SUCH AS RUSTING, ON THE FACE OF THE EQUIPMENT.
9. DISTANCE BETWEEN GALVANIZED CLAMPS IS 1 TO 1.5 METERS.

REFERENCES

1. SPECIFICATION NO.1008



DETAIL A



DETAIL B

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14 ตุลาคม 2568

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	ROUTING AND INSTALLATION OF OPTIC FIBER CABLE	C.KANITHA	C.KANITHA	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.KANITHA	RECOMMENDED AND VALIDATED	DRAWING NAME
DESIGNED	C.KANITHA	CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	TYPICAL DRAWING
VERIFIED	SIRAPAT	CONCURRED	DESCRIPTION OF DETAIL DRAWING
APPROVED		ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	ROUTING AND INSTALLATION OF OPTIC FIBER CABLE
		DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.13 / REV. - -

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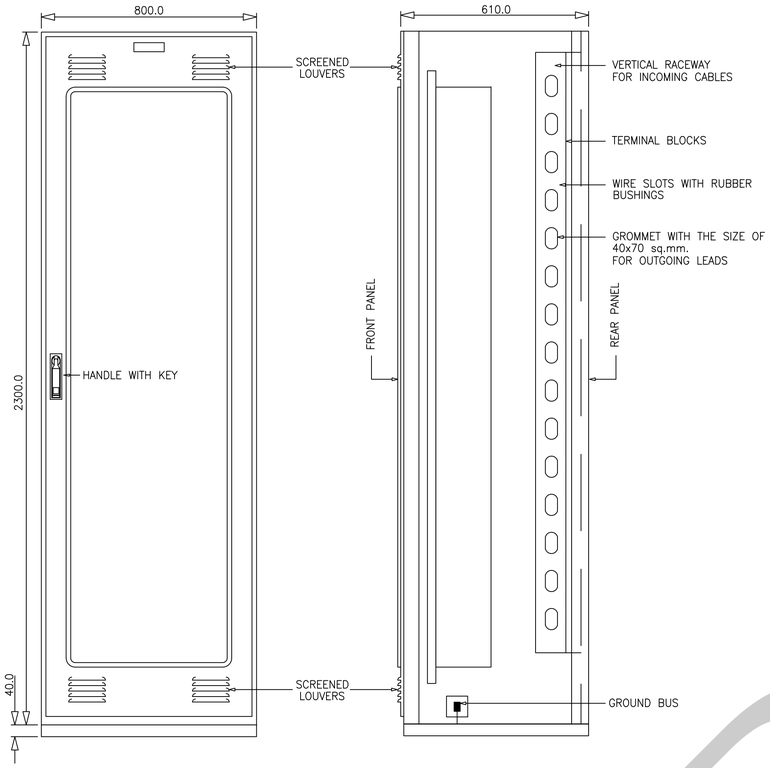
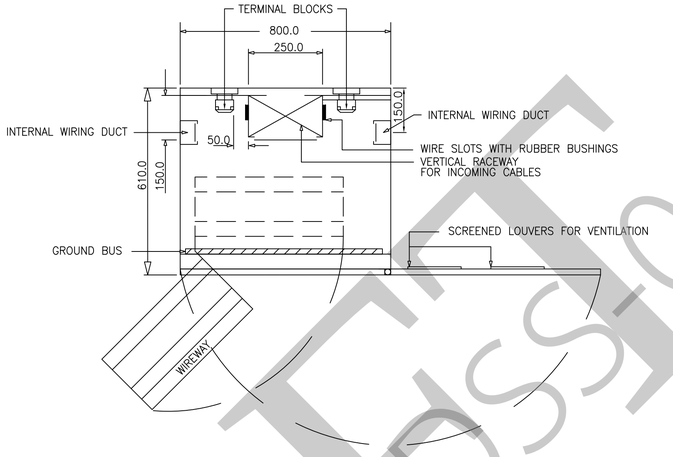
SWING RACK TYPE
PROTECTIVE RELAY SWITCHBOARD



