

การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย

**REGISTRATION FORM**

INVITATION TO BID NO. ESCL-S-01

FOR SUPPLY AND CONSTRUCTION OF BATTERY ENERGY STORAGE SYSTEM

AT 115 kV CHAI BADAN AND 115 kV BAMNET NARONG SUBSTATIONS

THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM

AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY

AVAILABLE DURATION FOR PURCHASING March 7, 2018 TO April 12, 2018

PRICE USD 480.- OR THB 15,000.-

**COMPLETE DATA IS REQUIRED FOR THE BIDDER'S OWN BENEFITS**

(โปรดกรอกรายละเอียดให้ครบถ้วนเพื่อประโยชน์ของบริษัท)

**Step 2 : Bring the payment receipt and filled-out registration Form (in English) to receive the bidding documents at Transmission System Development Area Foreign Procurement Department (Room No. 1202/2, 12<sup>th</sup> Floor, Building Tor. 101) Tel no. 02 436 0241-42**

FOR PURCHASER			TAX ID :	
NO.	RECEIPT NO. :	DATE :	PURCHASER (ผู้ซื้อ):	
BIDDER'S NAME (บริษัทผู้ซื้อเอกสาร)				
ADDRESS (ที่อยู่)		COUNTRY :		
ATTN. (ผู้รับผิดชอบ):		FAX NO.:	TEL.:	
E-mail :		e-GP Registration Date :		
LOCAL REPRESENTATIVE (ตัวแทนในประเทศ)				
ADDRESS (ที่อยู่)		TAX ID :		
ATTN. (ผู้รับผิดชอบ):		FAX NO.:	TEL.:	
E-mail :				

FOR PROCUREMENT OFFICER		CHANGE OF BIDDER'S NAME	TAX ID :	
BIDDER'S LETTER NO. :		DATED :		
NEW BIDDER'S NAME (ชื่อผู้ซื้อเอกสารเปลี่ยนเป็น)				
ADDRESS (ที่อยู่)		COUNTRY :		
ATTN. (ผู้รับผิดชอบ):		FAX NO.:	TEL.:	
E-mail :				
LOCAL REPRESENTATIVE (ตัวแทนในประเทศ)				
ADDRESS (ที่อยู่)		TAX ID :		
ATTN. (ผู้รับผิดชอบ):		FAX NO.:	TEL.:	
E-mail :		e-GP Registration Date :		
FOR PROCUREMENT OFFICER		FOR PURCHASER		
Procurement Officer (ผู้ส่งมอบเอกสาร)		Document received by (ผู้รับมอบเอกสาร)		

**Step 1 : Submit this part for payment at Receivable Cashier Section (1<sup>st</sup> Floor, TOR 100 Bldg., Counter 4-8) Tel no. 02 436 5512**

FOR PURCHASER		TAX ID :	
BIDDER'S NAME (บริษัทผู้ซื้อเอกสาร)			
ADDRESS (ที่อยู่)			
BID NO. <u>ESCL-S-01</u>	PRICE <u>USD 480.- OR THB 15,000.-</u> DURATION FOR PURCHASING <u>March 7, 2018</u> TO <u>April 12, 2018</u>		

Transmission System Development Area Foreign Procurement Department Tel no. 02 436 0241-42

(รพพศ.)



**INVITATION TO BID NO. ESCL-S-01**  
**SUPPLY AND CONSTRUCTION OF BATTERY ENERGY STORAGE SYSTEM**  
**AT 115 KV CHAI BADAN AND 115 KV BAMNET NARONG SUBSTATIONS**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF**  
**ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR**  
**MITIGATING IMPACT FROM RENEWABLE ENERGY**

The Electricity Generating Authority of Thailand (EGAT) is calling for the subject Invitation to Bid to be financed by EGAT's fund. The escalation factor (K) for price adjustment is applied to this Bid.

**Place of Construction** : Chai Badan and Bamnet Narong Substations

**Medium Cost (including Value Added Tax and other expenses)** : THB 1,465,000,000.-

**Eligibility of Bidders**

1. The Bidder shall be a juristic person who provides such services and shall not be named in the List of Work Abandoners published by the Office of Prime Minister and/or in the Debarment List and/or in the List of Work Abandoners declared by EGAT.
2. The Bidder shall neither fail to submit the Revenue and Expense Accounts nor fail to present proper and complete accounts under the Notification of National Anti-Corruption Commission Concerning Principles and Methods of Preparing Revenue and Expense Accounts of Project between Individual/Company and Government Agencies B.E. 2554 (A.D. 2011) issued on August 11, 2011 as amended from time to time ("the Notification").
3. The Bidder shall register for e-Government Procurement (e-GP) at Thai Government Procurement website ([www.gprocurement.go.th](http://www.gprocurement.go.th) at telephone No. 66 2127 7386 – 89) of the Comptroller General's Department of Thailand.
4. 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.
5. 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.
6. 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.
7. 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.

*Wilannat Osotpavapost*

### Availability of Bidding Documents

Bidding Documents in CD-ROM will be available for examination of Bidder's Qualifications and purchase during 8:00 hrs. to 15:00 hrs., Bangkok Standard Time, as from March 7, 2018 to April 12, 2018 at USD 480.- or THB 15,000.- per copy, non-refundable, at the following address :

Transmission System Development Area Foreign Procurement Department  
(Room No. 1202/2, 12<sup>th</sup> Floor, Building Tor. 101)  
Foreign Supply and Procurement Division  
Electricity Generating Authority of Thailand  
Bangkruai, Nonthaburi 11130, Thailand  
Fax no. 66 2433 6317, 66 2433 5523, 66 2434 4064  
Telephone no. 66 2436 0242  
E-mail : [procurement.tse@egat.co.th](mailto:procurement.tse@egat.co.th)

For more details and downloading Registration Form for purchasing Bidding Documents on website : <http://www4.egat.co.th/fprocurement/biddingeng/>

Payment can be made by a certified cheque or money order payable to EGAT or by a telegraphic transfer to EGAT's current 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.

Bidding Documents in CD-ROM will be either airmailed or airfreighted to the buyer at EGAT's expense upon receipt of the relevant remittance. In case the buyer requires the Bidding Documents to be sent by Express Mail Service (EMS), the charge will be at the buyer's expense.

### Delivery of Bids

Price and Technical Proposals shall be submitted at Room No. 1202/1, 12<sup>th</sup> Floor, Building Tor. 101 during 9:30 hrs. to 10:00 hrs., Bangkok Standard Time, May 8, 2018 and Technical Proposal will be opened publicly at 10:00 hrs.

ELECTRICITY GENERATING AUTHORITY OF THAILAND

February 23, 2018

*Nilanate Osotpavapusit*

(Mrs. Nilanate Osotpavapusit)

Chief, Transmission System Development Area  
Foreign Procurement Department



## ประกาศการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย

### เรื่อง ประกวดราคาจ้าง เลขที่ ESCL-S-01

การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย (กฟผ.) มีความประสงค์จะจัดหาและจ้างก่อสร้าง Battery Energy Storage System ที่สถานีไฟฟ้าแรงสูง 115 kV ชัยบาดาล และ 115 kV บำเหน็จณรงค์ ภายใต้โครงการปรับปรุง/แก้ปัญหาาระบบส่งไฟฟ้าโดยการติดตั้งระบบกักเก็บพลังงานที่จังหวัดชัยภูมิและลพบุรี เพื่อรองรับผลกระทบจากพลังงานหมุนเวียน โดยทำสัญญาแบบปรับราคาได้ (ค่า k) โดยใช้ขบประมาณ กฟผ.

**สถานที่ก่อสร้าง :** สถานีไฟฟ้าแรงสูงชัยบาดาลและสถานีไฟฟ้าแรงสูงบำเหน็จณรงค์

**ราคากลาง (รวมภาษีมูลค่าเพิ่มและค่าใช้จ่ายอื่นๆ) :** 1,465,000,000.- บาท

#### คุณสมบัติของผู้เสนอราคา

1. ต้องเป็นนิติบุคคลผู้มีอาชีพรับจ้างตามประกวดราคาจ้างดังกล่าว และต้องไม่เป็นผู้ทำงานซึ่งสำนักนายกรัฐมนตรีได้แจ้งเวียนชื่อไว้ หรือต้องไม่เป็นผู้ที่ กฟผ. ห้ามติดต่อหรือห้ามเข้าเสนอราคา หรือต้องไม่เป็นผู้ที่ได้รับผลของการสั่งให้นิติบุคคลหรือบุคคลอื่นเป็นผู้ทำงานตามคำสั่ง กฟผ.
2. ต้องไม่อยู่ในฐานะเป็นผู้ไม่แสดงบัญชีรายรับรายจ่าย หรือแสดงบัญชีรายรับรายจ่ายไม่ถูกต้องครบถ้วนในสาระสำคัญ ตามประกาศคณะกรรมการป้องกันและปราบปรามการทุจริตแห่งชาติ เรื่อง หลักเกณฑ์และวิธีการจัดทำและแสดงบัญชีรายการรับจ่ายของโครงการที่บุคคลหรือนิติบุคคลเป็นคู่สัญญากับหน่วยงานของรัฐ พ.ศ. 2554 และที่แก้ไขเพิ่มเติม
3. ต้องเป็นนิติบุคคลที่ได้ลงทะเบียนในระบบอิเล็กทรอนิกส์ (e-Government Procurement : e-GP) ของกรมบัญชีกลางที่เว็บไซต์ ศูนย์ข้อมูลจัดซื้อจัดจ้างภาครัฐ ([www.gprocurement.go.th](http://www.gprocurement.go.th)) โทรศัพท์ หมายเลข 0 2127 7386 – 89
4. ต้องไม่เป็นผู้มีผลประโยชน์ร่วมกันกับผู้เสนอราคารายอื่น ณ วันประกาศประกวดราคาครั้งนี้เป็นต้นไป หรือต้องไม่เป็นผู้กระทำการอันเป็นการขัดขวางการแข่งขันราคาอย่างเป็นธรรมในการดำเนินการประกวดราคาครั้งนี้
5. ต้องไม่เป็นที่ปรึกษาของ กฟผ. หรือมีส่วนร่วมในบริษัทที่ปรึกษาของ กฟผ. ในงานนี้ หรือต้องไม่มีผู้ปฏิบัติงาน กฟผ. เข้าไปมีส่วนร่วมในกิจการของผู้เสนอราคา ไม่ว่าจะในฐานะผู้ถือหุ้นที่มีสิทธิควบคุมการจัดการ กรรมการ ผู้อำนวยการ ผู้จัดการ พนักงาน ลูกจ้าง ตัวแทนหรือที่ปรึกษา ยกเว้น ในกรณีที่ผู้ปฏิบัติงานได้รับคำสั่งอย่างเป็นทางการจาก กฟผ. ให้ไปปฏิบัติงานหรือเข้าร่วมในกิจการของผู้เสนอราคา
6. ต้องไม่เป็นผู้ได้รับเอกสิทธิ์หรือความคุ้มกัน ซึ่งอาจปฏิเสธไม่ยอมขึ้นศาลไทย เว้นแต่รัฐบาลของผู้เสนอราคาได้มีคำสั่งให้สละสิทธิ์และความคุ้มกันเช่นนั้น
7. ผู้ประสงค์เข้าประกวดราคาในนามของกิจการร่วมค้า (Joint Venture or Consortium) จะต้องดำเนินการทุกขั้นตอนของการประกวดราคา ในนามของกิจการร่วมค้าตั้งแต่การเสนอราคาจนถึงสิ้นสุดข้อผูกพันกับ กฟผ.

นิพนธ์ โง้งงงงง

### การขายเอกสารประกวดราคา

ผู้สนใจติดต่อขอทราบรายละเอียด เพื่อตรวจสอบคุณสมบัติของผู้เสนอราคา และขอซื้อเอกสารประกวดราคา ในราคาชุดละ 15,000.- บาท ได้ที่ แผนกจ้างงานวิศวกรรมระบบส่ง (ห้อง 1202/2 ชั้น 12 อาคาร ท.101) กองจัดหาต่างประเทศสายงานพัฒนาระบบส่ง ฝ่ายพัสดุและจัดหาต่างประเทศ การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย เชียงสะพานพระราม 7 จังหวัดนนทบุรี ในวันทำการ ระหว่างเวลา 08:00 น. ถึง 15:00 น. ตั้งแต่วันที่ 7 มีนาคม 2561 ถึงวันที่ 12 เมษายน 2561 หรือสอบถามทางโทรศัพท์ หมายเลข 0 2436 0242 หรืออีเมล procurement.tse@egat.co.th ทั้งนี้ สามารถ download แบบฟอร์มลงทะเบียนผู้ซื้อเอกสารประกวดราคาได้ที่เว็บไซต์ <http://www4.egat.co.th/fprocurement/biddingeng/>

### การยื่นซองประกวดราคา

กำหนดยื่นซองข้อเสนอด้านเทคนิคพร้อมซองราคา ในวันที่ 8 พฤษภาคม 2561 เวลา 9:30 น. ถึง 10:00 น. และเปิดซองข้อเสนอด้านเทคนิคเวลา 10:00 น. ณ ห้อง 1202/1 ชั้น 12 อาคาร ท.101 การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย เชียงสะพานพระราม 7 จังหวัดนนทบุรี

ประกาศ ณ วันที่ 23 กุมภาพันธ์ 2561

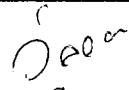
หิองเนร โองตภงตมิง

(นางนิลเนตร โอสถภวภูษิต)

หัวหน้ากองจัดหาต่างประเทศสายงานพัฒนาระบบส่ง

ตารางแสดงวงเงินงบประมาณที่ได้รับจัดสรรและราคากลาง(ราคาอ้างอิง)  
ในการจัดซื้อจัดจ้างที่มีใช้งานก่อสร้าง

1. ชื่อโครงการ ประกวตราค่าเลขที่ ESCL-S-01  
งานจัดหาและจ้างก่อสร้าง Battery Energy Storage System ที่สถานีไฟฟ้าแรงสูง  
115 kV ชัยบาดาล และ 115 kV บำเหน็จณรงค์  
โครงการปรับปรุง/แก้ปัญหาระบบส่งไฟฟ้า โดยการติดตั้งระบบกักเก็บพลังงาน  
ที่จังหวัดชัยภูมิและลพบุรี เพื่อรองรับผลกระทบจากพลังงานหมุนเวียน  
/หน่วยงานเจ้าของโครงการ ฝ่ายแผนงานและโครงการระบบส่ง การไฟฟ้าฝ่ายผลิตแห่งประเทศไทย
  2. วงเงินงบประมาณที่ได้รับจัดสรร  
โครงการปรับปรุง/แก้ปัญหาระบบส่งไฟฟ้า โดยการติดตั้งระบบกักเก็บพลังงาน  
ที่จังหวัดชัยภูมิและลพบุรี เพื่อรองรับผลกระทบจากพลังงานหมุนเวียน  
งบประมาณ 1,982.7 ล้านบาท
  3. วันที่กำหนดราคากลาง 12 กุมภาพันธ์ 2561 (วันที่ รวพส. โดย ขพสก. อนุมัติ )  
ราคารวมภาษีมูลค่าเพิ่มและค่าใช้จ่ายอื่นๆ เป็นเงิน 1,465,000,000.00 บาท ราคา/หน่วย ตามเอกสารแนบ
  4. แหล่งที่มาของราคากลาง หลักเกณฑ์การกำหนดราคากลางงานจัดซื้อจัดจ้างสายงานพัฒนาระบบส่ง
  5. รายชื่อเจ้าหน้าที่ผู้กำหนดราคากลาง
    - 5.1 นายสุริยะ                      ปรุ่งขวัญเมือง              ทสพ-พส.   กวอ-พส.
    - 5.2 นางสาววิลาวัลย์           ต้นวีระ                      ทสอร-พส.   กวอ-พส.
    - 5.3 นางสาววิภาสิริ              ฉัตรพุทธรักษา           ทมพ-พส.   กวอ-พส.
    - 5.4 นายเมธา                      รักปาน                      กวป-พส.
    - 5.5 นางรัมภา                      สุนทรินทุ                    กวย-พส.
- หมายเหตุ ค่าใช้จ่ายอื่นๆ ได้แก่ ค่าใช้จ่ายที่ กพผ. ต้องจ่ายตามวิธีการพิจารณาเปรียบเทียบราคาที่กำหนดไว้  
ในเอกสารประกวดราคา เช่น อกรขาเข้า เป็นต้น

  
วัลลภา ชีวชนากรณ์กุล

ทส-ท.  
23 ก.พ. 2561

INVITATION TO BID NO. ESCL-S-01

SUMMARY OF BID PRICE

SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 kV CHAI BADAN and 115 kV BAMNET NARONG

THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY

Schedule	Description	Currency	Supply of Equipment		Local Currency (excluding VAT) Baht	Local Transportation (excluding VAT) Baht	Local Transportation, Construction and Installation (excluding VAT) Baht
			Foreign Supply	Local Supply			
			CIF Thai Port	Ex-works Price (excluding VAT) Baht			
			Amount	Amount			
1	115 KV CHAI BADAN	THB	632,198,707.28				
				14,772,762.10	11,678,378.20	14,486.98	3,736,825.78
2	115 KV BAMNET NARONG	THB	482,270,160.44				
				14,622,827.22	17,063,334.00	14,478.98	3,754,842.56
BID PRICE		THB	1,114,468,867.72	Baht	Baht	Baht	Baht
				29,395,589.32	28,741,712.20	28,965.96	7,491,668.34
OTHER EXPENSE	FOREIGN SUPPLY EXCEPT 1AB28 & 2AB28	THB	89,377.35	Baht	Baht	Baht	Baht
				XXXXX	XXXXX	XXXXX	XXXXX
	OTHER EXPENSE OF 1AB28 & 2AB28	THB	188,700,000.00	Baht	Baht	Baht	Baht
				XXXXX	XXXXX	XXXXX	XXXXX
	TOTAL	THB	188,789,377.35	Baht	Baht	Baht	Baht
				XXXXX	XXXXX	XXXXX	XXXXX

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23 ก.พ. 2561

(นางสาวพนา ชิวพนากรณกุล)  
อ.ท.

INVITATION TO BID NO. ESCL-S-01

SUMMARY OF BID PRICE

SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 kV CHAI BADAN and 115 kV BAMNET NARONG

THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY

Schedule	Description	Currency	Supply of Equipment		Local Currency (excluding VAT) Baht Amount	Local Transportation (excluding VAT) Baht Amount	Local Transportation, Construction and Installation (excluding VAT) Baht Amount
			Foreign Supply	Local Supply			
			CIF Thai Port	Ex-works Price (excluding VAT) Baht			
			Amount	Amount			
	VAT	THB	91,228,077.15	Baht 2,057,691.25	Baht 2,011,919.85	Baht 2,027.62	Baht 524,416.78
	SUMMARY OF BID PRICE	THB	1,394,486,322.22	Baht 31,453,280.57	Baht 30,753,632.05	Baht 30,993.58	Baht 8,016,085.12
	TOTAL MEDIUM COST	THB	1,464,740,313.54				
	TOTAL MEDIUM COST (ROUNDED)	THB	1,465,000,000.00				

In case Bidder proposes price discount without specifying whether or not it includes Value Added Tax (VAT), EGAT will consider it as the price discount excluding VAT.