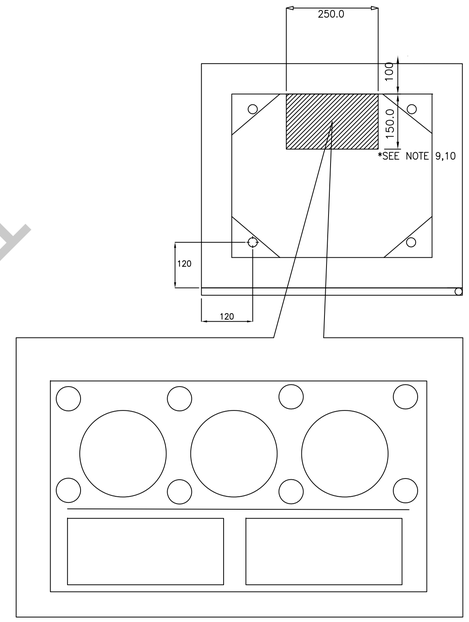
FRONT VIEW TYPICAL UNIT

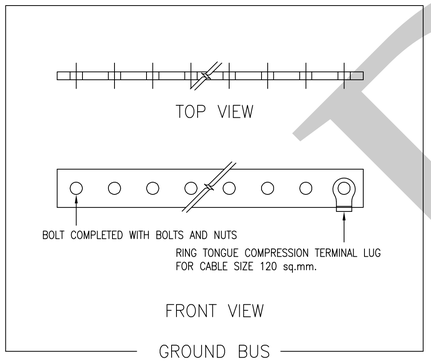
SIDE SECTION VIEW TYPICAL UNIT

TOP SECTION VIEW TYPICAL UNIT



FOUNDATION PLATE





NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. THE DEGREE OF PROTECTION SHALL BE AT LEAST IP3X AS PER IEC 60529.
3. THE INSIDE AND OUTSIDE OF THE PANEL SHALL BE FINISH–PAINTED WITH ANSI 61 MEDIUM GRAY OR RAL 7036 SEMI GLOSS.
4. THE RELAY RACK ASSEMBLY SHALL BE ABLE TO SWING THROUGH NOT LESS THAN 120 DEGREE FROM THE CLOSED POSITION AND BE INSTALLED WITH TOOLS TO HOLD IT OPEN.
5. THE FLOOR CLOSING PLATES SHALL BE STRONG ENOUGH TO WITHSTAND AT LEAST 100 kg.
6. THE VERTICAL RACEWAY SHALL BE MADE FROM STEEL.
7. THE LED LAMP SHALL AT LEAST BE 9 W.
8. THIS DRAWING SHOWS GENERAL REQUIREMENTS FOR THE CONSTRUCTION OF THE PANEL. THE CONTRACTOR SHALL SUBMIT THE DETAILED DESIGN
9. CABLE ENTRY MANAGEMENT SHALL BE HAD FUNCTIONS AS FOLLOWS:
   - MARSHALLING FOR ALL OF CABLE ENTRY
   - FIRE SPREADING STOPPER
   - MOISTURE PREVENTION
10. SPARES OF CABLE ENTRY WHICH ARE POWER CABLE AND FIBER OPTIC SHALL BE PROVIDED AT LEAST 50% OF THE ACTUAL USING.

REFERENCES

1. SPECIFICATION NO.1008

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14 ตุลาคม 2568

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Bid No.PBS1-DSS01

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
–	–	DESIGNED SWING RACK TYPE PANEL FOR DIGITAL SUBSTATION.	C.KANITHA	C.KANITHA	–	–	–	–	–	–