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23 ก.พ. 2561



**INVITATION TO BID NO. ESCL-S-01**  
**SCHEDULE 1 : 115 KV CHAI BADAN**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI**  
**PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Currency (excluding VAT) Baht	Local Transportation (excluding VAT) Baht	Local Transportation, Construction and Installation (excluding VAT) Baht
		Foreign Supply	Local Supply			
		CIF Thai Port	Ex-works Price (excluding VAT) Baht			
		Amount	Amount			
PART IAB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT	THB	632,143,828.28	14,537,922.10			3,736,825.78
PART IC : CIVIL WORK				11,678,378.20		
PART ID : SUPPLY OF SPARE PARTS	THB	54,879.00	234,840.00		14,486.98	
<b>TOTAL PRICE</b>	THB	<b>632,198,707.28</b>	Baht	Baht	Baht	Baht
<i>On</i> วิมลภา ชีวธนากรกุล ทจส-ท.			14,772,762.10	11,678,378.20	14,486.98	3,736,825.78

**INVITATION TO BID NO. ESCL-S-01**  
**PART 1AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**


Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation ( excluding VAT ) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price ( excluding VAT ) Baht	
		Amount	Amount	
Schedule 1AB1 : Power Transformer and Marshalling Control Cubicle			79,000.00	8,690.00
Schedule 1AB2 : Distribution Transformer			900,000.00	99,000.00
Schedule 1AB4 : Surge Arrester				
Schedule 1AB5 : Current Transformer and Junction Box				122,980.00

*On*  
**วัลลภา ชีวธนากรณกุล**  
**นางส-ท.**  
**23 ก.พ. 2561**

(นางสาวพนา *[Signature]*)

**INVITATION TO BID NO. ESCL-S-01**  
**PART 1AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation ( excluding VAT ) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price ( excluding VAT ) Baht	
		Amount	Amount	
Schedule 1AB6 : Coupling Capacitor Voltage Transformer, Coupling Capacitor, Voltage Transformer and Junction Box				55,880.00
Schedule 1AB9 : Power Circuit Breaker				80,428.34
Schedule 1AB10 : Disconnecting Switch	THB	184,800.00		132,310.60
Schedule 1AB11 : Power Fuse, Fuse Link and Hook Stick	THB	479,272.20		52,719.94

  
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**INVITATION TO BID NO. ESCL-S-01**  
**PART 1AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation ( excluding VAT ) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price ( excluding VAT ) Baht	
		Amount	Amount	
Schedule 1AB12 : AC&DC Distribution Board and Termination Box			1,631,549.00	179,470.39
Schedule 1AB13 : Stationary Battery and Battery Charger	THB	881,100.00	690,384.10	172,863.25
Schedule 1AB14 : Substation Steel Structure			62,033.84	85,463.03
Schedule 1AB15 : Insulator	THB	107,940.36		24,736.33

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*[Signature]*

**INVITATION TO BID NO. ESCL-S-01**  
**PART 1AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation ( excluding VAT ) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price ( excluding VAT ) Baht	
		Amount	Amount	
Schedule 1AB16 : Cable Terminations	THB	121,809.60	397,188.00	124,519.89
Schedule 1AB17 : XLPE Power Cable			3,753,420.00	860,158.75
Schedule 1AB18 : Low Voltage Cable and Conductor			4,920,743.52	1,127,670.39
Schedule 1AB19 : Switchyard Lighting Fixtures			395,437.68	106,202.91

  
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23 ก.พ. 2561

**INVITATION TO BID NO. ESCL-S-01**  
**PART 1AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT) Baht	
		Amount	Amount	
Schedule 1AB20 : Aluminum Tube, Connector and Miscellaneous Hardware			83,768.52	19,196.95
Schedule 1AB21 : Bus Fitting	THB	125,397.80		28,737.00
Schedule 1AB22 : Grounding Material	THB	243,508.32		55,803.99

  
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**INVITATION TO BID NO. ESCL-S-01**  
**PART 1AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation ( excluding VAT ) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price ( excluding VAT ) Baht	
		Amount	Amount	
Schedule 1AB23 : Substation Miscellaneous			297,220.44	68,113.02
Schedule 1AB24 : Control and Protection System			1,327,177.00	168,469.00
Schedule 1AB25 : Fault Recording System				47,313.00
Schedule 1AB28 : Battery Energy Storage System	THB	630,000,000.00		

*On*  
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 23 ก.พ. 2561

**INVITATION TO BID NO. ESCL-S-01**  
**PART 1AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT ) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT ) Baht	
		Amount	Amount	
Schedule 1AB38 : Remote Terminal Unit				112,099.00
Schedule 1AB39 : Commissioning				
Schedule 1AB40 : Installation of Equipment and Steel Structure Supplied by EGAT				4,000.00
<b>PART 1AB</b>	<b>THB</b>	<b>632,143,828.28</b>	<b>Baht</b>	<b>Baht</b>
 <b>วิมลภา ชีวนากรอนกุล</b> <b>ทอศ.ท.</b>			<b>14,537,922.10</b>	<b>3,736,825.78</b>



INVITATION TO BID NO. ESCL-S-01

PART 1C : CIVIL WORK

SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN

THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY

Description	Local Currency
	( excluding VAT ) Baht Amount
Schedule 1C1 : Foundation Work	936,736.00
Schedule 1C2 : Cable Trench	2,070,495.20
Schedule 1C3 : Control Building	
Schedule 1C4 : Earth Work, Road and Crushed Rock Surfacing	757,857.00
Schedule 1C6 : Drainage System	2,803,001.00
Schedule 1C7 : Special Construction Works	730,000.00
Schedule 1C8 : Miscellaneous	813,631.00
Schedule 1C9 : Fire Protection System	3,558,362.00
<b>PART 1C</b>	<b>Baht</b> <b>11,678,378.20</b>

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**INVITATION TO BID NO. ESCL-S-01**

**PART 1D : SUPPLY OF SPARE PARTS**

**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV CHAI BADAN**

**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation (excluding VAT) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT) Baht	
		Amount	Amount	
Schedule 1D11 : Spare Parts for Power Fuse, Fuse Link and Hook Stick	THB	54,879.00		2,743.98
Schedule 1D24 : Spare Parts for Control and Protection System			234,840.00	11,743.00
<b>PART 1D</b> <i>On</i> วัลลภา ชีวธนากรณ์กุล	<b>THB</b>	<b>54,879.00</b>	<b>Baht</b> 234,840.00	<b>Baht</b> 14,486.98

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23 ก.พ. 2561

**INVITATION TO BID NO. ESCL-S-01**  
**SCHEDULE 2 : 115 KV BAMNET NARONG**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI**  
**PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Currency (excluding VAT) Baht	Local Transportation (excluding VAT) Baht	Local Transportation, Construction and Installation (excluding VAT) Baht
		Foreign Supply	Local Supply			
		CIF Thai Port	Ex-works Price (excluding VAT) Baht			
		Amount	Amount			
PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT	THB	482,215,281.44	14,388,106.22			3,754,842.56
PART 2C : CIVIL WORK				17,063,334.00		
PART 2D : SUPPLY OF SPARE PARTS	THB	54,879.00	234,721.00		14,478.98	
<b>TOTAL PRICE</b>	<b>THB</b>	<b>482,270,160.44</b>	<b>Baht</b>	<b>Baht</b>	<b>Baht</b>	<b>Baht</b>
<i>On</i> วัลลภา ชีวชนากรณ์กุล หจส-ท.			14,622,827.22	17,063,334.00	14,478.98	3,754,842.56

**INVITATION TO BID NO. ESCL-S-01**  
**PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT ) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT ) Baht	
		Amount	Amount	
Schedule 2AB1 : Power Transformer and Marshalling Control Cubicle			79,000.00	8,690.00
Schedule 2AB2 : Distribution Transformer			900,000.00	99,000.00
Schedule 2AB4 : Surge Arrester				
Schedule 2AB5 : Current Transformer and Junction Box				121,000.00

  
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
INVITATION TO BID NO. ESCL-S-01

PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT

SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG

THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT) Baht	
		Amount	Amount	
Schedule 2AB6 : Coupling Capacitor Voltage Transformer, Coupling Capacitor, Voltage Transformer and Junction Box				55,880.00
Schedule 2AB9 : Power Circuit Breaker				80,428.34
Schedule 2AB10 : Disconnecting Switch	THB	184,800.00		132,310.60

  
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**INVITATION TO BID NO. ESCL-S-01**  
**PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT ) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT ) Baht	
		Amount	Amount	
Schedule 2AB11 : Power Fuse, Fuse Link and Hook Stick	THB	479,272.20		52,719.94
Schedule 2AB12 : AC&DC Distribution Board and Termination Box			1,453,793.00	159,917.23
Schedule 2AB13 : Stationary Battery and Battery Charger	THB	881,100.00	690,384.10	172,863.25
Schedule 2AB14 : Substation Steel Structure			70,726.48	86,984.24

*Dr*  
**วิมลภา ชีวชนกรรณกุล**  
**นางส-ท.**

**INVITATION TO BID NO. ESCL-S-01**  
**PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation ( excluding VAT ) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price ( excluding VAT ) Baht	
		Amount	Amount	
Schedule 2AB15 : Insulator	THB	158,092.44		36,229.52
Schedule 2AB16 : Cable Terminations	THB	121,809.60	397,188.00	124,519.89
Schedule 2AB17 : XLPE Power Cable			3,753,420.00	860,158.75
Schedule 2AB18 : Low Voltage Cable and Conductor			5,060,876.04	1,159,784.09

  
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23 ก.พ. 2561

**INVITATION TO BID NO. ESCL-S-01**  
**PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT ) Baht Amount
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT ) Baht	
		Amount	Amount	
Schedule 2AB19 : Switchyard Lighting Fixtures			395,437.68	106,202.91
Schedule 2AB20 : Aluminum Tube, Connector and Miscellaneous Hardware			111,195.48	25,482.30
Schedule 2AB21 : Bus Fitting	THB	123,086.72		28,207.37

*On*  
**วัลลภา ชิวชนากรณ์กุล**  
**ทจส-ท.**



**INVITATION TO BID NO. ESCL-S-01**  
**PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT) Baht	
		Amount	Amount	
Schedule 2AB22 : Grounding Material	THB	267,120.48		61,215.11
Schedule 2AB23 : Substation Miscellaneous			297,220.44	68,113.02
Schedule 2AB24 : Control and Protection System			1,178,865.00	143,224.00
Schedule 2AB25 : Fault Recording System				47,313.00

*On*  
**วัลลภา ชีวชนากรณ์กุล**  
**ทจส-ท.**

**INVITATION TO BID NO. ESCL-S-01**  
**PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation ( excluding VAT ) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price ( excluding VAT ) Baht	
		Amount	Amount	
Schedule 2AB28 : Battery Energy Storage System	THB	480,000,000.00		
Schedule 2AB38 : Remote Terminal Unit				112,099.00
Schedule 2AB39 : Commissioning				
Schedule 2AB40 : Installation of Equipment and Steel Structure Supplied by EGAT			On วัลลภา ชีวนากรณ์กุล	12,500.00

**INVITATION TO BID NO. ESCL-S-01**  
**PART 2AB : SUPPLY AND INSTALLATION OF SUBSTATION EQUIPMENT**  
**SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG**  
**THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND**  
**LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

Description	Currency	Supply of Equipment		Local Transportation, Construction and Installation (excluding VAT ) Baht
		Foreign Supply	Local Supply	
		CIF Thai Port	Ex-works Price (excluding VAT ) Baht	
		Amount	Amount	
PART 2AB	THB	482,215,281.44	Baht	Baht
			14,388,106.22	3,754,842.56

  
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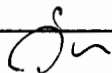
INVITATION TO BID NO. ESCL-S-01

PART 2C : CIVIL WORK

SUPPLY AND CONSTRUCTION OF BATTERY STORAGE SYSTEM AT 115 KV BAMNET NARONG

THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY

Description	Local Currency (excluding VAT) Baht
	Amount
Schedule 2C1 : Foundation Work	1,003,204.00
Schedule 2C2 : Cable Trench	2,969,981.00
Schedule 2C3 : Control Building	
Schedule 2C4 : Earth Work, Road and Crushed Rock Surfacing	1,855,348.00
Schedule 2C6 : Drainage System	4,344,032.00
Schedule 2C7 : Special Construction Works	730,000.00
Schedule 2C8 : Miscellaneous	1,396,977.00
Schedule 2C9 : Fire Protection System	4,760,595.00
<b>PART 2C</b>	<b>Baht 17,063,334.00</b>

  
 วัลลภา ชีวชนากรณ์กุล



# DATA SHEET

for

## Invitation to Bid No. ESCL-S-01

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This Section consists of provisions that are specific to each procurement and supplement the information or requirements included in Bidding Documents.

1. Article A-1. Invitation

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

“The Letter of Intent 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.”

2. Article B-3. Bid Security

The amount of bid security shall be USD 2,302,310.- or THB 73,250,000.-.

3. Maintenance Guarantee Period

The Contractor shall guarantee the proper functioning of the Work for a period of one (1) year except the following Equipment the guarantee period of which shall be as follows :

<u>Equipment</u>	<u>Period of Guarantee (Year)</u>
- Fault Recording System	2
- Control and Protection System	2
- <i>Equipment in Battery Energy Storage System (BESS)</i>	3
- <i>Control System for Battery Energy Storage System (BESS)</i>	3
- <i>Battery for Battery Energy Storage System (BESS)</i>	5

*The guarantee period of performance function for whole Battery Energy Storage System (BESS) shall be 3 years. If the performance function of BESS could not be fulfilled during the guarantee period, the guarantee period shall be extended as specified in Maintenance Guarantee in section F.*

4. Defective Equipment to be replaced with the whole new set

Not Applicable

# **ELECTRICITY GENERATING AUTHORITY OF THAILAND**

Nonthaburi  
Thailand

Tlx No. 72348 EGAT TH  
Facsimile No. : 66 2433 6317

## **INVITATION TO BID NO. ESCL-S-01**

### **SUPPLY AND CONSTRUCTION OF BATTERY ENERGY STORAGE SYSTEM AT 115 kV CHAI BADAN AND 115 kV BAMNET NARONG SUBSTATIONS**

### **THE TRANSMISSION SYSTEM IMPROVEMENT PROJECT BY INSTALLATION OF ENERGY STORAGE SYSTEM AT CHAIYAPHUM AND LOP BURI PROVINCE FOR MITIGATING IMPACT FROM RENEWABLE ENERGY**

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#### **Invitation**

The Electricity Generating Authority of Thailand (EGAT) hereby invites sealed bids for supply and construction of Battery Energy Storage System at 115 kV Chai Badan and 115 kV Bamnet Narong Substations under The Transmission System Improvement Project by Installation of Energy Storage System at Chaiyaphum and Lop Buri Province for Mitigating Impact from Renewable Energy as described herein in accordance with terms, conditions and Specifications described in these Bidding Documents.

#### **Work Description**

The supply and construction of Battery Energy Storage System at 115 kV Chai Badan and 115 kV Bamnet Narong Substations will be on a supply and construction basis, the Contractor shall be responsible for complete supply, installation, construction and also engineering design work to the standard specified and best modern practice. The substations to be constructed and the scope of work under this Invitation are described in Section H. Scope of Work.

#### **Eligibility of Bidders: General Requirements**

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

I. 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 shall be well-established and maintain a permanent place of business.
- c. The Bidder shall not be, or supply the Equipment, from the country under the state of Civil War.
- d. The Bidder shall be a juristic person who manufactures or provides such material or services, as the case may be, and not be named in the List of Work Abandoners published by the Office of Prime Minister and/or in the Debarment List and/or in the List of Work Abandoners declared by EGAT.
- e. The Bidder shall be a juristic person who neither fails to submit the Revenue and Expense Accounts nor fails to present proper and complete accounts to the Revenue Department of Thailand, in accordance with the Notification of the National Anti-Corruption Commission Concerning Principles and Methods of Preparing Revenue and Expense Accounts of Project between Individual/Company and Government Agencies B.E. 2554 (A.D. 2011) as amended from time to time (“the Notification”).
- f. The Bidder shall be a juristic person who registers for e-Government Procurement (e-GP) at Thai Government Procurement website ([www.gprocurement.go.th](http://www.gprocurement.go.th) at telephone No. 662 1277386 – 89) of the Comptroller General’s Department of Thailand.

Due to the fact that the e-GP system is not ready for registration for foreign Bidders who have no taxpayer identification number at this moment, foreign Bidders are, therefore, temporarily released from this qualification. However, whenever the e-GP system is ready, all foreign Bidders shall register in the e-GP system.

- g. The Bidder shall not be a Jointly Interested Bidder with other Bidders as from the date of EGAT's issuance of the 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.
- h. The Bidder shall not either be EGAT's consultant or involving 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 for the ones who are officially ordered by EGAT to act or participate therein.
- i. 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.



- j. In case of a joint venture or consortium, the Bidder shall carry out all the work under such formation from the time of bidding until the fulfillment of the Contract.
  - k. The Bidder shall have purchased the Bidding Documents from EGAT as described under Article A-6. Availability of Bidding Documents. For a joint venture or consortium, only one member of the joint venture or consortium is required to purchase the Bidding Documents.
- II. All Bidders should preferably meet the following requirements; failure to so comply may constitute sufficient ground for rejection.
- a. The Bidder shall have adequate fund to meet financial obligations incidental to this Contract.
  - b. The Bidder shall supply documentary evidence established in accordance with Article B-8. Information to be Submitted with Bid to demonstrate adequately that he is eligible to bid and is qualified to perform the Contract if his bid is accepted. Bidder should also demonstrate his capacity to perform the Work either with or without the use of subcontractor.

### **Eligibility of Bidders: Technical Requirements**

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

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

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.

If 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 pending claim of the Bidder.

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

- b. The Bidder shall have one of the following qualifications regarding experiences executing contract of supply and construction substation.
  - 1) Having experience with EGAT in executing at least one (1) contract as contractor (not as subcontractor) for supply and construction of a complete 115 kV or above conventional or GIS substation, with its overall performance satisfactory to EGAT;

- 2) Having experience in executing at least two (2) contracts as contractor (not as subcontractor) for supply and construction of 115 kV or above conventional or GIS substation with other Electricity Authorities of Thailand or in an overseas country (not his own country).

Experience record of the Bidder or either member of the joint venture /consortium, including experience record derived from being a member of other joint venture or consortium in previous project(s) is acceptable. It is not allowed to combine the experience records of each member of the joint venture/consortium in order to meet the experience requirements.

- c. Further to b.1) and b.2) mentioned above, having a record of experience within the last ten (10) years on the technical knowledge and practical experience on design, construction and installation of Equipment of a 115 kV or above complete conventional or GIS substation. Bidder shall also demonstrate his capacity to perform Work.

Experience record of the Bidder or either member of the joint venture /consortium, including experience record derived from being a member of other joint venture or consortium in previous project(s) is acceptable, provided that there is a letter from the project owner certifying that the Works as described in c. above were performed by the Bidder or either member of the joint venture/ consortium of this project. It is not allowed to combine the experience records of each member of the joint venture/consortium in order to meet the experience requirements.

With respect to item b. and c. above, reference records of either the parent or affiliated companies of the Bidder or of either member of joint venture or consortium shall not be acceptable. If the Bidder has previously formed as the joint venture/consortium with other company and the experience record(s) of the joint venture/consortium meet(s) the requirement set forth herein, such experience record(s) of the joint venture/consortium is(are) also acceptable as the experience record(s) of the Bidder.

- d. The Bidder shall propose Equipment manufactured by the qualified manufacturers who shall fulfill the following requirements :
  1. Regularly manufacturing of Equipment of the type and similar ratings proposed.
  2. Being well-established and maintaining a permanent place of business.
  3. The manufacturer shall have the experience records that meet the requirements set forth herein.

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

4. 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 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, provided that each item of the equipment to be supplied under this bid shall be manufactured from the same source of supply as indicated in each of such relevant supply records as described in Item I.d.5 thru I.d.10 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.

5. System integrator for Battery Energy Storage System (BESS) shall have experience in executing at least three (3) successfully operated contracts for supply and construction of complete both 1MW or above and 1MWh or above of each module. At least one (1) of these three (3) contracts shall be successfully operated for at least three (3) consecutive years.
6. Control System for Battery Energy Storage System (BESS) shall be manufactured by the qualified manufacturer who shall fulfill the following requirements :
  - 6.1 Having a supply record of Control System for BESS with successful operation/use of at least three (3) systems. At least one (1) of these three (3) systems shall be successfully operated for at least three (3) consecutive years.
  - 6.2 Having a past design test record of the Equipment as proposed, if specified in EGAT's specification. Such past design test record shall conform to the test specified in EGAT's specification.
7. For 115 kV Ratings of Gas-Insulated Switchgear (GIS). These Equipment shall be manufactured by the qualified manufacturers who shall fulfill the following requirements :
  - 7.1 Having one of the following qualifications:
    - 7.1.1 Proposing the Equipment of the type and ratings which has already been accepted by EGAT.

OR

- 7.1.2 Having a supply record of Equipment of the type proposed at the nominal system voltage of 110 kV or above, busbar current of 2000 A or above, 40 kA or above, with successful operation/use of at least three (3) consecutive years in an overseas country (not his own country) and at least three (3) substations of which total GIS bays shall not be less than twelve (12).

However, the Equipment of the type and short circuit current ratings proposed shall have a supply record of successful operation/use of at least three (3) consecutive years in an overseas country (not his own country) and at least one (1) substation of which total GIS bays shall not be less than four (4).

In case that the supply record of Equipment of the type and ratings proposed fulfills the requirement, the manufacturer may propose a newly developed or modified type of such Equipment with successful operation/use of at least three (3) substations of which total GIS bays shall not be less than twelve (12) and having minimum one (1) year in an overseas country (not his own country). The detailed information of the development or modification shall be submitted with his proposal. EGAT, however, reserves the right and will make its own judgment whether or not to consider or accept the proposed developed or modified type.

- 7.2 Having a past design test record of the Equipment as proposed, if specified in EGAT's specification. Such past design test record shall conform to the test specified in EGAT's specification.

8. For 115 kV Ratings of Power Circuit Breaker shall be manufactured by the qualified manufacturers who shall fulfill the following requirements :

- 8.1 Having one of the following qualifications :

- 8.1.1 Proposing the Equipment of the type and ratings which has already been accepted by EGAT.

OR

- 8.1.2 Having a supply record of Equipment of the type proposed at nominal system voltage of 110 kV or above, 2000 A or above, 40 kA or above, with successful operation/use of at least three (3) consecutive years in an overseas country (not his own country) and at least three (3) three phase sets.

However, the Equipment of the type and short circuit current ratings proposed shall have a supply record of successful operation/use of at least three (3) consecutive years in an overseas country (not his own country) and at least one (1) three phase set.

In case that the supply record of Equipment of the type and ratings proposed fulfilled the requirement, the manufacturer may propose a newly developed or modified type of such Equipment with successful operation/use for at least one (1) year in an overseas country (not his own country) and at least three (3) three phase sets. The detailed information of the development or modification shall be submitted with his proposal. EGAT, however, reserves the right and will make its own judgment whether or not to consider or accept the proposed developed or modified type.

8.2 Having a past design test record of the Equipment as proposed, if specified in EGAT's specification. Such past design test record shall conform to the test specified in EGAT's specification.

9. For 115 kV Ratings of following Equipment: Instrument Transformer, Surge Arrester and Disconnecting Switch. These Equipment shall be manufactured by the qualified manufacturers who shall fulfill the following requirements :

9.1 Having one of the following qualifications :

9.1.1 Proposing the Equipment of the type and ratings which has already been accepted by EGAT.

OR

9.1.2 Having a supply record of Equipment of the type and ratings proposed with successful operation/use of at least three (3) three-phase sets and having minimum three (3) consecutive years in an overseas country (not his own country).

In case that the supply record of Equipment of the type and ratings proposed fulfills the requirement, the manufacturer may propose a newly developed or modified type of such Equipment with successful operation/use of at least three (3) three-phase sets and having minimum one (1) year in an overseas country (not his own country). The detailed information of the development or modification shall be submitted with his proposal. EGAT,

however, reserves the right and will make its own judgment whether or not to consider or accept the proposed developed or modified type.

Supply records of the higher rating Equipment shall not be considered if the Bidder does not propose such higher rating Equipment in his bid.

9.2 Having a past design test record of the Equipment as proposed, if specified in EGAT's specification. Such past design test record shall conform to the test specified in EGAT's specification.

10. For Control and Protection System, having the following qualifications:

10.1 Being local manufacturer.

10.2 Having one of the following qualifications :

10.2.1 Having a supply record of successful operation/use in EGAT's or other Electricity Authorities of Thailand's 110 kV or above Transmission System for at least three (3) consecutive years and at least three (3) units of each type of Protective Relay Panels having similar characteristics to the ones specified herein.

OR

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

***II. All Bidders should preferably meet the following technical requirements; failure to so comply may constitute sufficient ground for rejection.***

- a. The Bidder shall have sufficient capacity to carry out the work.
- b. 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. In case the Bidder is a joint venture/consortium, either member of the joint venture/consortium 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.
- c. The Bidder himself or his subcontractors, at the time of submitting this proposal, shall not carry excessive work nor be in a default position with respect to work with EGAT. Unsatisfactory past performance on Contract awarded by EGAT may be a sufficient reason of being disqualified.
- d. The Bidder shall propose Equipment from manufacturers who fulfill the requirements below. If there is any deficiency, EGAT reserves the right

to require the Bidder to propose new manufacturer or new type/model of Equipment without any additional cost to EGAT.

1. Regularly manufacturing of Equipment of the type and similar ratings proposed.
2. Being well-established and maintaining a permanent place of business
3. The manufacturer shall have the experience records that meet the requirements set forth herein.

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

4. 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 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, provided that each item of the equipment to be supplied under this bid shall be manufactured from the same source of supply as indicated in each of such relevant supply records as described in Item II.d.5 thru II.d.14 below.

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.

5. For Battery and Battery Management System (BMS), Power Conversion System (PCS), AC Metal-Clad Switchgear, DC Metal-Clad Switchgear and Inverter Transformer for Battery Energy Storage System (BESS).

For Battery and BMS for Battery Energy Storage System (BESS)

5.1 Having one of the following qualifications :

5.1.1 Having a supply record of Battery and BMS of the type proposed with successful operation/use of at least three (3) systems. The total installed capacity of each aforementioned system shall be 1MWh or above. At least one (1) of these three (3) systems shall be successfully operated for at least three (3) consecutive years.

OR

5.1.2 Having a letter of acceptance for manufacturing of the specific Equipment issued by EGAT within the scope specified therein (For the local manufacturer).

For PCS for Battery Energy Storage System (BESS)

5.2 Having one of the following qualifications :

5.2.1 Having a supply record of PCS of the type proposed at rating 500 kVA or above of each module-design unit with successful operation/use of at least three (3) consecutive years and at least 6 units.

OR

5.2.2 Having a supply record of PCS of the type proposed at total installed capacity of 4MVA or above with successful operation/use of at least three (3) consecutive years.

For AC Metal-Clad Switchgear, DC Metal-Clad Switchgear and Inverter Transformer for Battery Energy Storage System (BESS)

5.3 Having a supply record of Equipment of the type proposed with successful operation/use of at least 3 sets for BESS. At least one (1) of these three (3) sets shall be successfully operated for at least three (3) consecutive years.

6. For 33, 22 and 11 kV ratings of following Equipment : Metal-Clad SF<sub>6</sub> Gas Insulated Switchgear, Power Circuit Breaker, Instrument Transformer, Disconnecting Switch and Surge Arrester

Having one of the following qualifications :

6.1 Proposing the Equipment of the type and ratings which has already been accepted by EGAT.

OR

6.2 Having a supply record of Equipment of the type and ratings proposed with successful operation/use of at least three (3) consecutive years in an overseas country (not his own country) and at least three (3) three phase sets. The ratings and features of Equipment shall be the same or similar rating as EGAT specifies.

In case that the supply record of Equipment of the type and ratings proposed fulfilled the requirement, the manufacturer may propose a newly developed or modified type of such Equipment with successful operation/use of at least one (1) year in an overseas country (not his own country) and at least three (3) three phase sets. The detailed information of the development or modification shall be submitted with his proposal. EGAT, however, reserves the right and will make its own judgment whether or not to consider or accept the proposed developed or modified type.

Supply records of the higher rating Equipment shall not be considered if the Bidder does not propose such higher rating Equipment in his bid.



7. For Distribution Transformer, Power Fuse, AC&DC Distribution Board and Lighting Relay Panel (LRP), Load Center Unit Substation (LCUS), Junction Box, Battery Charger, Substation Steel Structure, 33 kV and below Cable Terminations, XLPE Power Cable, Power Cable, Control Cable and Switchboard Wire, Lighting Cable, Copper Ground Wire, Overhead Ground Wire, Aluminum Conductor, Optical Fiber Cable, Switchyard Lighting Fixtures, Aluminum Tube, Compression Connector and Miscellaneous Hardware, Bus Fittings, Ground Rod, Thermite Welding Material, Grounding Hardware, Conduit and Conduit Fittings

7.1 Being local manufacturer for the following Equipment :

Distribution Transformer, AC&DC Distribution Board and Lighting Relay Panel (LRP), Load Center Unit Substation (LCUS), Junction Box, Battery Charger, Substation Steel Structure, 115 kV and below XLPE Power Cable, Power Cable, Control Cable and Switchboard Wire, Lighting Cable, Copper Ground Wire, Overhead Ground Wire, Aluminum Conductor, Single mode optical fiber cable, Switchyard Lighting Fixtures, Aluminum Tube, Compression Connector and Miscellaneous Hardware, Thermite Welding Material and Conduit.

7.2 Having been granted a licence for producing standard product by Thai Industrial Standard Institute (TISI), Ministry of Industry for the following Equipment:

60 kV through 115 kV XLPE Power Cable, Lighting cable and Aluminum conductor.

7.3 Having one of the following qualifications :

7.3.1 Having supply record of Equipment of the type and similar ratings proposed with successful operation/use for at least one (1) year.

OR

7.3.2 Having a letter of acceptance for manufacturing and/or fabrication of the specific Equipment issued by EGAT within the scope specified therein (For the local manufacturer).

8. For Insulator

Having one of the following qualifications :

8.1 Having supply record with successful operation/use for at least three (3) consecutive years in an overseas country (not his own country) and for following equipment :

8.1.1 Suspension Insulator, at least 10,000 units having the similar ANSI class as proposed.

8.1.2 Station Post Insulator, having the similar ANSI technical reference number as proposed.

OR

8.2 Having a letter of acceptance for manufacturing and/or fabrication of the specific Equipment issued by EGAT within the scope specified therein (For the local manufacturer).

9. For Stationary Battery

Having one of the following qualifications :

9.1 Having supply record of Equipment of the type and similar ratings proposed with successful operation/use in substations/switchyards of at least three (3) consecutive years and at least three (3) sets.

In case that the supply record of Equipment of the type and similar ratings proposed fulfilled the requirements, the manufacturer may propose a newly developed or modified type of such Equipment with successful operation/use of at least one (1) year. The detailed information of the development or modification shall be submitted with his proposal. EGAT, however, reserves the right and will make its own judgement whether or not to consider or accept the proposed developed or modified type.

OR

9.2 Having a letter of acceptance for manufacturing and/or fabrication of the specific Equipment issued by EGAT within the scope specified therein (For the local manufacturer).

10. For above 33kV through 115 kV Outdoor Type Cable Termination and Cable Termination for GIS.

Having one of the following qualifications :

10.1 Proposing the Equipment of the type and ratings which have ever been accepted by EGAT.

OR

10.2 Having a supply record of Equipment of the type and ratings proposed with successful operation/use for at least three (3) consecutive years in an overseas country (not his own country) and at least five (5) three phase sets. The ratings and features of Equipment shall be the same or similar rating as EGAT specifies.

In case that the supply record of Equipment of the type and ratings proposed fulfilled the requirement, the manufacturer

may propose a newly developed or modified type of such Equipment with successful operation/use for at least one (1) year in overseas country (not his own country) and at least five (5) three phase sets. The detailed information of the development or modification shall be submitted with his proposal. EGAT, however, reserves the right and will make its own judgment whether or not to consider or accept the proposed developed or modified type.

Supply records of the higher rating Equipment shall not be accepted if the Bidder does not propose such higher rating Equipment in his bid.

11. Proposing the protective relay from the manufacturers as listed in EGAT's Specifications and shall be in compliance with the details specified in EGAT's Specifications. Type/Model of the main protective relays proposed shall be as specified in EGAT ACCEPTED MAIN RELAY LIST NO.1 and NO.2 attached at the end of Section A. Invitation to Bid.
12. For Fault Recording System.
  - 12.1 Having one of the following qualifications :
    - 12.1.1 The cabinet and all equipment is completely wired by the manufacturer before shipping to Thailand.
  - OR
  - 12.1.2 The cabinet and the equipment are wired in Thailand by the manufacturer that has obtained special permission from EGAT for manufacturing and/or fabrication of the Control and Protection System within the scope specified in the Letter of Permission which is issued by EGAT (for the local manufacturer). The design and engineering shall be performed by the FRS's manufacturer. The assembly, factory test and commissioning shall be in accordance with the FRS's manufacturer standard and performed under the manufacturer's supervisor.
- 12.2 The Fault Recording System (FRS) proposed shall be in compliance with the details specified in EGAT's Specifications. Manufacturer/type/model of FRS proposed shall be as specified in EGAT ACCEPTED FAULT RECORDING SYSTEM LIST attached at the end of Section A. Invitation to Bid
13. Being local manufacturer for steel supporting structure of Instrument Transformer, Surge Arrester and Disconnecting Switch.
14. For Closed-circuit television (CCTV) system and equipment

14.1 Proposed camera and Network Video Recorder (NVR) manufacturer shall have a representative or a branch office of manufacturer in Thailand for at least ten (10) years.

14.2 Proposed brand of IP cameras shall have a supply record of IP cameras for at least five hundred (500) IP cameras per contract with successful operation/use for at least three (3) years in Thailand.

14.3 The bidder or subcontractor shall have one of the following qualifications:

14.3.1 Having experiences in installation and cabling of outdoor-type IP cameras for at least fifty (50) cameras per contract with successful operation/use for at least three (3) years in Thailand.

OR

14.3.2 Having experiences in optical fiber cabling in substation switchyards for at least five (5) substations per contract with successful operation/use for at least three (3) years in Thailand.

14.4 Being local manufacturer for the following Equipment: CCTV Rack cabinet, Monitoring desk, CCTV pole, 12-core ADSS optical fiber cable.

e. Proposing the manufacturer who has no just or proper claims pending against Equipment of the same type/model to be proposed under this bid.

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

f. Proposing reputable subcontractors, for the portion of the work to be subcontracted, having adequate technical knowledge, ability and capacity to perform such work and having at least three years experience in the performance of similar work and of equal magnitude to the work to be subcontracted. If any proposed subcontractor(s) is (are) not qualified in the opinion of EGAT, the Bidder is required to select other subcontractor(s) at his own cost to the satisfaction of EGAT.

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**EGAT ACCEPTED MAIN RELAY LIST No.1**

Scheme	Technique	Accepted Type/Model	Manufacturer	Acceptance for			Notes
				500kV	230kV	115&69kV	
Current Differential	Numerical	RED670	ABB	YES	YES	YES	Only software version 1.1 is accepted.
		P543	GE	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		L90	GE	YES	YES	YES	
		SEL-311L	SEL	YES	YES	YES	
		7SD52	Siemens	YES	YES	YES	
		GRL100	Toshiba	YES	YES	YES	
		P543	Schneider Electric	YES	YES	YES	
		EF-LD	INGETEAM	YES	YES	YES	
		PCS-931	NR Electric	YES	YES	YES	
Distance Protection	Numerical	REL670	ABB	YES	YES	YES	Only software version 1.1 is accepted.
		P443	GE	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		D30	GE		YES	YES	Only for three pole tripping and line protection that no need carrier scheme.
		D60	GE		YES	YES	
		ALPSDA1	GE	YES	YES	YES	
		SEL-311C	SEL			YES	Only for three pole tripping and line protection that no need carrier scheme.
		SEL-421	SEL	YES	YES	YES	For 21P, 85, 67N. The relay with auto-reclosing function can not be accepted.
		7SA522	Siemens	YES	YES	YES	
		7SA6 series	Siemens	YES	YES	YES	
		GRZ100	Toshiba		YES	YES	
		GRZ200	Toshiba		YES	YES	
		ZLV	ZIV		YES	YES	
		P443	Schneider Electric	YES	YES	YES	
		EF-ZT	INGETEAM	YES	YES	YES	
		PCS-902	NR Electric	YES	YES	YES	
Transformer Differential	Numerical	RET670	ABB	YES	YES	YES	Only software version 1.1 is accepted.
		RET650	ABB	YES	YES	YES	3-restraints.
		P64x	GE	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"

NR

**EGAT ACCEPTED MAIN RELAY LIST No.1**

Scheme	Technique	Accepted Type/Model	Manufacturer	Acceptance for			Notes
				500kV	230kV	115&69kV	
Transformer Differential	Numerical	T35	GE		YES	YES	
		T60	GE		YES	YES	
		Duobias	Siemens		YES	YES	The manufacturer's name "Reyrolle" is changed to "Siemens"
		SEL-387	SEL		YES	YES	4-restraints.
		SEL-487E	SEL	YES	YES	YES	
		SEL-587	SEL			YES	2-restraints.
		SEL-787	SEL			YES	2-restraints.
		7UT6	Siemens	YES	YES	YES	5-restraints.
		GRT100	Toshiba	YES	YES	YES	
		GRT200	Toshiba	YES	YES	YES	
		IDV	ZIV	YES	YES	YES	
		P645	Schneider Electric	YES	YES	YES	
		EF-TD	INGETEAM	YES	YES	YES	3-restraints.
		PCS-978	NR Electric	YES	YES	YES	
Busbar Protection	High Impedance	REB650	ABB	YES	YES	YES	
		SEL-587Z	SEL	YES	YES	YES	
		GRB150	Toshiba	YES	YES	YES	
Busbar Protection	Numerical Low Impedance	REB670	ABB	YES	YES	YES	Only software version 1.1 is accepted.
		REB500	ABB	YES	YES	YES	
		P746	GE	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		P740	GE	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		B90	GE	YES	YES	YES	
		B30	GE	YES	YES	YES	Only use in case that the bus arrangement is Breaker-and-a half, Double-bus-Double-Breaker or Main-and-Transfer.
		P747	GE	YES	YES	YES	
		SEL-487B	SEL	YES	YES	YES	
		7SS52	Siemens	YES	YES	YES	
7SS60	Siemens	YES	YES	YES	Only use in case that the bus arrangement is Breaker-and-a half, Double-bus-Double-Breaker or Main-and-Transfer.		

N.A

**EGAT ACCEPTED MAIN RELAY LIST No.1**

Scheme	Technique	Accepted Type/Model	Manufacturer	Acceptance for			Notes
				500kV	230kV	115&69kV	
Busbar Protection	Numerical Low Impedance	7SS85	Siemens	YES	YES	YES	
		GRB100	Toshiba	YES	YES	YES	
		P746	Schneider Electric	YES	YES	YES	
		P740	Schneider Electric	YES	YES	YES	
Breaker Failure Protection	Numerical	RAHB411	ABB	YES	YES	YES	
		REQ650	ABB			YES	
		P141	GE	YES	YES	YES	3-phase Breaker failure function only. The manufacturer's name "ALSTOM" is changed to "GE"
		P14Nx	GE	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		C60	GE		YES	YES	
		F60	GE		YES	YES	
		SEL-501	SEL	YES	YES	YES	3-phase Breaker failure function only.
		P821	Schneider Electric		YES	YES	Only firmware version 1.F is accepted.
		7VK6 series	Siemens	YES	YES	YES	The function and the operating time for each system shall be conform to Specification nos. 1005 and 1002.
		GRC100	Toshiba		YES	YES	
		GRD200	Toshiba	YES	YES	YES	
		EF-ZT	INGETEAM	YES	YES	YES	
		PCS-9611	NR Electric	YES	YES	YES	3-phase Breaker failure function only.

**Note**

- The procedures for being listed in EGAT ACCEPTED MAIN RELAY LIST can be requested from Transmission System Engineering Division.
- If any type of relay in the list is planned not to be manufactured, the manufacturer or the representative is responsible for informing EGAT at least 1 year before it is obsolete.
- The relays shall be configured to comply with all EGAT's needed functions.