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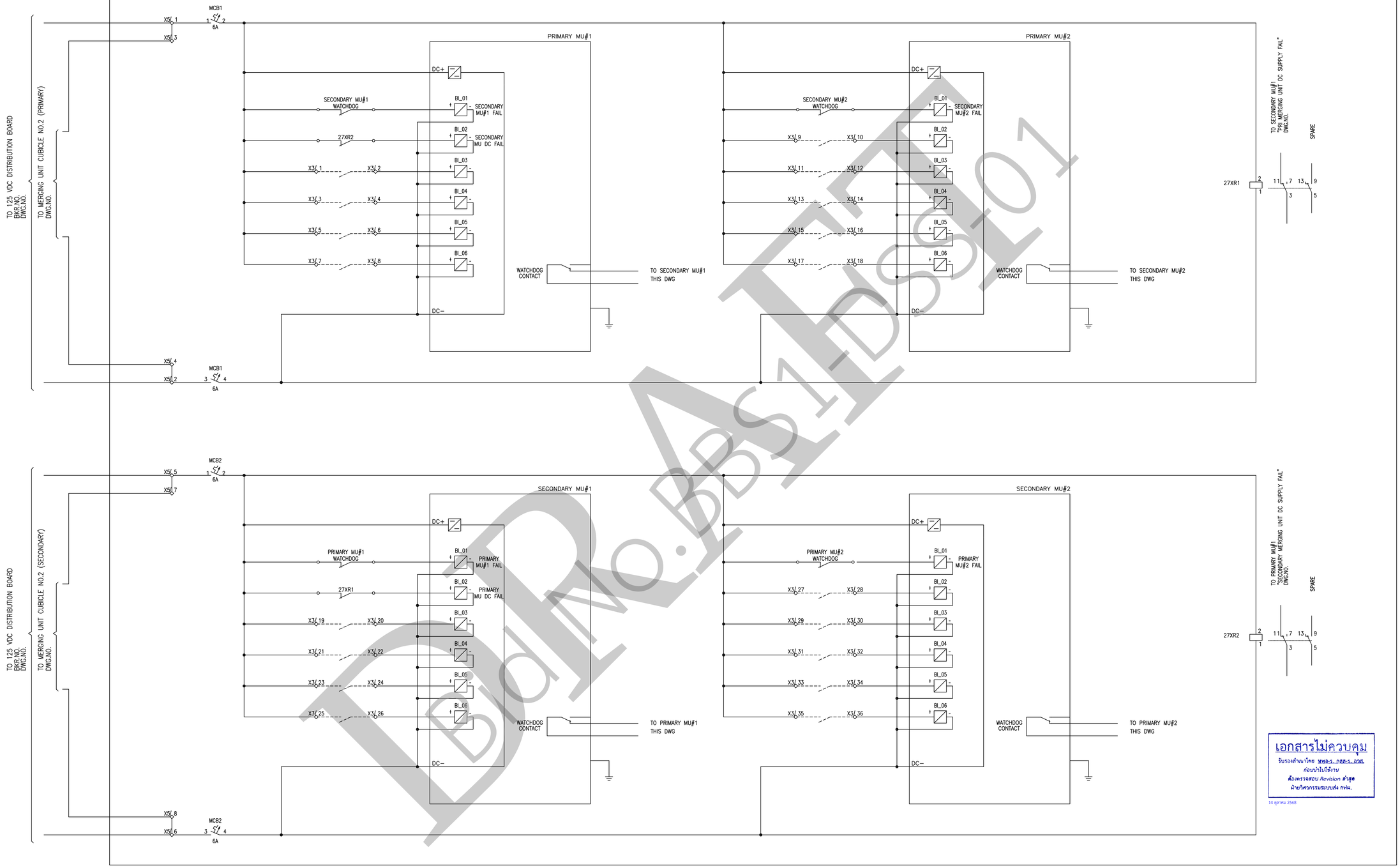
ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN C.KANITHA	RECOMMENDED AND VALIDATED — CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	DRAWING NAME	TYPICAL DRAWING
DESIGNED C.KANITHA			
VERIFIED S.T.RAPAT	CONCURRED — ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION–1	DESCRIPTION OF DETAIL DRAWING	SWING RACK TYPE FOR DIGITAL SUBSTATION
APPROVED — DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION	DATE 23/3/2568	JOB NO.	REPLACING DWG.NO. / DWG.NO. TP–E–20.14 / REV. – –

DWG.NO.	REV.
TP-E-20.15	-

MERGING UNIT CUBICLE NO.1



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14 ตุลาคม 2568

BID NO.BD-01

REV.NO.	JOB NO.	JOB DESCRIPTION	DRAWN	DESIGNED	VERIFIED	VALIDATED	RECOMMENDED	CONCURRED	APPROVED	DATE
-	-	125 VDC SUPPLY FOR MERGING UNIT	C.WANNAPORN	C.WANNAPORN	-	-	-	-	-	-

ELECTRICITY GENERATING AUTHORITY OF THAILAND

DRAWN	C.WANNAPORN	RECOMMENDED AND VALIDATED	DRAWING NAME
DESIGNED	C.WANNAPORN	CHIEF, CONTROL AND PROTECTION SYSTEM ENGINEERING DEPARTMENT	TYPICAL DRAWING
VERIFIED	...ศ.ร.ถ.ท.ส.ท	CONCURRED	DESCRIPTION OF DETAIL DRAWING
APPROVED		ASSISTANT DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION-1	125 VDC SUPPLY FOR MERGING UNIT
		DIRECTOR, TRANSMISSION SYSTEM ENGINEERING DIVISION DATE 23/3/2568	JOB NO. / REPLACING DWG.NO. / DWG.NO. TP-E-20.15 / REV. - -

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