**EGAT ACCEPTED MAIN RELAY LIST No.2**

Scheme	Technique	Accepted Type/Model	Manufacturer	Acceptance for				Notes
				500kV	230kV	69&115kV	22&33kV	
Directional Overcurrent Relay	Numerical	REQ650	ABB	YES	YES	YES	YES	
		P14Dx	GE	YES	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		P841	GE	YES	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		SEL-351A	SEL	YES	YES	YES	YES	
		SEL-451	SEL	YES	YES	YES	YES	
		SEL-751	SEL	YES	YES	YES	YES	
		GRE140	Toshiba	YES	YES	YES	YES	
		GRD200	Toshiba	YES	YES	YES	YES	
		7SJ62	Siemens	YES	YES	YES	YES	
		7SJ85	Siemens	YES	YES	YES	YES	
		IRV	ZIV		YES	YES	YES	
		EF-MD	INGETEAAM	YES	YES	YES	YES	
		PCS-9611	NR Electric				YES	None of line fault locator. Only use with feeder.
Overcurrent Relay	Numerical	REQ650	ABB	YES	YES	YES	YES	
		P141	GE	YES	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		P14Dx	GE	YES	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		P14Nx	GE	YES	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		P841	GE	YES	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		F60	GE	YES	YES	YES	YES	
		F650	GE	YES	YES	YES	YES	
		SR350	GE	YES	YES	YES	YES	
		P120	Schneider Electric	YES	YES	YES	YES	

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**EGAT ACCEPTED MAIN RELAY LIST No.2**

Scheme	Technique	Accepted Type/Model	Manufacturer	Acceptance for				Notes
				500kV	230kV	69&115kV	22&33kV	
Overcurrent Relay	Numerical	P122	Schneider Electric	YES	YES	YES	YES	
		SEL-351A	SEL	YES	YES	YES	YES	
		SEL-451	SEL	YES	YES	YES	YES	
		SEL-551	SEL	YES	YES	YES	YES	
		SEL-751	SEL	YES	YES	YES	YES	
		SEL-751A	SEL	YES	YES	YES	YES	
		7SJ61	Siemens	YES	YES	YES	YES	
		7SJ62	Siemens	YES	YES	YES	YES	
		7SJ85	Siemens	YES	YES	YES	YES	
		GRE140	Toshiba	YES	YES	YES	YES	
		GRD200	Toshiba	YES	YES	YES	YES	
		IRV	ZIV		YES	YES	YES	
		EF-MD	INGETTEAM	YES	YES	YES	YES	
		PCS-9611	NR Electric	YES	YES	YES	YES	3 pole trip only
Synchronism Check Relay	Numerical	REQ650	ABB	YES	YES	YES		
		SPAU140C	ABB	YES	YES	YES		
		P841	GE	YES	YES	YES		The manufacturer's name "ALSTOM" is changed to "GE"
		F60	GE	YES	YES	YES		
		F650	GE	YES	YES	YES		
		SEL-279H	SEL	YES	YES	YES		
		SEL-351A	SEL	YES	YES	YES		
		SEL-451	SEL	YES	YES	YES		
		SEL-751	SEL	YES	YES	YES		
		SEL-751A	SEL	YES	YES	YES		
		7VK61	Siemens	YES	YES	YES		
		7SJ85	Siemens	YES	YES	YES		
GRD200	Toshiba	YES	YES	YES				

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**EGAT ACCEPTED MAIN RELAY LIST No.2**

Scheme	Technique	Accepted Type/Model	Manufacturer	Acceptance for				Notes
				500kV	230kV	69&115kV	22&33kV	
Synchronism Check Relay	Numerical	EF-MD	INGETEAM	YES	YES	YES		
		PCS-9611	NR Electric	YES	YES	YES		
	Static	RASC	ABB	YES	YES	YES		only use in Interposing Panel.
Auto Reclosing Relay	Numerical	REQ650	ABB	YES	YES	YES		
		P841	GE	YES	YES	YES		The manufacturer's name "ALSTOM" is changed to "GE"
		F60	GE		YES	YES		3 pole reclose only
		F650	GE		YES	YES		3 pole reclose only
		DRS	GE		YES	YES		3 pole reclose only
		SEL-279H	SEL		YES	YES		3 pole reclose only
		SEL-351A	SEL		YES	YES		3 pole reclose only
		SEL-451	SEL		YES	YES		3 pole reclose only
		SEL-751	SEL		YES	YES		3 pole reclose only
		7VK512	Siemens	YES	YES	YES		
		7VK61	Siemens	YES	YES	YES		
		GRR100	Toshiba	YES	YES	YES		
		GRD200	Toshiba	YES	YES	YES		
		EF-ZT	INGETEAM	YES	YES	YES		
		PCS-9611	NR Electric		YES	YES		3 pole reclose only
Overfluxing Relay	Static	RALK	ABB	YES	YES	YES		
	Numerical	7RW600	Siemens	YES	YES	YES		
		EF-TD	INGETEAM	YES	YES	YES		
Frequency Relay	Numerical	P94Vx	GE	YES	YES	YES	YES	The manufacturer's name "ALSTOM" is changed to "GE"
		MIV	GE		YES	YES	YES	
		SEL-351A	SEL	YES	YES	YES	YES	
		SEL-451	SEL	YES	YES	YES	YES	
		SEL-751	SEL	YES	YES	YES	YES	

**EGAT ACCEPTED MAIN RELAY LIST No.2**

Scheme	Technique	Accepted Type/Model	Manufacturer	Acceptance for				Notes
				500kV	230kV	69&115kV	22&33kV	
Frequency Relay	Numerical	SEL-751A	SEL	YES	YES	YES	YES	
		7SJ85	Siemens	YES	YES	YES	YES	
		EF-MD	INGETEAM	YES	YES	YES	YES	
		PCS-9611	NR Electric	YES	YES	YES	YES	
Under/Overvoltage Relay	Numerical	MIV	GE		YES	YES	YES	
		P94V	GE	YES	YES	YES	YES	None of VT input (open delta connection) for 59N.
		SEL-351A	SEL	YES	YES	YES	YES	
		SEL-751	SEL	YES	YES	YES	YES	
		SEL-751A	SEL	YES	YES	YES	YES	
		7SJ62	Siemens	YES	YES	YES	YES	
		7SJ85	Siemens	YES	YES	YES	YES	
		GRD200	Toshiba	YES	YES	YES	YES	
		IRV	ZIV	YES	YES	YES	YES	
		EF-MD	INGETEAM	YES	YES	YES	YES	
		PCS-9611	NR Electric		YES	YES	YES	C-Bank protection only

**Note**

- The procedures for being listed in EGAT ACCEPTED MAIN RELAY LIST can be requested from Transmission System Engineering Division.
- If any type of relay in the list is planned not to be manufactured, the manufacturer or the representative is responsible for informing EGAT at least 1 year before it is obsolete.
- The relays shall be configured to comply with all EGAT's needed functions.

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## EGAT ACCEPTED FAULT RECORDING SYSTEM LIST

Accepted Type/Model	Manufacturer
IDM+	QUALITROL
M871	GE
7KE85	SIEMENS
TESLA 4000	ERL Phase
TR2100	Rochester (RIS)

### Note

- The procedures for being listed in EGAT ACCEPTED FAULT RECORDING SYSTEM LIST can be obtained from Transmission System Engineering Division.
- If any type of FRS in the list is planned not to be manufactured, the manufacturer or the representative is responsible for informing EGAT at least 1 year before it is obsolete.

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## SCOPE OF WORK

### **H-1. General**

<u>No.</u>	<u>Substation</u>	<u>Page</u>
1.	CHAI BADAN SUBSTATION (JOB NO. ESCL-01-S01)	H1-1
2.	BAMNET NARONG SUBSTATION (JOB NO. ESCL-01-S02)	H2-1

## **1. CHAI BADAN SUBSTATION (JOB NO. ESCL-01-S01)**

### **General**

The work for Chai Badan Substation in Lopburi Province includes design, supply and construction of Battery Energy Storage System (BESS) for renewable firming to handle fluctuating power from renewable energy (RE) generation in this area. The voltage level at the Point of Common Coupling (PCC) for the BESS is **115 kV**. The nominal rating of the BESS is **21MW/21MWh**. Other specific requirements associated with this BESS are described in details in the Specification.

### **For Electrical Work**

The Contractor shall design, supply and construct an extension of one (1) 115 kV bay with main-and-transfer bus arrangement at 115 kV Chai Badan Substation for the installation of Battery Energy Storage System (BESS).

The Contractor's scope of work includes the engineering, designing, furnishing of all equipment, delivery, installation, test, and commissioning of the BESS at Chai Badan Substation, rated 21MW/21MWh, 50 Hz, three-phase with Li-ion battery technology that is performed under strict quality control standards using the highest quality of materials and workmanship.

All specified equipment, studies, designs, materials and installation shall be the Contractor's responsibility in providing complete, tested and fully functional 115 kV BESS installation.

All work necessary for a complete installation ready for commercial operation shall be performed and included in the Contractor's prices for the work hereunder.

Additionally, the Contractor shall also furnish all detailed engineering design work, calculation, drawing preparation, backup data, test report, and instruction books.

1. As stated elsewhere in the Bidding Documents, the drawings included in the Bidding Documents except drawings marked "For Construction" are for bidding purposes only and shall not be used for execution of the work.
2. The drawings furnished by the Contractor shall provide detailed descriptions of Equipment, installation methods, and requirement. Provided that the furnished drawings are perceived inadequately, EGAT retains the right to request additional details.
3. Calculation, backup data, and documentation are required for all parts of the design. All furnished data shall be verified to ensure that such data is accurate and adequate for the purpose of execution.

### **Work included in this Contract.**

The Work included in this Contract to be performed by the Contractor shall be as specified in the Contract Documents and as follows:

### **AIS and BESS**

1. Design and installation of all equipment and related accessories required for complete 115 kV extension bay installation with main-and-transfer bus arrangement for the installation of the BESS system as indicated in Bidding drawing.

2. Design, supply, and installation of all equipment required for complete 22 kV system and all related equipment for the complete operation.
3. Design, supply, and installation of all equipment required for the complete BESS. The design of BESS shall conform to DWG. NO. SE-BESS-001.
4. AC Switchgear shall conform to EGAT's Specification and DWG. NO. SE-BESS-001.
5. The data of the existing system for BESS design:
  - 5.1 The voltage unbalance at Chai Badan Substation (measured by CCVT, VY1A) is **0.72%** of the nominal voltage of 115 kV.
  - 5.2 Total Harmonic Voltage Distortion (measured from CCVT, VY1A) as follows:

	Phase A	Phase B	Phase C
%THDv	2.09	1.67	2.01

Table 1: Total harmonic voltage distortion (THDv) in the percent of the nominal voltage of 115kV

- 5.3 The harmonic voltage distortion in percent of the nominal voltage of 115 kV from 2<sup>nd</sup> to 49<sup>th</sup> harmonic orders as follows:

Harmonic Order	(%V)	Harmonic Order	(%V)
2	0.16	26	0.00
3	0.62	27	0.05
4	0.00	28	0.00
5	1.61	29	0.03
6	0.00	30	0.00
7	1.22	31	0.04
8	0.00	32	0.00
9	0.12	33	0.04
10	0.00	34	0.00
11	0.49	35	0.04
12	0.00	36	0.00
13	0.32	37	0.04
14	0.00	38	0.00
15	0.11	39	0.00
16	0.00	40	0.00
17	0.10	41	0.00
18	0.00	42	0.00
19	0.10	43	0.00
20	0.00	44	0.00
21	0.06	45	0.00
22	0.00	46	0.00
23	0.09	47	0.00
24	0.00	48	0.00
25	0.08	49	0.00

Table 2: The harmonic voltage distortion in percent of the nominal voltage of 115kV from 2<sup>nd</sup> to 49<sup>th</sup> harmonic orders

Note : The result of harmonic distortion measured from CCVT may be erroneous because CCVT may not have a good response at high frequency.

6. Design, supply, and installation of a substation lighting system completed with all integral accessories required for providing a complete operation. The lighting system shall mainly consist of equipment lighting, fence lighting, terminal boxes, lighting relay panel, raceways, and cable for lighting circuits. The lamps for the lighting system of the BESS area shall be **LED** type with all integral accessories. The lighting cable shall be single core conductor. The intensity of the lighting installation shall be as follows:

Area	Lux
Substation Area	50
Transformer Area	50

Table 3: The intensity requirement for outdoor area

7. Design, supply and installation of the following 22kV XLPE cable systems:
  1. 22 kV XLPE cable system running from KT1A to KW1AB and from KT2A to KW2AB (Note that KW1AB and KW2AB shall be installed in BESS area.)
  2. 22 kV XLPE cable system running from KT3A to switchgear
  3. 22 kV XLPE cable system running from switchgear to Inverter transformers

The design and calculation of the 22 kV cable systems shall conform to IEC or IEEE standards.

Design, supply and installation of all equipment, accessories, hardware and civil work required for completion of the above 22 kV XLPE cable systems. They shall include but not be limited to the following items:

- 22 kV XLPE cable - a single-core cable with copper conductor. The cross-sectional area of the cable shall be determined by the Contractor to meet the ampacity requirement.
- Cable trenches with concrete trench covers. The Contractor shall design the cable trench taking into account the minimum bending radius of the cable and cable installation.
- Cable supporting structures, metallic cable cleats, cable terminations, cable termination supporting structures, miscellaneous and grounding hardware.

The 22 kV XLPE cable shall be laid in a trefoil formation with cable cleats as shown in the Figure 2.

**Cable Cleats:** The cleats shall rigidly support and secure the cables when installed at intervals along the length of the cables. The surface of cleats shall be free from sharp edges, burrs, flash, etc. that are likely to damage cables or inflict injury to the installer or user. The cleats shall be made of aluminum or stainless steel or composite material according to IEC61914's definition. For composite material, the integral pad shall be smoke, low fume and halogen free. One cleat shall be provided with the closure bolt and nut assembly, and the mounting bolt and nut assembly. The closure bolt and nut shall be made of stainless steel. The cleats shall be designed conform to IEC61914 and able to resist the electromechanical force, withstanding more than one short circuit. The cleats shall be able to resist ultraviolet light (UV), very heavy impact and corrosion. The cable cleat shall have the operating temperature range from – 15°C to 105°C. For EPC project, the position and number of cable cleats shall be calculated and determined by Contractor to withstand the electromechanical



force from short circuit according to IEC61914. However, the maximum span between cleats is 1.2 meters for a straight path and 0.3 meters at a bending point as shown in Figure 1. For calculation of forces caused by short-circuit currents, the peak short circuit current shall be 62.5 kA

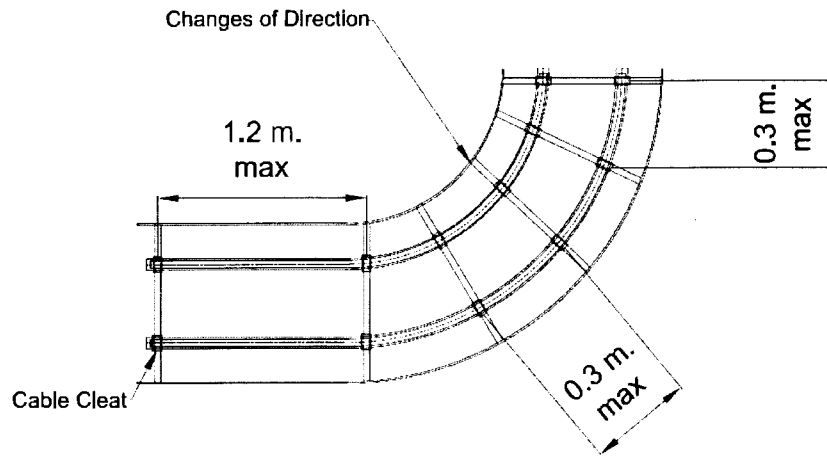


Figure 1: maximum span of cable cleats

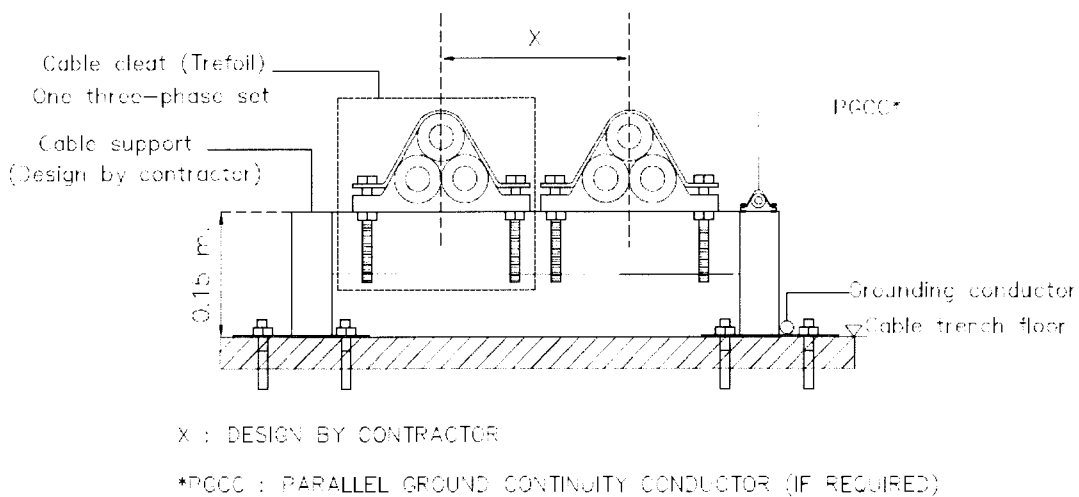


Figure 2: Trefoil Formation

The cable supporting structure shall be made of stainless steel, aluminum alloy or galvanized steel. The contractor shall design, supply and install the cable supporting structures that are suitable for cable cleat and cable system installation, and their grounding. For each Bid, the following document shall be submitted at the opening date to EGAT for approval;

1. The type test report or the commission test report of each structural type for
  - 1.1 The test for resistance to electromechanical force withstanding more than one short circuit conform to IEC61914.
  - 1.2 The test for resistance to ultraviolet light conform to IEC61914.

2. The official letter from manufacturer or the official agent to confirm the intention to be the supplier and will supply the product according to the type test report or the commission test report.

The Contractor shall design the 22 kV cable systems to meet the ampacity requirement for the rated load current with a proper design margin given that the ambient temperature is not less than 45°C and the effect of solar heat shall be considered. The other parameters used in the design shall be practical, reasonable, operational and conform to IEC or IEEE standards. The calculated continuous current rating shall be shown in the single-line diagram and submitted to EGAT for approval.

The Contractor shall design and select the type of metallic screen bonding. The induced voltage measured in every point of the metallic screen of the 22 kV XLPE cables shall be less than 60 V or shall conform to the IEC or IEEE standards.

If the single-point bonding is used, the Contractor shall design, supply and install the parallel grounding continuity cable (PGCC), if necessary. The type, insulation level and cross-sectional area of the PGCC shall be determined by the Contractor.

Design, supply and installation the equipment to protect the power cable from the surge voltage (if any).

8. The calculation of sag and tension of the phase conductors and overhead ground wires (OHGW) shall conform to IEC standard or other internationally accepted standards and be submitted to EGAT for approval. The ambient temperature of 45°C shall be used for the calculation.
9. Design, supply, and installation of marshalling cubicle for the 115/22 kV transformer.
10. Design, supply, and installation of all hardware for suspension insulator assembly.
11. The Contractor shall design BESS to achieve the performance as per specified in the Ratings and Features. The design of BESS shall be consistent with characteristic of the 115/22 kV transformer. The characteristic of 115/22 kV transformer is provided in CD-ROM including the following information;
  - Specification of 115/22 kV transformer
  - Ratings and Features of 115/22 kV transformer
  - The total loss of the 115/22 kV transformer is less than 200 kW at rated capacity.

#### **BESS layout**

12. The BESS shall consist of the following containers;

- Switchgear container
- Inverter transformer and Power conditioning system (PCS) container
- BESS battery container

A container shall be properly designed to allocate the space for the installation of all essential systems and sub-systems, e.g. equipment, HMI, local control, stationary battery, Inert gas system and etc.

Contractor shall design and layout the container and equipment inside with consideration of easy installation and maintenance, heat dissipation (minimum space for side, rear and top of panel shall be recommended). The access and maintenance

area around each container shall be properly designed for convenient maintenance and installation.

The Contractor shall design the partition for inverter transformer to separate the transformer from other necessary equipment.

The container shall be installed at least 1.50 meter above ground level with loading platform and stairs.

13. The service roads for BESS maintenance shall be provided and designed by the Contractor. They shall include but not be limited to the following:

- The service road in the BESS area with the minimum width of 4.00 m.

14. Cable laying at the ground floor of all the containers shall be in cable trenches. Cable ladders shall not be used

- 14.1 All conductors shall run in cable trench.

- 14.2 The cable trench of power cable and control cable shall be separated.

15. The container shall be weather-proof IP54 or above and equipped with Air ventilation and Air conditioning systems to achieve service condition as per EGAT's specification. The container shall be designed to protect the equipment inside from harmful effects resulting from the ingress of water, dirt, dust and wind.

16. The container's ventilation system shall be designed to achieve the conditions as specified in Specification.

The containers shall be ventilated 24 hours a day continuously by 2 (two) categories 8-hour interval of the explosion-proof exhaust fans operating alternately (if any).

The air conditioning system in the container shall operate 24 hours a day continuously and consist of 2 (two) categories of air conditioners for alternate operation 8-hour interval.

The cooling system of PCS shall be properly designed by the Contractor.

17. The Contractor shall design supply and installation plates for BESS project as the following;

- Identification plates
- Danger of battery explosion from open flame sparks and smoking
- Other plates if necessary

#### **Operational strategies and design study**

18. The Contractor shall design the BESS to fulfill the EGAT's performance requirements for the BESS operational strategies as follows:

**Renewable Semi-firming:** BESS shall be designed to maintain supplying power from connected RE power plants (Bay No.9 and Bay No.10 as shown in DWG.NO. CBD-S-1) using the slope reference line shown in Figure 3 during the firming-period, i.e. from 2.00 PM to 3.00 PM or until the battery is run out (whichever comes first). Importantly, battery charging is not required during the firming-period. In addition, the firming-period and slope reference line shall be adjustable.

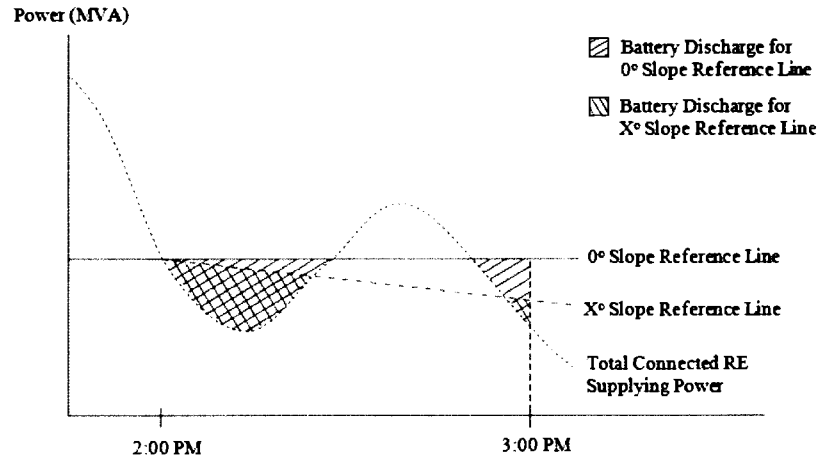


Figure 3: RE firming operational strategy

**Energy shifting (support function):** BESS shall be designed to charge and discharge BESS for energy shifting. The charge and discharge time and duration shall be adjustable. In addition, BESS shall be designed to supply the remaining stored energy (if any) until BESS is run out during night peak time given the daily load curve specified in the Rating and Features (RF).

19. The Contractor shall submit all reports on the system studies, engineering and design, and shall satisfy EGAT as to the completeness and accuracy of the studies to be carried out in accordance with the Contract. The Contractor shall also carry out all studies which are necessary for completion of the design and engineering.

The studies shall include but not be limited to the following:

- **Main component study:** the study is conducted to determine voltage and current stresses on the equipment within the systems and sub-systems of the BESS, during steady-state and transient conditions for all relevant BESS operating modes and ranges. The results of the study shall be used for deciding the design and rating points, operational strategy and limits of the BESS. For example
  - Electrical operation and performance characteristic of individual battery cell, battery module and battery rack: This shall include but not limit to
    - Voltage (nominal, end of discharge, top of discharge)
    - Current (maximum and minimum)
    - Capacity
    - Etc.
  - The physical characteristic of individual battery cell, battery module and battery rack
  - Electrical operation and performance characteristic PCS: This shall include but not limit to
    - DC input voltage (nominal, maximum, minimum)
    - AC output voltage and current
    - Etc.
  - The physical characteristic of PCS
- **Short circuit study**
- **Insulation Coordination Study**
- **Harmonic performance and ratings study:**
  - The Contractor shall provide the harmonic performance and rating study.

The network impedance for harmonic performance and rating shall be referred to as the CIGRE' sector Method, where impedance boundaries are calculated:

$$Z_{\max} = Z_{\max \text{ s.c.}} \times n$$

$$Z_{\min} = Z_{\min \text{ s.c.}} \times \sqrt{n}$$

0-80 degree  $n < 5$   
 $\pm 75$   $5 \leq n \leq 11$   
 $\pm 70$   $11 \leq n \leq 50$

where

$Z_{\max \text{ s.c.}}$  = ac system maximum short circuit impedance at fundamental frequency and nominal system voltage

$Z_{\min \text{ s.c.}}$  = ac system minimum short circuit impedance at fundamental frequency and nominal system voltage

- The maximum 3 phase short circuit current: 7.017 kA
- The minimum 3 phase short circuit current: 5.975 kA
- The maximum L-G short circuit current: 6.846 kA
- The minimum L-G short circuit current: 5.621 kA
- The harmonic impedance range is defined by the area in the resistance (R-X) plane enclosed by the maximum and minimum impedance, limited by the impedance angles as depicted below



Figure 4: Impedance area with parameter for limitation according to CIGRE WG14.30

- The Contractor shall design the BESS to limit harmonics as specified in Ratings and Features.
- **System Voltage and System Frequency:** the Contractor shall design BESS by considering system voltage level and system frequency at the Point of Common Coupling (PCC) as per EGAT's requirement. The system voltage shall be limited to  $\pm 5\%$  interval of nominal voltage and the system frequency shall be  $50 \pm 0.5$  Hz as specified in Operation Code.
  - **Electrical Interfere:** the Contractor shall design the operation of BESS by considering the electrical interference from wind farm and solar farm. The distance between Chai Badan substation and wind farm is 40 km approximately.
  - **Noise study:** the Contractor shall provide the noise study to identify and mitigate possible source of noise. This shall include air condition units and other source of noise such as transformers and power electronic.

Indoor: the time weight average level of noise inside container shall not be more than 75 dB(A) for time weight average during BESS operating hour (2.00AM-6.00AM and 2.00PM-3.00PM). The noise

level inside container shall be maximum 90 dB(A) in areas where personnel are permitted during BESS operation.

Outdoor: the noise shall not increase more than 7 dB(A) from background noise. EGAT shall submit background noise after award. For the noise study, shall also be submitted after award. The noise shall be measured at least 3 points at new additional fence of BESS as per Figure 5

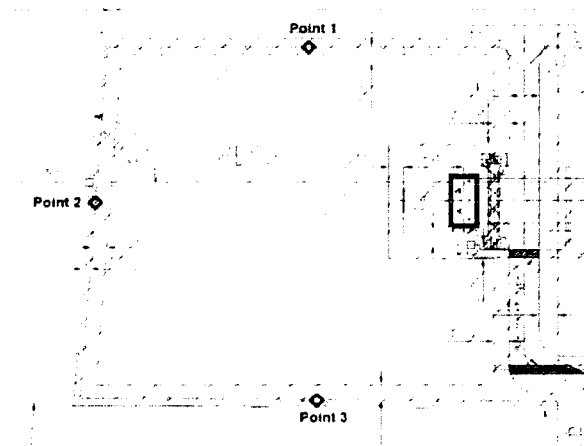


Figure 5: Location for measuring noise (Chai Badan Substation)

**20. Electrical design drawing:** the Contractor shall design and submit this following drawing but not limited to:

1. **Single Line Diagram (S-1):** the Contractor shall provide single line showing the major equipment electric circuitry and switching device as per dwg.no. CBD-S-1 and SE-BESS-001.
2. **General Layout (S-2)**
3. **Bus Structure Plan (S-3):** the physical arrangement of equipment shall match with the general layout.
4. **Bus Structure Sections (S-4):** the Contractor shall provide interconnection drawing for major equipment that is in either separated container or physical separated compartment of a single container.
5. **Grounding System (S-5):** the Contractor shall provide grounding system drawing for 115 kV, 22 kV and BESS. This drawing shall show ground grid and ground connection point of all related equipment as per dwg.no. ISO/BB-S-5.
6. **Equipment Layout (S-6):** the Contractor shall provide the equipment layout of each container including control building equipment layout.
7. **Structure Layout (S-7)**
8. **Cable Trench and Conduit Layout (S-8):** the Contractor shall provide conduit and cable trench for any required conduit at 115 kV, 22 kV and BESS. These drawing shall show the approximate location, designation of each conduit, cable trench and conductor route.
9. **Identification Plate and Location (S-9):** nameplate drawing of component for which it is general practice to furnish nameplate.
10. **Lighting Plan (L-1):** the Contractor shall provide lighting system drawing for BESS.
11. **Lighting Fixture and Load Schedule (L-2):** the lighting equipment which are designed as lighting plan including load schedule shall be shown in this

drawing.

12. **Power Supply for BESS (L-5):** the Contractor shall provide single line diagram to show the necessary equipment for station service of BESS.

### **Grounding**

21. Design, supply and installation of the grounding system of the following:

- 115 kV conventional substation
- 22 kV system and 22 kV cable systems
- The containers and BESS area
- Connection of the grounding system of the BESS to that of the existing substation.

22. The Contractor shall conduct the soil resistivity measurement. The result shall be submitted to EGAT for approval.

23. The Contractor shall design a grounding grid based on the measured soil resistivity by hand calculation using the equations in IEEE-80 standard and submitted to EGAT for Approval. The following parameters for grounding system calculation shall be used;

- The symmetrical fault current (rms) = **31.5 kA**
- Time duration of fault = 1 sec
- The fault current division factor ( $S_f$ ) = 1 shall be used for determining the RMS symmetrical grid current. The fault current division factor ( $S_f$ ) shall be equal to one (1), that is, the fault current only dissipates in the Chai Badan Substation's grounding system and is not divided to other substations.
- X/R ratio = **20**
- The maximum ground grid conductor spacing ( $D_0$ ) shall be **3.50** meters.
- The number of ground rods shall be **30** pieces.

These parameters shall be used for determine the size of grounding conductor for the substation grounding system. However, the 4/0 AWG bare copper wires shall be used for ground grid and 2 x 4/0 AWG for cable tap and risers from ground grid to all equipment structure.

If the ground conductor spacing calculated by hand ( $D_1$ ) is less than the grounding conductor spacing for reference ( $D_0$ ), the Contractor shall design a grounding grid by using the software. The certification of software shall be acceptable for commercial use.

24. All substation metal parts such as structure, equipment, cable trays and containers in the BESS area shall be connected to the grounding system by exothermic connection.

25. The design of the grounding system for the BESS indoor equipment shall follow the recommendations made by the BESS manufacturer.

### **Lightning protection**

26. Design, supply, and installation of the substation lightning protection system completed with all related equipment including lightning protection masts. Masts shall be used for lightning protection in BESS area (if necessary). This includes

proper system insulation coordination, overhead ground wire, and surge arresters. The Contractor shall design the lightning protection system for the protection of all substation equipment which is under the protective zone. To meet EGAT's design criteria for the lightning protection system and to enhance the stability of lightning protection system, the following values shall be used in the design:

- BIL of 550 kV for 115 kV substation
- For 22 kV Substation, the stroke current of **2 kA** shall be used for the calculation.

27. The design of lightning protection system shall conform to IEC, NEMA and E.I.T. standards or other internationally accepted standards.

#### **Station service**

28. Design, supply, and installation of the station service system complete with integral accessories required for providing a complete operation of the BESS. The abnormal condition which occurs from the design and installation of the station service system for example ferroresonance etc. shall be responsible by Contractor. The station service system shall mainly consist of as follows:

- XXX kVA, 22,000-400/230 V distribution transformers (KW1AB)
- XXX kVA, 22,000-400/230 V distribution transformers (KW2AB)
- Automatic Transfer Switch Board (ATS)
- The drawing No.SE-ATS-7-03-01-01 shall be reference only. The Contractor shall design all circuit breaker ampere-trip and number of feeders to meet with BESS load required.
- 22 kV power fuse
- 600 V, XXX A Safety switch
- 22 kV equipment, AC & DC distribution board, stationary batteries, battery chargers, power cables, and all related equipment required for the complete operation.

29. Design, supply and installation of the stationary battery, in which the battery is capable of delivering power to the control and protection for tripping all circuit breakers and emergency essential load for at least 8 hours and emergency lighting for at least 3 hours as shown in the figure below if normal station service fails. In case of bus faults occurring on the last hour of battery power, the battery shall generate sufficient power for tripping all circuit breakers. The stationary battery shall be designed and calculated in accordance with IEEE or other acceptable international standards. In addition, the size of the stationary battery shall be designed to support the operation of existing and future bay as shown on the attached Bidding Document Drawing. The calculation shall be submitted to EGAT for approval. The size of battery shall not be less than **200 Ah** for BESS.



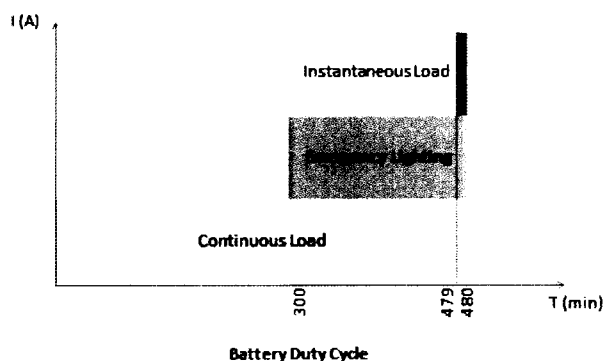


Figure 6: Battery duty cycle

**Facility System**

30. Design, supply, and installation of electrical system, lighting system, and fire alarm system for the BESS. Recommendations for the aforesaid systems are as follows:

- All cable wiring systems shall conform to NEC and IEC standards or other internationally accepted standards.
- The lamps for the lighting system of the BESS shall be **LED** type with all integral accessories, e.g. lamp holders, fixtures, reflectors, and etc. All steel accessories e.g. lip-channel, conduit, conduit fittings, conduit accessories, box and cover shall be hot dip galvanized. The Contractor shall provide drawings that show details for installation. The required intensity of the lighting installation shall be as follows:

Area	Lux
Around container	20
Switchgear container	300
Inverter transformer and PCS container	300
BESS battery container	300

Table 4: The intensity for BESS building

The lighting intensity of other necessary containers (if any) shall be properly designed by the Contractor (HMI and local control areas within the container shall be 500 Lux).

- The lighting fixtures for the BESS battery and stationary battery containers shall be explosion-proof type.
- The following areas of the BESS shall be with the emergency lighting:
  - Switchgear container
  - Inverter transformer and PCS container
  - Battery container
  - Stairway
  - All exits

The emergency lighting system shall provide the illumination of **150** Lux.

- The size of low voltage cable shall be sufficient to keep the voltage drop from Automatic Transfer Switch (ATS) to the load point less than 5% at rated load current.

- A summary of the type and quantity of fire extinguishers required for the specified areas are given in the table below:

Area	Fire Extinguish (Located at Entrance/Exiting)	
	Dry	Carbon
Switchgear container	-	2
Inverter Transformer and PCS container	-	2
BESS battery container	-	2
Other necessary containers (if any)	-	2

Table 5: The type and quantity of fire extinguishers for BESS

- As for the indoor electrical system and communication system, the Contractor shall use standardized and cutting-edge equipment. The lighting fixture and installation detail shall be confirmed to DWG. NO. SE-FX-4-01. The indoor electrical system and communication system shall serve the following areas:

Area	Receptacle (QTY)	Duplex RJ45 outlet (QTY)	
	Duplex (Wall)	For LAN	For Telephone
Container	As specified in specification	2	1

Table 6: The quantity of receptacle and outlet for BESS

- The HMI and local control area in container shall be provided at least 4 duplex (Wall) receptacles, 2 floor receptacles, 2 duplex RJ45 outlets (for LAN) and 1 duplex RJ45 outlet (for telephone).
- All steel accessories e.g. lip-channel, conduit, conduit fittings, conduit accessories, box and cover shall be hot-dip galvanized.

### Control and Protection System

31. Design, supply, install, test and commissioning of complete control and protection system including the following equipment:

- Swing-rack type switchboard panels
- Interposing relay panels and transducer panels
- Cables and accessories as well as connection of cables among all of the boards and the associated equipment in order to complete the function of the control and protection system.

32. Design, supply, install, test and commissioning of complete BESS control and protection system which include following equipment:

- BESS major equipment: control, protection, metering, local control system, remote control system and protection relay switchboards with recommended spare parts (Breakdown in price schedule of each items)
- A Remote Terminal Unit system and marshalling panels for Digital Remote Terminal Unit system
- A digital fault recording system and marshalling panels for digital fault recording system

- 400/230 VAC, 125 VDC distribution boards and 125 VDC power panels which meet EGAT's design standard with required spare part
  - Cables and accessories as well as connection of cables among all of the boards and the associated equipment in order to complete the function of the control and protection system.
33. Design, modification, wire, test and commissioning of existing control and protection system as per bidding drawing required by EGAT which include the following equipment:
- Duplex type switch board panels
  - Interposing relay panel and transducer panel
  - Marshalling panels for the teleprotection interface
  - The digital fault recording system and marshalling panel for digital fault recording system
  - The Remote Terminal Unit system and marshalling panel for the Remote Terminal Unit
  - Other panels which related to control and protection system.
34. Design, modification, wire, test and commissioning of the Remote Terminal Units (RTUs) and Master Station Unit are supplied by EGAT whereas configuration that include in this contract must be fulfilled under EGAT's supervision.
35. Design the schematic and wiring diagrams of the additional inputs to the existing Computerized Control System (CCS), including test and commissioning of the complete CCS.
36. Design the schematic and wiring diagrams of the additional inputs to the existing Fault Recording System (FRS), including test and commissioning of the complete FRS.
37. Design, modify, install, wire, test and commissioning of Optical Fiber Cable of Remote Terminal Unit (RTU) that connection within the control room.
38. Design, supply, install, wire, test and commissioning of Optical Fiber Cable of Fault Recording System (FRS) that connection within the control room.
39. The Contractor shall be responsible for providing complete schematic and wiring diagrams of the control and protection system.
40. The National Control Center (NCC) and the Regional Control Center (RCC) of EGAT or CCS shall be able to access BESS HMI for adjusting parameters as mention in Rating and Features then the function shall be working properly and automatically
- Charge/ Discharge duration function  
NCC, RCC and CCS shall be able to set time duration of
    - Start / stop charging
    - Start / stop discharging
  - Instant command to Charge/ Discharge

NCC, RCC and CCS shall be able to execute command of start/stop charging/  
discharging BESS suddenly

41. Any modification and interfacing works to the existing metering, control and protection panels, including supply of related accessory equipment which is required for incorporating the new equipment. The modified existing drawings shall be performed by the Contractor and submitted to EGAT for approval. The final drawings shall be submitted as ACAD files.
42. The telecommunication of BESS system designed by contractor shall be capable of interfacing to EGAT's SCADA system which consists of local SCADA and remote SCADA via IEC 60870-5-104. In addition, remote SCADA shall comprise at least National Control Center (NCC), Backup National Control Center (BNCC), Regional Control Center (RCC) and Group Control Center (GCC).
43. A smooth energizing of the BESS shall be achieved and shall not affect EGAT's customers or cause any malfunctions to the existing substation and nearby power plants. In addition, the proposed BESS design shall demonstrate that it fulfills the said requirements.
44. The BESS control shall be designed with the optimized parameters and functions in order to fulfill all conditions under the given short circuit level.
45. Unused existing cables shall be removed. The removed cables shall be neatly reeled and kept in a suitable place recommended by EGAT.
46. Control System or Energy Management System for whole system of BESS shall have redundancy and show mimic diagram and status (for example: battery's SOC, current, voltage, etc.) of all battery modules, racks, containers and Power Conversion System in HMIs.
47. Battery Management System or Battery Monitoring System (BMS) shall consist of at least Module level BMS and Rack level BMS.
48. All Battery containers shall be designed with access protection which is normally not allow to access by interlocking, however, battery containers shall be accessible without tripping BESS when operator unlocked the access protection manually.
49. The contractor shall provide PCSs to fully perform input and output power of both active and reactive power according to the figure 7 below.

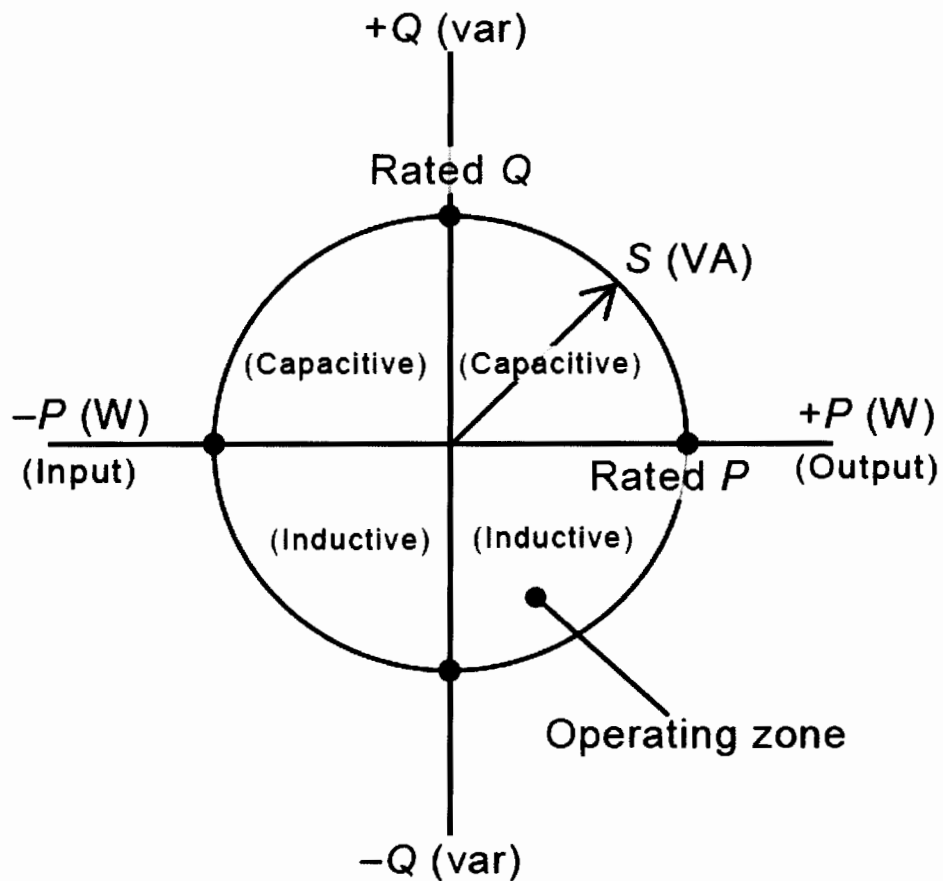


Figure 7. Operation Zone of PCS

**Remark:** Relaying and metering diagram on Drawing No. CBD-E-1.1 and CBD-E-1.2 is used as guideline. The drawing can be modified by the contractor. However, they shall meet EGAT's standard design criteria and be submitted to EGAT for approval.

#### Civil and Architectural work

50. Design and construction of substation civil work
  - 50.1 Steel structure and foundations for Specified equipment and the others not shown in "For Construction drawings" and / or EGAT's specification.
  - 50.2 Road and drainage system.
  - 50.3 Drainage system for cable trench.
  - 50.4 Oil containing pit with steel grating and black steel spiral-seam pipes (TIS 427-2531) with protection method according to AWWA C217, C205.
  - 50.5 Oil separator for 25 cu m transformer oil. The contractor shall make an Oil separator design calculation in accordance with "IEEE STD-979" (IEEE Guide for Substation Fire Protection), "IEEE STD-980" (IEEE Guide for containment and control of oil spills in substation) and "Wastewater Quality Standard" of Pollution Control Department, Ministry of Natural Resources and Environment.

51. Construction of substation civil work
  - 51.1 Steel structure foundation.
  - 51.2 Take-off foundation.
  - 51.3 Equipment structure foundation with sub trench (if required).
  - 51.4 Dead man hook for loading transformer
  - 51.5 Transformer loading.
  - 51.6 Cable trench.
  - 51.7 RC Road.
  - 51.8 Crushed rock surfacing.
  - 51.9 Wire mesh fence.
  - 51.10 Site office.
  - 51.11 Lamp post for fence and access road lighting LED type foundation.
  
52. Design and construction of Battery energy storage system containers and all components.
  - 52.1 Code treatment shall not be inferior to requirements in all relevant IFC, NFPA, IEC, and IEEE standards.
  - 52.2 Container structure, modifications, and foundation, seismic and structural design shall be in accordance with IBC chapter 16. The configuration can be selected for the design and construction and shall be submitted to EGAT for approval.
  - 52.3 Containers must be separated 1.50 m from lot lines, public ways, buildings, and other exposure hazard according to International Fire Code.
  - 52.4 1.50 m high hot dip galvanized steel structure container support with hot dip galvanized steel loading platforms and stairs.
  - 52.5 Architecture, civil, air condition, ventilation, fire protection, and lighting works of the containers:
    - 52.5.1 The design of exterior surface and the following aspects shall be analyzed and taken into consideration; aesthetic to encourage EGAT corporate, eco-friendly identity and including the latest official EGAT's logo and slogan in proper size.
    - 52.5.2 The design of exterior surface shall be submitted to EGAT for approval.
    - 52.5.3 The exterior surface shall be finished with powder coat system.
    - 52.5.4 The interior surface shall be finished with white color steel lining
    - 52.5.5 Wall and ceiling planes shall be smooth and plain.
    - 52.5.6 There shall be anti-corrosive system for containers.
    - 52.5.7 Containers walls, ceilings, floors shall be insulated with PU foam spray.
    - 52.5.8 Doors & windows shall be explosion proof type
    - 52.5.9 There shall be at least two fire exit doors for each container
    - 52.5.10 Louvers for ventilation, air condition, and fire protection system shall be performance aluminum louvers. The exterior aluminum louvers, assembled from ventilation hidden mullion louvers system, shall achieve a BSRIA or AMCA class A1 for an air flow performance of class 3 and pressure drop must be less than 40 Pa, with titanium color coating on front blade and natural anodized NA 1 color coating on rear blades.
    - 52.5.11 All louvers shall be installed with motorized fire shut-off damper.

- 52.5.12 Electricity and illumination system including cable work for illumination, ventilation system, power supply, air conditioning system, and telephone system.
- 52.5.13 Plumbing system for water supply, building drain and vent, storm water drainage including sanitary wares and fittings. (if any)
- 52.5.14 Miscellaneous including grounding and labeling.
- 52.5.15 Cable routing and cable support (cable tray and cable ladder) from main cable trench.
- 52.5.16 Access floor, switchgears and heavy-duty areas type. (if any)
- 52.5.17 Warning sign provided in accordance with EIT Standard or Quality and Safety Development Division Standard (EGAT).
- 52.5.18 Fire protection system of containers:
- All containers shall be protected with Standard Fire Detection (photo electric smoke detector) and Early Warning Fire Detection System (ASD) according to NFPA 72, 75, and IG-100 total flood fire suppression system according to NFPA 2001.
  - There shall be linear heat detector for battery rack which can monitor temperature at the resolution of 0.1 degree Celsius and of which sensor spacing can be selected.
  - There shall be a room in all containers for fire protection system devices and IG-100 agent cylinders.
  - Detection system shall be able to locate a source of fire in each compartment and room in containers.
  - The system will alarm if only one of Standard Fire Detection device or one of Early Warning Fire Detection System device reaches alarm sensitivity.
  - The system will enter pre-discharge and discharge states if one of Standard Fire Detection device and one of Early Warning Fire Detection System device reach alarm sensitivity.
  - There shall be sounder and beacon on the top of containers.
  - For air sampling detector as shown on specification 3001-10.13.2 part i item no.1, 7, 13 and 14 shall be changed to the new details as followings :
  - Air Sampling Smoke Detector.
    - (1) Shall consist of a high sensitivity type detector, using light scatter technology.
    - (7) Detection system must be included in all control cabinet and can locate a scene.
    - (13) The minimum sensitivity settings for a single sampling hole are so that the detection system alarm at 1.5% obs/ft (4.95% obs/m). A sampling hole maximum coverage area is 400.0 sq.ft (37.2 sq.m).
    - (14) Maximum transport time from the most remote hole to the detection unit of an air-sampling system shall be a maximum of 90 seconds.
  - There shall be fire extinguishers in all containers. A summary of the type and quantity of fire extinguishers required for the specified areas are given in the table below:

Area	Fire Extinguisher (Located at Entrance/Exiting)	
	Dry	Carbon
Switchgear container	-	2
Inverter Transformer and PCS container	-	2
BESS battery container	-	2
Other necessary containers (if any)	-	2

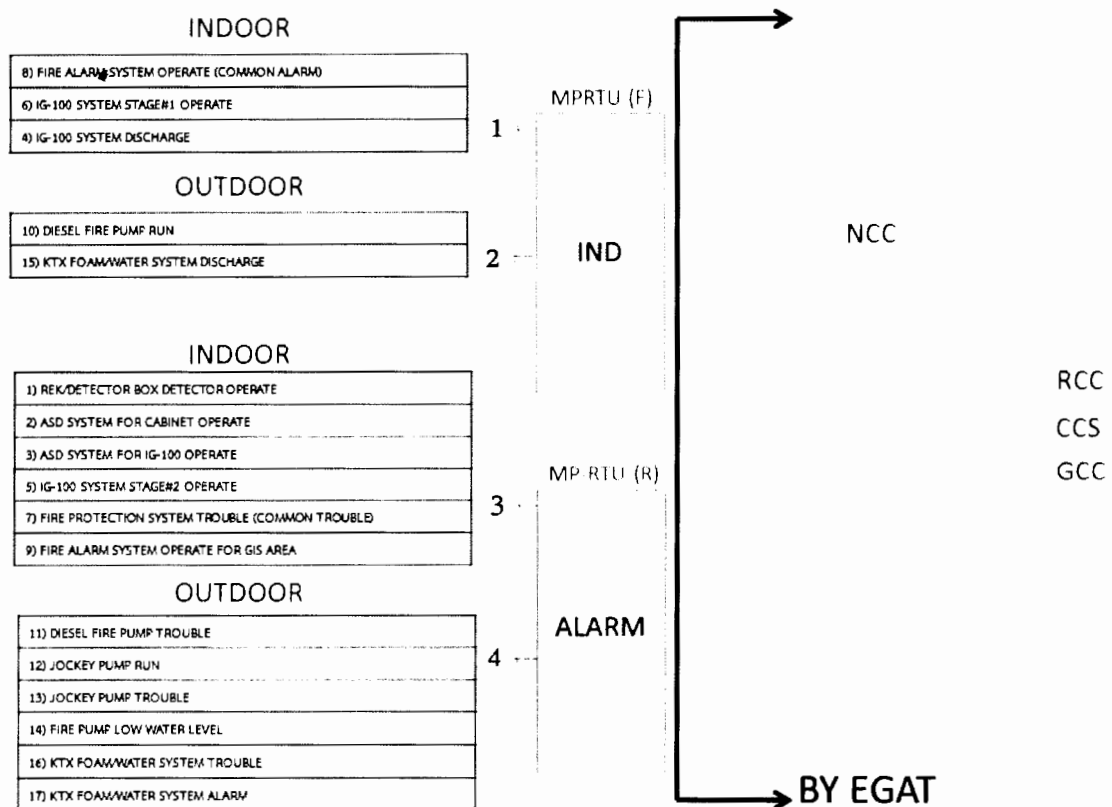
52.6 Fire protection system, fire alarm system, air condition and ventilation system, installation, arrangement, accessories and battery energy storage system equipment, installation, arrangement, accessories shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards, including all further reference critical standards shown in the following codes and standards:

- IFC: International Fire Code
- IEC 62897, Stationary Energy Storage Systems with Lithium Batteries Safety Requirements
- UN 38.3: Transportation Code
- UL 489: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- UL 810A: Electrochemical Capacitors
- UL 1642: Standard for Lithium Batteries
- UL 1741, Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- UL 9540: Standard for Energy Storage System and Equipment
- IEEE/ASHRAE 1635: Ventilation, exhaust, thermal management and mitigation of the generation of hydrogen or other hazardous or combustible gases or fluids
- NFPA 1: Fire Code
- NFPA 2001: Clean Agent Fire Extinguishing Systems
- NFPA 70: National Electrical Code.
- NFPA 72: National Fire Alarm Code.
- NFPA 75: Standard for the Fire Protection of Information Technology Equipment.
- NFPA 76: Standard for the Fire Protection of Telecommunications Facilities.
- NFPA 110: Standard for Emergency and Standby Power Systems
- NFPA 111: Standard for Stored Electrical Energy Emergency and Standby Power Systems
- NFPA 855: Standard for the Installation of Stationary Energy Storage System
- EGAT's Standard Design Manual of Fire Protection and Suppression for Substation. (คู่มือมาตรฐานการออกแบบเพื่อป้องกันและระงับอัคคีภัยสถานีไฟฟ้าแรงสูงการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย)
- IEEE Std 979: IEEE Guide for Substation Fire Protection
- NFPA 850: Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Substations



53. Design and construction of outdoor fire protection system

- 53.1 Fire protection system for the switchyard to meet the requirement as specified in IEEE Guide for Substation Fire Protection: IEEE Std 979, all requirements of NFPA 850 and EGAT's Standard Design Manual of Fire Protection and Suppression for Substation (คู่มือมาตรฐานการออกแบบเพื่อป้องกันและระงับอัคคีภัยสถานีไฟฟ้าแรงสูงการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย).
- 53.2 Fire Pump System, conforming to NFPA 14, 20, 24, 72
- 53.3 250 cu.m water storage tank, fire pump, and jockey pump shall have trouble and operation visual and audible signals (environmental monitoring), which indicate change of state of any connected devices, shown and recorded at control room. The installation practice shall be in accordance with the latest edition of NFPA 72.
- 53.4 There shall be one graphic annunciator which displays alarm, discharge and trouble signals of fire alarm system of fire pump houses, battery energy storage fire protection system at the building where control room locates.
- 53.5 Fire protection system circuits for buildings, switchyards, and containers: notification appliance circuits, and signaling line circuits, shall be class A circuit. Initiating device circuits can be class B circuit.
- 53.6 For Control System Logic as shown on specification 3001-13.4 item 4.1 shall be changed to the new detail below. Signals of outdoor battery energy storage system fire protection system shall be sent to local CCS, GCC, RCC, and NCC in a manner similar to following details;



- 53.7 There shall be only one subcontractor engaging in design, supply and installation of Fire Protection System for Buildings and Switchyard.
- 53.8 Water supply system.

54. Construction of outdoor fire protection system
  - 54.1 Fire pump house.
  - 54.2 Cabinet with 2x50 lbs wheel fire extinguisher.
  - 54.3 Water storage tank for fire protection system (capacity not less than 250 cu m).
55. All design works and the fabrication drawings for all steel structures shall be submitted to EGAT for approval.
56. All design, construction and testing shall be in accordance with Specification No. 3001: Civil and Architectural Work.
57. Bored hole for soil investigation shall conform to Specification No. 3001. The position shall be submitted to EGAT for approval.
58. In case of soil layer is soft clay, consolidation test shall be performed from clay of one bored hole only. The position shall be submitted to EGAT for approval.
59. All foundations shall be as specified in layout drawing. Except the result of soil investigation shows that the specified foundations are not appropriate, the Contractor shall design the proposed foundations.
60. The Contract price shall be adjusted (added or reduced) in case that the soil investigation results to be used for the design works is different from the layout and standard drawings.
61. Dynamic load test (DLT) according to ASTM D4945-89 shall be applied to at least 2% of driven piles (if driven pile type is required) except for driven pile of fence and lamp post.
62. Seismic load test (sonic integrity test) according to ASTM D5882-96 shall be applied to all bored piles (if bored pile type is required).
63. Plate bearing test according to ASTM D1194-94 shall be submitted to EGAT for approval. (if pad type foundation is required).
64. The Contractor shall remove all debris from construction material and other works in order to make the site clean and be in the condition acceptable to EGAT.
65. According to the Contract Document Section G-3: Contractor's Office and Other Construction Facilities; the detail in paragraph 3 shall be changed as follows: the Contractor shall provide for EGAT an office container at the site during construction with a minimum space of 36 sq.m for office area, 24 sq.m for conference room which shall both be air-conditioned and 4 sq.m for toilet. The facilities as shown on the section G-3 are required for 2 sets.

**Other work**

66. Removal of all debris, construction materials, and other works as required after the project is completed so that the site is in a clean and orderly condition acceptable to EGAT.
67. Test and commissioning of all equipment as required for ensuring the proper functioning of the substation.
68. Modification of the existing metering structure for the installation of fuses and terminations (for station service transformer).
69. Modification to 22 kV bus supporting structure (BS202).
70. Testing and commissioning of all equipment required to make the BESS function properly.
71. Supply and installation of cabling from the marshalling control cubicle (MC002) to the associated equipment.

**Work not included in this Contract**

The Work not included in this Contract shall be as shown on the drawings and as follows:

1. Supply and installation of 115/22 kV transformer “KT3A”.
2. Supply of 115kV equipment e.g. disconnecting switch, power circuit breaker, CT, CVT, bus pole structure, take-off structure and etc. as indicated drawing.

## **2. BAMNET NARONG SUBSTATION (JOB NO. ESCL-01-S02)**

### **General**

The work for Bamnet Narong Substation in Chaiyaphom Province includes design, supply and construction of Battery Energy Storage System (BESS) for renewable firming to handle fluctuating power from renewable energy (RE) generation in this area. The voltage level at the Point of Common Coupling (PCC) for the BESS is **115 kV**. The nominal rating of the BESS is **16MW/16MWh**. Other specific requirements associated with this BESS are described in details in the Specification.

### **For Electrical Work**

The Contractor shall design, supply and construct an extension of one (1) 115 kV bay with main-and-transfer bus arrangement at 115 kV Bamnet Narong Substation for the installation of Battery Energy Storage System (BESS).

The Contractor's scope of work includes the engineering, designing, furnishing of all equipment, delivery, installation, test, and commissioning of the BESS at Bamnet Narong Substation, rated 16MW/16MWh, 50 Hz, three-phase with Li-ion battery technology that is performed under strict quality control standards using the highest quality of materials and workmanship.

All specified equipment, studies, designs, materials and installation shall be the Contractor's responsibility in providing complete, tested and fully functional 115 kV BESS installation.

All work necessary for a complete installation ready for commercial operation shall be performed and included in the Contractor's prices for the work hereunder.

Additionally, the Contractor shall also furnish all detailed engineering design work, calculation, drawing preparation, backup data, test report, and instruction books.

1. As stated elsewhere in the Bidding Documents, the drawings included in the Bidding Documents except drawings marked "For Construction" are for bidding purposes only and shall not be used for execution of the work.
2. The drawings furnished by the Contractor shall provide detailed descriptions of Equipment, installation methods, and requirement. Provided that the furnished drawings are perceived inadequately, EGAT retains the right to request additional details.
3. Calculation, backup data, and documentation are required for all parts of the design. All furnished data shall be verified to ensure that such data is accurate and adequate for the purpose of execution.

### **Work included in this Contract.**

The Work included in this Contract to be performed by the Contractor shall be as specified in the Contract Documents and as follows:

### **AIS and BESS**

1. Design and installation of all equipment and related accessories required for complete 115 kV extension bay installation with main-and-transfer bus arrangement for the installation of the BESS system as indicated in Bidding drawing.

2. Design, supply, and installation of all equipment required for complete 22 kV system and all related equipment for the complete operation.
3. Design, supply, and installation of all equipment required for the complete BESS. The design of BESS shall conform to DWG. NO. SE-BESS-001.
4. AC Switchgear shall conform to EGAT's Specification and DWG. NO. SE-BESS-001.
5. The data of the existing system for BESS design:
  - 5.1 The voltage unbalance at Chai Badan Substation (measured by CCVT, VY3A) is **0.66%** of the nominal voltage of 115 kV.
  - 5.2 Total Harmonic Voltage Distortion (measured from CCVT, VY3A) as follows:

	Phase A	Phase B	Phase C
%THDv	1.80	1.90	1.60

Table 1: Total harmonic voltage distortion (THDv) in the percent of the nominal voltage of 115kV

- 5.3 The harmonic voltage distortion in percent of the nominal voltage of 115 kV from 2<sup>nd</sup> to 49<sup>th</sup> harmonic orders as follows:

Harmonic Order	(%V)	Harmonic Order	(%V)
2	0.03	26	0.00
3	0.77	27	0.02
4	0.04	28	0.00
5	1.20	29	0.02
6	0.03	30	0.00
7	0.60	31	0.02
8	0.04	32	0.00
9	0.35	33	0.01
10	0.08	34	0.00
11	1.40	35	0.01
12	0.08	36	0.00
13	0.90	37	0.01
14	0.05	38	0.00
15	0.12	39	0.00
16	0.03	40	0.00
17	0.18	41	0.00
18	0.02	42	0.00
19	0.10	43	0.00
20	0.02	44	0.00
21	0.03	45	0.00
22	0.01	46	0.00
23	0.07	47	0.00
24	0.01	48	0.00
25	0.05	49	0.00

Table 2: The harmonic voltage distortion in percent of the nominal voltage of 115 kV from 2<sup>nd</sup> to 49<sup>th</sup> harmonic orders

Note : The result of harmonic distortion measured from CCVT may be erroneous because CCVT may not have a good response at high frequency.

6. Design, supply, and installation of a substation lighting system completed with all integral accessories required for providing a complete operation. The lighting system shall mainly consist of equipment lighting, fence lighting, terminal boxes, lighting relay panel, raceways, and cable for lighting circuits. The lamps for the lighting system of the BESS area shall be **LED** type with all integral accessories. The lighting cable shall be single core conductor. The intensity of the lighting installation shall be as follows:

Area	Lux
Substation Area	50
Transformer Area	50

Table 3: The intensity requirement for outdoor area

7. Design, supply and installation of the following 22 kV XLPE cable systems:
1. 22 kV XLPE cable system running from KT1A to KW1AB and from KT2A to KW2AB (Note that KW1AB and KW2AB shall be installed in BESS area.)
  2. 22 kV XLPE cable system running from KT3A to switchgear
  3. 22 kV XLPE cable system running from switchgear to Inverter transformers

The design and calculation of the 22 kV cable systems shall conform to IEC or IEEE standards.

Design, supply and installation of all equipment, accessories, hardware and civil work required for completion of the above 22 kV XLPE cable systems. They shall include but not be limited to the following items:

- 22 kV XLPE cable - a single-core cable with copper conductor. The cross-sectional area of the cable shall be determined by the Contractor to meet the ampacity requirement.
- Cable trenches with concrete trench covers. The Contractor shall design the cable trench taking into account the minimum bending radius of the cable and cable installation.
- Cable supporting structures, metallic cable cleats, cable terminations, cable termination supporting structures, miscellaneous and grounding hardware.

The 22 kV XLPE cable shall be laid in a **trefoil** formation with cable cleats as shown in the Figure 2.

**Cable Cleats:** The cleats shall rigidly support and secure the cables when installed at intervals along the length of the cables. The surface of cleats shall be free from sharp edges, burrs, flash, etc. that are likely to damage cables or inflict injury to the installer or user. The cleats shall be made of aluminum or stainless steel or composite material according to IEC61914's definition. For composite material, the integral pad shall be smoke, low fume and halogen free. One cleat shall be provided with the closure bolt and nut assembly, and the mounting bolt and nut assembly. The closure bolt and nut shall be made of stainless steel. The cleats shall be designed conform to IEC61914 and able to resist the electromechanical force, withstanding more than one short circuit. The cleats shall be able to resist ultraviolet light (UV), very heavy impact and corrosion. The cable cleat shall have the operating temperature range from - 15°C to 105°C. For EPC project, the position and number of cable cleats shall be calculated and determined by Contractor to withstand the electromechanical force from short circuit according to IEC61914. However, the maximum span between cleats is 1.2 meters for a straight path and 0.3 meters at a bending point as

shown in Figure 1. For calculation of forces caused by short-circuit currents, the peak short circuit current shall be 62.5 kA

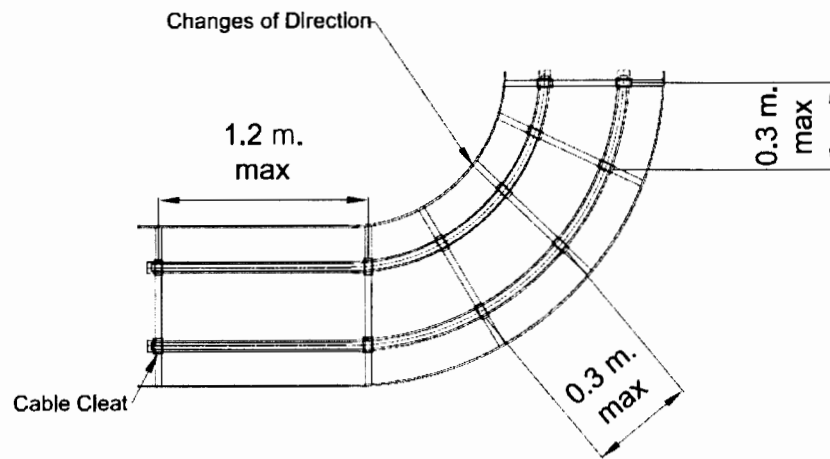
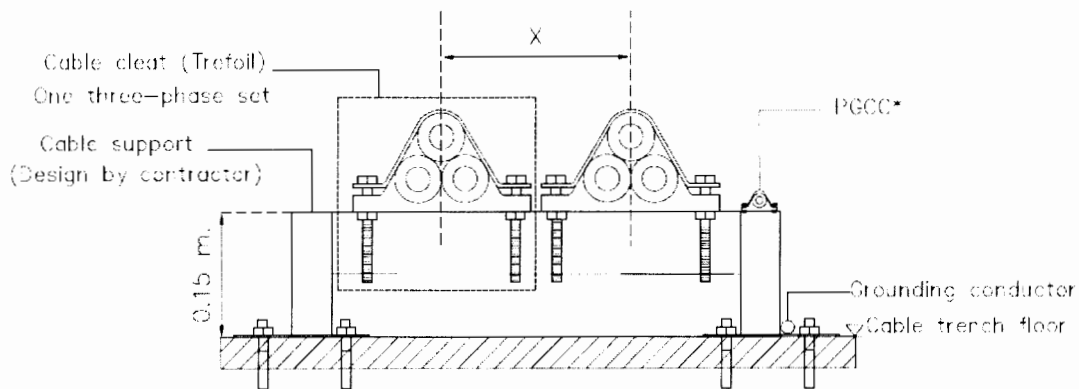


Figure 1: maximum span of cable cleats



X : DESIGN BY CONTRACTOR

\*PGCC : PARALLEL GROUND CONTINUITY CONDUCTOR (IF REQUIRED)

Figure 2: Trefoil Formation

The cable supporting structure shall be made of stainless steel, aluminum alloy or galvanized steel. The contractor shall design, supply and install the cable supporting structures that are suitable for cable cleat and cable system installation, and their grounding. For each Bid, the following document shall be submitted at the opening date to EGAT for approval;

1. The type test report or the commission test report of each structural type for
  - 1.1 The test for resistance to electromechanical force withstanding more than one short circuit conform to IEC61914.
  - 1.2 The test for resistance to ultraviolet light conform to IEC61914.
2. The official letter from manufacturer or the official agent to confirm the intention to be the supplier and will supply the product according to the type test report or the commission test report.

The Contractor shall design the 22 kV cable systems to meet the ampacity requirement for the rated load current with a proper design margin given that the ambient temperature is not less than 45°C and the effect of solar heat shall be considered. The other parameters used in the design shall be practical, reasonable, operational and conform to IEC or IEEE standards. The calculated continuous current rating shall be shown in the single-line diagram and submitted to EGAT for approval.

The Contractor shall design and select the type of metallic screen bonding. The induced voltage measured in every point of the metallic screen of the 22 kV XLPE cables shall be less than **60 V** or shall conform to the IEC or IEEE standards.

If the single-point bonding is used, the Contractor shall design, supply and install the parallel grounding continuity cable (PGCC), if necessary. The type, insulation level and cross-sectional area of the PGCC shall be determined by the Contractor.

Design, supply and installation the equipment to protect the power cable from the surge voltage (if any).

8. The calculation of sag and tension of the phase conductors and overhead ground wires (OHGW) shall conform to IEC standard or other internationally accepted standards and be submitted to EGAT for approval. The ambient temperature of 45°C shall be used for the calculation.
9. Design, supply, and installation of marshalling cubicle for the 115/22 kV transformer.
10. Design, supply, and installation of all hardware for suspension insulator assembly.
11. The Contractor shall design BESS to achieve the performance as per specified in the Ratings and Features. The design of BESS shall be consistent with characteristic of the 115/22 kV transformer. The characteristic of 115/22 kV transformer is provided in CD-ROM including the following information;
  - Specification of 115/22 kV transformer
  - Ratings and Features of 115/22 kV transformer
  - The total loss of the 115/22 kV transformer is less than 200 kW at rated capacity.

#### **BESS layout**

12. The BESS shall consist of the following containers;

- Switchgear container
- Inverter transformer and Power conditioning system (PCS) container
- BESS battery container

A container shall be properly designed to allocate the space for the installation of all essential systems and sub-systems, e.g. equipment, HMI, local control, stationary battery, Inert gas system and etc.

Contractor shall design and layout the container and equipment inside with consideration of easy installation and maintenance, heat dissipation (minimum space for side, rear and top of panel shall be recommended). The access and maintenance area around each container shall be properly designed for convenient maintenance and installation.



The Contractor shall design the partition for inverter transformer to separate the transformer from other necessary equipment.

The container shall be installed at least 1.50 meter above ground level with loading platform and stairs.

13. The service roads for BESS maintenance shall be provided and designed by the Contractor. They shall include but not be limited to the following:
  - The service road in the BESS area with the minimum width of 4.00 m.
14. Cable laying at the ground floor of all the containers shall be in cable trenches. Cable ladders shall not be used
  - 14.1 All conductors shall run in cable trench.
  - 14.2 The cable trench of power cable and control cable shall be separated.
15. The container shall be weather-proof IP54 or above and equipped with Air ventilation and Air conditioning systems to achieve service condition as per EGAT's specification. The container shall be designed to protect the equipment inside from harmful effects resulting from the ingress of water, dirt, dust and wind.
16. The container's ventilation system shall be designed to achieve the conditions as specified in Specification.

The containers shall be ventilated 24 hours a day continuously by 2 (two) categories 8-hour interval of the explosion-proof exhaust fans operating alternately (if any).

The air conditioning system in the container shall operate 24 hours a day continuously and consist of 2 (two) categories of air conditioners for alternate operation 8-hour interval.

The cooling system of PCS shall be properly designed by the Contractor.
17. The Contractor shall design supply and installation plates for BESS project as the following;
  - Identification plates
  - Danger of battery explosion from open flame sparks and smoking
  - Other plates if necessary

#### **Operational strategies and design study**

18. The Contractor shall design the BESS to fulfill the EGAT's performance requirements for the BESS operational strategies as follows:

**Renewable Semi-firming:** BESS shall be designed to maintain supplying power from connected RE power plants (Bay No.2 as shown in DWG.NO. BNN-S-1-01/01) using the slope reference line shown in Figure 3 during the firming-period, i.e. from 2.00 PM to 3.00 PM or until the battery is run out (whichever comes first). Importantly, battery charging is not required during the firming-period. In addition, the firming-period and slope reference line shall be adjustable.

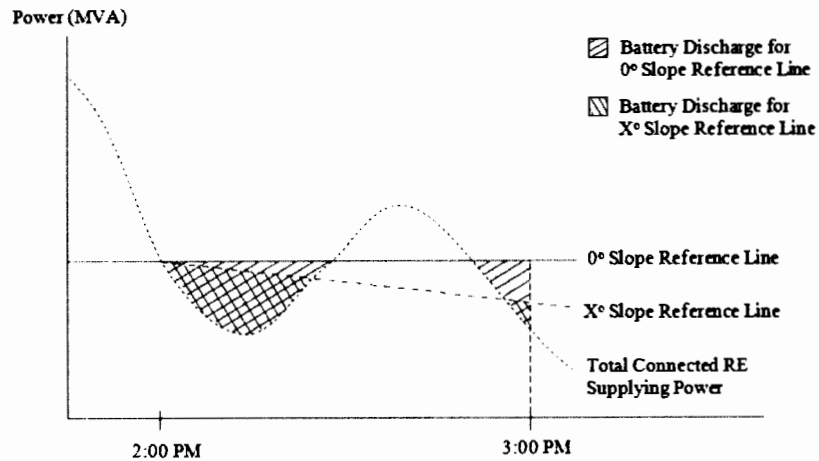


Figure 3: RE firming operational strategy

**Energy shifting (support function):** BESS shall be designed to charge and discharge BESS for energy shifting. The charge and discharge time and duration shall be adjustable. In addition, BESS shall be designed to supply the remaining stored energy (if any) until BESS is run out during night peak time given the daily load curve specified in the Rating and Features (RF).

19. The Contractor shall submit all reports on the system studies, engineering and design, and shall satisfy EGAT as to the completeness and accuracy of the studies to be carried out in accordance with the Contract. The Contractor shall also carry out all studies which are necessary for completion of the design and engineering.

The studies shall include but not be limited to the following:

- **Main component study:** the study is conducted to determine voltage and current stresses on the equipment within the systems and sub-systems of the BESS, during steady-state and transient conditions for all relevant BESS operating modes and ranges. The results of the study shall be used for deciding the design and rating points, operational strategy and limits of the BESS. For example
  - Electrical operation and performance characteristic of individual battery cell, battery module and battery rack: This shall include but not limit to
    - Voltage (nominal, end of discharge, top of discharge)
    - Current (maximum and minimum)
    - Capacity
    - Etc.
  - The physical characteristic of individual battery cell, battery module and battery rack
  - Electrical operation and performance characteristic PCS: This shall include but not limit to
    - DC input voltage (nominal, maximum, minimum)
    - AC output voltage and current
    - Etc.
  - The physical characteristic of PCS
- **Short circuit study**
- **Insulation Coordination Study**
- **Harmonic performance and ratings study:**

- The Contractor shall provide the harmonic performance and rating study. The network impedance for harmonic performance and rating shall be referred to as the CIGRE' sector Method, where impedance boundaries are calculated:

$$Z_{\max} = Z_{\max \text{ s.c.}} \times n$$

$$Z_{\min} = Z_{\min \text{ s.c.}} \times \sqrt{n}$$

0-80 degree  $n < 5$   
 $\pm 75$   $5 \leq n \leq 11$   
 $\pm 70$   $11 \leq n \leq 50$

where

$Z_{\max \text{ s.c.}}$  = ac system maximum short circuit impedance at fundamental frequency and nominal system voltage

$Z_{\min \text{ s.c.}}$  = ac system minimum short circuit impedance at fundamental frequency and nominal system voltage

- The maximum 3 phase short circuit current: 4.693 kA
- The minimum 3 phase short circuit current: 4.150 kA
- The maximum L-G short circuit current: 2.919 kA
- The minimum L-G short circuit current: 2.486 kA
- The harmonic impedance range is defined by the area in the resistance (R-X) plane enclosed by the maximum and minimum impedance, limited by the impedance angles as depicted below

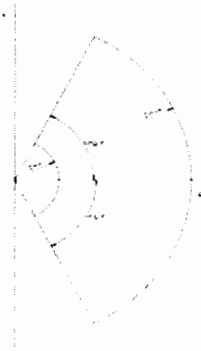


Figure 4: Impedance area with parameter for limitation according to CIGRE WG14.30

- The Contractor shall design the BESS to limit harmonics as specified in Ratings and Features.
- **System Voltage and System Frequency:** the Contractor shall design BESS by considering system voltage level and system frequency at the Point of Common Coupling (PCC) as per EGAT's requirement. The system voltage shall be limited to  $\pm 5\%$  interval of nominal voltage and the system frequency shall be  $50 \pm 0.5 \text{ Hz}$  as specified in Operation Code.
  - **Electrical Interfere:** the Contractor shall design the operation of BESS by considering the electrical interference from wind farm and solar farm. The distance between Bamnet Narong substation and wind farm is 28 km approximately.
  - **Noise study:** the Contractor shall provide the noise study to identify and mitigate possible source of noise. This shall include air condition units and other source of noise such as transformers and power electronic.

Indoor: the time weight average level of noise inside container shall not be more than 75 dB(A) for time weight average during BESS operating hour (2.00AM-6.00AM and 2.00PM-3.00PM). The noise level inside container shall be maximum 90 dB(A) in areas where personnel are permitted during BESS operation.

Outdoor: the noise shall not increase more than 7 dB(A) from background noise. EGAT shall submit background noise after award. For the noise study, shall also be submitted after award. The noise shall be measured at least 3 points at new additional fence of BESS as per Figure 5

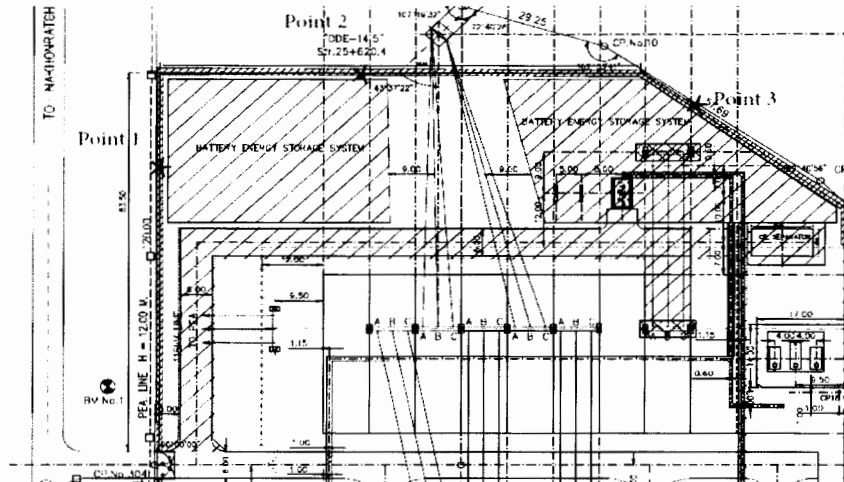


Figure 5: Location for measuring noise (Bamnet Narong Substation)

**20. Electrical design drawing:** the Contractor shall design and submit this following drawing but not limited to:

1. **Single Line Diagram (S-1):** the Contractor shall provide single line showing the major equipment electric circuitry and switching device as per dwg.no. BNN-S-1 and SE-BESS-001.
2. **General Layout (S-2)**
3. **Bus Structure Plan (S-3):** the physical arrangement of equipment shall match with the general layout.
4. **Bus Structure Sections (S-4):** the Contractor shall provide interconnection drawing for major equipment that is in either separated container or physical separated compartment of a single container.
5. **Grounding System (S-5):** the Contractor shall provide grounding system drawing for 115 kV, 22 kV and BESS. This drawing shall show ground grid and ground connection point of all related equipment as per dwg.no. ISO/BB-S-5.
6. **Equipment Layout (S-6):** the Contractor shall provide the equipment layout of each container including control building equipment layout.
7. **Structure Layout (S-7)**
8. **Cable Trench and Conduit Layout (S-8):** the Contractor shall provide conduit and cable trench for any required conduit at 115 kV, 22 kV and BESS. These drawing shall show the approximate location, designation of each conduit, cable trench and conductor route.
9. **Identification Plate and Location (S-9):** nameplate drawing of component

for which it is general practice to furnish nameplate.

10. **Lighting Plan (L-1):** the Contractor shall provide lighting system drawing for BESS.
11. **Lighting Fixture and Load Schedule (L-2):** the lighting equipment which are designed as lighting plan including load schedule shall be shown in this drawing.
12. **Power Supply for BESS (L-5):** the Contractor shall provide single line diagram to show the necessary equipment for station service of BESS.

### **Grounding**

21. Design, supply and installation of the grounding system of the following:
  - 115 kV conventional substation
  - 22 kV system and 22 kV cable systems
  - The containers and BESS area
  - Connection of the grounding system of the BESS to that of the existing substation.
22. The Contractor shall conduct the soil resistivity measurement. The result shall be submitted to EGAT for approval.
23. The Contractor shall design a grounding grid based on the measured soil resistivity by hand calculation using the equations in IEEE-80 standard and submitted to EGAT for Approval. The following parameters for grounding system calculation shall be used;
  - The symmetrical fault current (rms) = **31.5 kA**
  - Time duration of fault = 1 sec
  - The fault current division factor ( $S_f$ ) = 1 shall be used for determining the RMS symmetrical grid current. The fault current division factor ( $S_f$ ) shall be equal to one (1), that is, the fault current only dissipates in the Bamnet Narong Substation's grounding system and is not divided to other substations.
  - X/R ratio = **20**
  - The maximum ground grid conductor spacing ( $D_0$ ) shall be **3.50** meters.
  - The number of ground rods shall be **30** pieces.

These parameters shall be used for determine the size of grounding conductor for the substation grounding system. However, the 4/0 AWG bare copper wires shall be used for ground grid and 2 x 4/0 AWG for cable tap and risers from ground grid to all equipment structure.

If the ground conductor spacing calculated by hand ( $D_1$ ) is less than the grounding conductor spacing for reference ( $D_0$ ), the Contractor shall design a grounding grid by using the software. The certification of software shall be acceptable for commercial use.
24. All substation metal parts such as structure, equipment, cable trays and containers in the BESS area shall be connected to the grounding system by exothermic connection.
25. The design of the grounding system for the BESS indoor equipment shall follow the recommendations made by the BESS manufacturer.

### **Lightning protection**

26. Design, supply, and installation of the substation lightning protection system completed with all related equipment including lightning protection masts. Masts shall be used for lightning protection in BESS area (if necessary). This includes proper system insulation coordination, overhead ground wire, and surge arresters. The Contractor shall design the lightning protection system for the protection of all substation equipment which is under the protective zone. To meet EGAT's design criteria for the lightning protection system and to enhance the stability of lightning protection system, the following values shall be used in the design:
- BIL of 550 kV for 115 kV substation
  - For 22 kV Substation, the stroke current of **2 kA** shall be used for the calculation.
27. The design of lightning protection system shall conform to IEC, NEMA and E.I.T. standards or other internationally accepted standards.

### **Station service**

28. Design, supply, and installation of the station service system complete with integral accessories required for providing a complete operation of the BESS. The abnormal condition which occurs from the design and installation of the station service system for example ferroresonance etc. shall be responsible by Contractor. The station service system shall mainly consist of as follows:
- XXX kVA, 22,000-400/230 V distribution transformers (KW1AB)
  - XXX kVA, 22,000-400/230 V distribution transformers (KW2AB)
  - Automatic Transfer Switch Board (ATS)  
The drawing No.SE-ATS-7-03-01-01 shall be reference only. The Contractor shall design all circuit breaker ampere-trip and number of feeders to meet with BESS load required.
  - 22 kV power fuse
  - 600 V, XXX A Safety switch
  - 22 kV equipment, AC & DC distribution board, stationary batteries, battery chargers, power cables, and all related equipment required for the complete operation.
29. Design, supply and installation of the stationary battery, in which the battery is capable of delivering power to the control and protection for tripping all circuit breakers and emergency essential load for at least 8 hours and emergency lighting for at least 3 hours as shown in the figure below if normal station service fails. In case of bus faults occurring on the last hour of battery power, the battery shall generate sufficient power for tripping all circuit breakers. The stationary battery shall be designed and calculated in accordance with IEEE or other acceptable international standards. In addition, the size of the stationary battery shall be designed to support the operation of existing and future bay as shown on the attached Bidding Document Drawing. The calculation shall be submitted to EGAT for approval. The size of battery shall not be less than **200 Ah** for BESS.

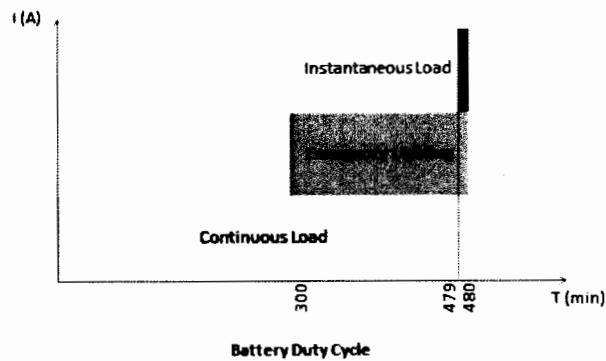


Figure 6: Battery duty cycle

### Facility System

30. Design, supply, and installation of electrical system, lighting system, and fire alarm system for the BESS. Recommendations for the aforesaid systems are as follows:

- All cable wiring systems shall conform to NEC and IEC standards or other internationally accepted standards.
- The lamps for the lighting system of the BESS shall be **LED** type with all integral accessories, e.g. lamp holders, fixtures, reflectors, and etc. All steel accessories e.g. lip-channel, conduit, conduit fittings, conduit accessories, box and cover shall be hot dip galvanized. The Contractor shall provide drawings that show details for installation. The required intensity of the lighting installation shall be as follows:

- Area	Lux
Around container	20
Switchgear container	300
Inverter transformer and PCS container	300
BESS battery container	300

Table 4: The intensity for BESS building

The lighting intensity of other necessary containers (if any) shall be properly designed by the Contractor (HMI and local control areas within the container shall be 500 Lux).

- The lighting fixtures for the BESS battery and stationary battery containers shall be explosion-proof type.
- The following areas of the BESS shall be with the emergency lighting:
  - Switchgear container
  - Inverter transformer and PCS container
  - Battery container
  - Stairway
  - All exits

The emergency lighting system shall provide the illumination of **150 Lux**.

- The size of low voltage cable shall be sufficient to keep the voltage drop from Automatic Transfer Switch (ATS) to the load point less than 5% at rated load current.

- A summary of the type and quantity of fire extinguishers required for the specified areas are given in the table below:

Area	Fire Extinguish (Located at Entrance/Exiting)	
	Dry	Carbon
Switchgear container	-	2
Inverter Transformer and PCS container	-	2
BESS battery container	-	2
Other necessary containers (if any)	-	2

Table 5: The type and quantity of fire extinguishers for BESS

- As for the indoor electrical system and communication system, the Contractor shall use standardized and cutting-edge equipment. The lighting fixture and installation detail shall be confirmed to DWG. NO. SE-FX-4-01. The indoor electrical system and communication system shall serve the following areas:

Area	Receptacle (QTY)	Duplex RJ45 outlet (QTY)	
	Duplex (Wall)	For LAN	For Telephone
Container	As specified in specification	2	1

Table 6: The quantity of receptacle and outlet for BESS

- The HMI and local control area in container shall be provided at least 4 duplex (Wall) receptacles, 2 floor receptacles, 2 duplex RJ45 outlets (for LAN) and 1 duplex RJ45 outlet (for telephone).
- All steel accessories e.g. lip-channel, conduit, conduit fittings, conduit accessories, box and cover shall be hot-dip galvanized.

### Control and Protection System

31. Design, supply, install, test and commissioning of complete control and protection system including the following equipment:
  - Duplex type switchboard panels
  - Cables and accessories as well as connection of cables among all of the boards and the associated equipment in order to complete the function of the control and protection system.
32. Design, supply, install, test and commissioning of complete BESS control and protection system which include following equipment:
  - BESS major equipment: control, protection, metering, local control system, remote control system and protection relay switchboards with recommended spare parts (Breakdown in price schedule of each items)
  - A Remote Terminal Unit system and marshalling panels for Digital Remote Terminal Unit system
  - A digital fault recording system and marshalling panels for digital fault recording system
  - 400/230 VAC, 125 VDC distribution boards and 125 VDC power panels which meet EGAT's design standard with required spare part



- Cables and accessories as well as connection of cables among all of the boards and the associated equipment in order to complete the function of the control and protection system.
33. Design, modification, wire, test and commissioning of existing control and protection system as per bidding drawing required by EGAT which include the following equipment:
    - Duplex type switch board panels
    - Interposing relay panel and transducer panel
    - Marshalling panels for the teleprotection interface
    - The digital fault recording system and marshalling panel for digital fault recording system
    - The Remote Terminal Unit system and marshalling panel for the Remote Terminal Unit
    - Other panels which related to control and protection system.
  34. Design, modification, wire, test and commissioning of the Remote Terminal Units (RTUs) and Master Station Unit which are supplied by EGAT whereas configuration that include in this contract must be fulfilled under EGAT's supervision.
  35. Design the schematic and wiring diagrams of the additional inputs to the existing Computerized Control System (CCS), including test and commissioning of the complete CCS.
  36. Design the schematic and wiring diagrams of the additional inputs to the existing Fault Recording System (FRS), including test and commissioning of the complete FRS.
  37. Design, modify, install, wire, test and commissioning of Optical Fiber Cable of Remote Terminal Unit (RTU) that connection within the control room.
  38. Design, supply, install, wire, test and commissioning of Optical Fiber Cable of Fault Recording System (FRS) that connection within the control room.
  39. The Contractor shall be responsible for providing complete schematic and wiring diagrams of the control and protection system.
  40. The National Control Center (NCC) and the Regional Control Center (RCC) of EGAT or CCS shall be able to access BESS HMI for adjusting parameters as mention in Rating and Features then the function shall be working properly and automatically
    - Charge/ Discharge duration function  
NCC, RCC and CCS shall be able to set time duration of
      - Start / stop charging
      - Start / stop discharging
    - Instant command to Charge/ Discharge

NCC, RCC and CCS shall be able to execute command of start/stop charging/  
discharging BESS suddenly

41. Any modification and interfacing works to the existing metering, control and protection panels, including supply of related accessory equipment which is required for incorporating the new equipment. The modified existing drawings shall be performed by the Contractor and submitted to EGAT for approval. The final drawings shall be submitted as ACAD files.
42. The telecommunication of BESS system designed by contractor shall be capable of interfacing to EGAT's SCADA system which consists of local SCADA and remote SCADA via IEC 60870-5-104. In addition, remote SCADA shall comprise at least National Control Center (NCC), Backup National Control Center (BNCC), Regional Control Center (RCC) and Group Control Center (GCC).
43. A smooth energizing of the BESS shall be achieved and shall not affect EGAT's customers or cause any malfunctions to the existing substation and nearby power plants. In addition, the proposed BESS design shall demonstrate that it fulfills the said requirements.
44. The BESS control shall be designed with the optimized parameters and functions in order to fulfill all conditions under the given short circuit level.
45. Unused existing cables shall be removed. The removed cables shall be neatly reeled and kept in a suitable place recommended by EGAT.
46. Control System or Energy Management System for whole system of BESS shall have redundancy and show mimic diagram and status (for example: battery's SOC, current, voltage, etc.) of all battery modules, racks, containers and Power Conversion System in HMIs.
47. Battery Management System or Battery Monitoring System (BMS) shall consist of at least Module level BMS and Rack level BMS.
48. All Battery containers shall be designed with access protection which is normally not allow to access by interlocking, however, battery containers shall be accessible without tripping BESS when operator unlocked the access protection manually.
49. The contractor shall provide PCSs to fully perform input and output power of both active and reactive power according to the figure 7.

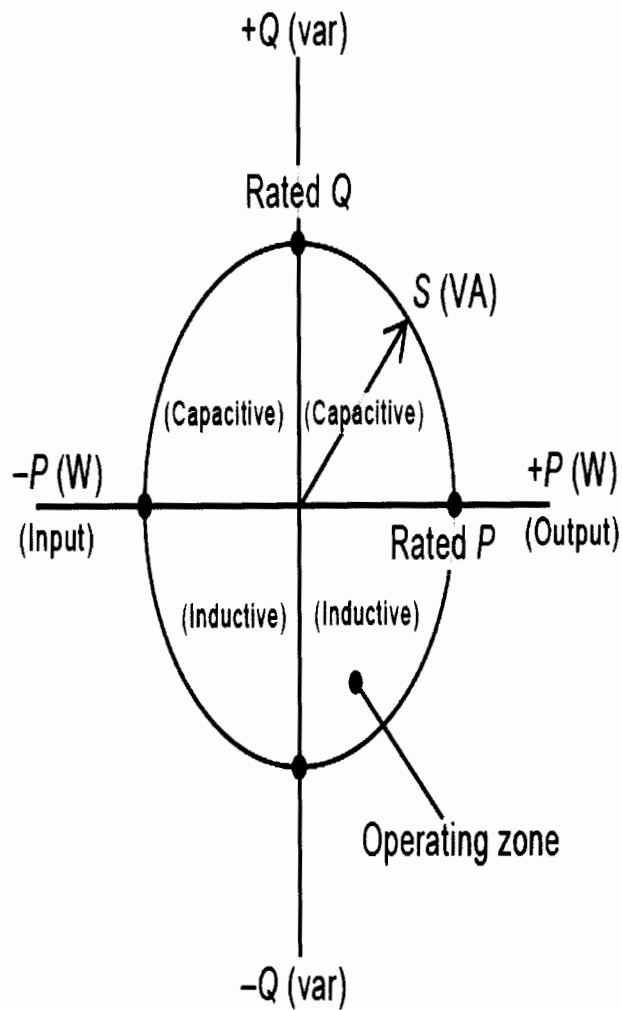


Figure 7. Operation Zone of PCS

**Remark:** Relaying and metering diagram on Drawing No. BNN-E-1 is used as guideline. The drawing can be modified by the contractor. However, they shall meet EGAT's standard design criteria and be submitted to EGAT for approval.

#### Civil and Architectural work

50. Design and construction of substation civil work
  - 50.1 Steel structure and foundations for Specified equipment and the others not shown in "For Construction drawings" and / or EGAT's specification.
  - 50.2 Road and drainage system.
  - 50.3 Drainage system for cable trench.
  - 50.4 Oil containing pit with steel grating and black steel spiral-seam pipes (TIS 427-2531) with protection method according to AWWA C217, C205.
  - 50.5 Oil separator for 25 cu m transformer oil. The contractor shall make an Oil separator design calculation in accordance with "IEEE STD-979" (IEEE Guide for Substation Fire Protection), "IEEE STD-980" (IEEE Guide for containment and control of oil spills in substation) and "Wastewater Quality Standard" of Pollution Control Department, Ministry of Natural Resources and Environment.

51. Construction of substation civil work
  - 51.1 Steel structure foundation.
  - 51.2 Take-off foundation.
  - 51.3 Equipment structure foundation with sub trench (if required).
  - 51.4 Dead man hook for loading transformer
  - 51.5 Transformer loading.
  - 51.6 Cable trench.
  - 51.7 RC Road.
  - 51.8 Crushed rock surfacing.
  - 51.9 Wire mesh fence.
  - 51.10 Site office.
  - 51.11 Lamp post for fence and access road lighting LED type foundation.
  
52. Design and construction of Battery energy storage system containers and all components.
  - 52.1 Code treatment shall not be inferior to requirements in all relevant IFC, NFPA, IEC, and IEEE standards.
  - 52.2 Container structure, modifications, and foundation, seismic and structural design shall be in accordance with IBC chapter 16. The configuration can be selected for the design and construction and shall be submitted to EGAT for approval.
  - 52.3 Containers must be separated 1.50 m from lot lines, public ways, buildings, and other exposure hazard according to International Fire Code.
  - 52.4 1.50 m high hot dip galvanized steel structure container support with hot dip galvanized steel loading platforms and stairs.
  - 52.5 Architecture, civil, air condition, ventilation, fire protection, and lighting works of the containers:
    - 52.5.1 The design of exterior surface and the following aspects shall be analyzed and taken into consideration; aesthetic to encourage EGAT corporate, eco-friendly identity and including the latest official EGAT's logo and slogan in proper size.
    - 52.5.2 The design of exterior surface shall be submitted to EGAT for approval.
    - 52.5.3 The exterior surface shall be finished with powder coat system.
    - 52.5.4 The interior surface shall be finished with white color steel lining
    - 52.5.5 Wall and ceiling planes shall be smooth and plain.
    - 52.5.6 There shall be anti-corrosive system for containers.
    - 52.5.7 Containers walls, ceilings, floors shall be insulated with PU foam spray.
    - 52.5.8 Doors & windows shall be explosion proof type
    - 52.5.9 There shall be at least two fire exit doors for each container
    - 52.5.10 Louvers for ventilation, air condition, and fire protection system shall be performance aluminum louvers. The exterior aluminum louvers, assembled from ventilation hidden mullion louvers system, shall achieve a BSRIA or AMCA class A1 for an air flow performance of class 3 and pressure drop must be less than 40 Pa, with titanium color coating on front blade and natural anodized NA 1 color coating on rear blades.
    - 52.5.11 All louvers shall be installed with motorized fire shut-off damper.

- 52.5.12 Electricity and illumination system including cable work for illumination, ventilation system, power supply, air conditioning system, and telephone system.
- 52.5.13 Plumbing system for water supply, building drain and vent, storm water drainage including sanitary wares and fittings. (if any)
- 52.5.14 Miscellaneous including grounding and labeling.
- 52.5.15 Cable routing and cable support (cable tray and cable ladder) from main cable trench.
- 52.5.16 Access floor, switchgears and heavy-duty areas type. (if any)
- 52.5.17 Warning sign provided in accordance with EIT Standard or Quality and Safety Development Division Standard (EGAT).
- 52.5.18 Fire protection system of containers:
  - All containers shall be protected with Standard Fire Detection (photo electric smoke detector) and Early Warning Fire Detection System (ASD) according to NFPA 72, 75, and IG-100 total flood fire suppression system according to NFPA 2001.
  - There shall be linear heat detector for battery rack which can monitor temperature at the resolution of 0.1 degree Celsius and of which sensor spacing can be selected.
  - There shall be a room in all containers for fire protection system devices and IG-100 agent cylinders.
  - Detection system shall be able to locate a source of fire in each compartment and room in containers.
  - The system will alarm if only one of Standard Fire Detection device or one of Early Warning Fire Detection System device reaches alarm sensitivity.
  - The system will enter pre-discharge and discharge states if one of Standard Fire Detection device and one of Early Warning Fire Detection System device reach alarm sensitivity.
  - There shall be sounder and beacon on the top of containers.
  - For air sampling detector as shown on specification 3001-10.13.2 part i item no.1, 7, 13 and 14 shall be changed to the new details as followings :
  - Air Sampling Smoke Detector.
    - (1) Shall consist of a high sensitivity type detector, using light scatter technology.
    - (7) Detection system must be included in all control cabinet and can locate a scene.
    - (13) The minimum sensitivity settings for a single sampling hole are so that the detection system alarm at 1.5% obs/ft (4.95% obs/m). A sampling hole maximum coverage area is 400.0 sq.ft (37.2 sq.m).
    - (14) Maximum transport time from the most remote hole to the detection unit of an air-sampling system shall be a maximum of 90 seconds.
  - There shall be fire extinguishers in all containers. A summary of the type and quantity of fire extinguishers required for the specified areas are given in the table below:

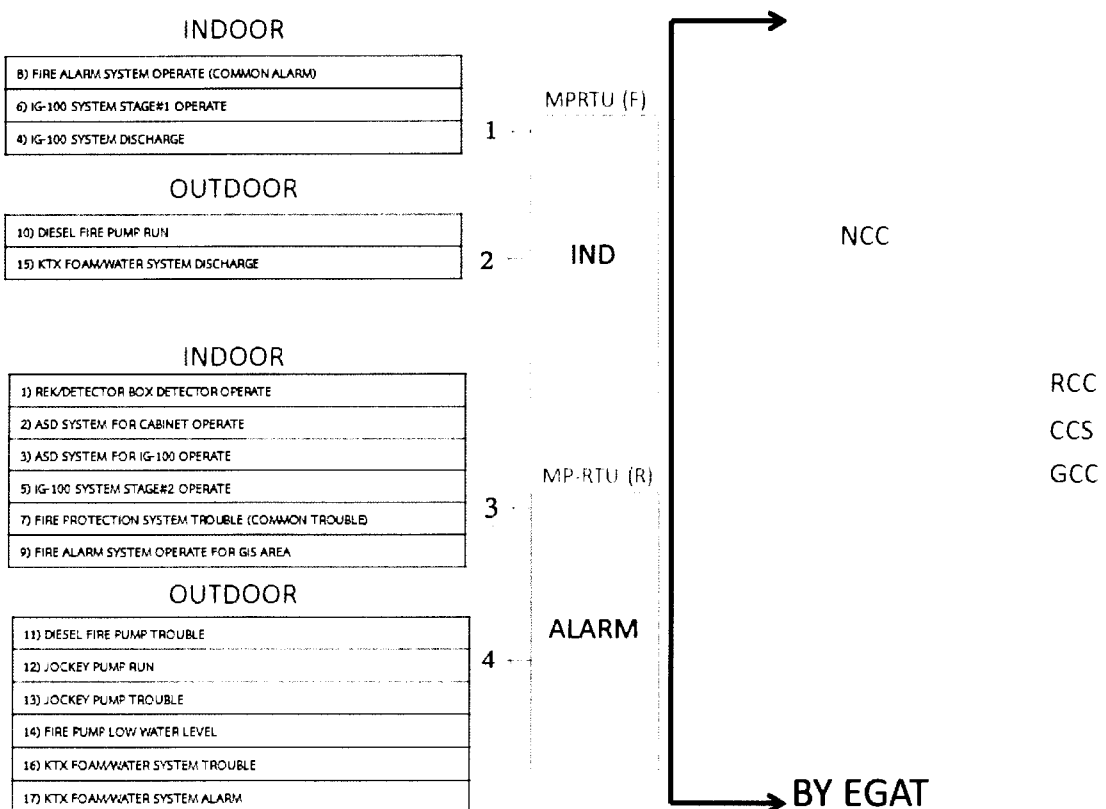
Area	Fire Extinguisher (Located at Entrance/Exiting)	
	Dry	Carbon
Switchgear container	-	2
Inverter Transformer and PCS container	-	2
BESS battery container	-	2
Other necessary containers (if any)	-	2

52.6 Fire protection system, fire alarm system, air condition and ventilation system, installation, arrangement, accessories and battery energy storage system equipment, installation, arrangement, accessories shall be in accordance with the applicable requirements set forth in the latest edition of the following codes and standards, including all further reference critical standards shown in the following codes and standards:

- IFC: International Fire Code
- IEC 62897, Stationary Energy Storage Systems with Lithium Batteries Safety Requirements
- UN 38.3: Transportation Code
- UL 489: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- UL 810A: Electrochemical Capacitors
- UL 1642: Standard for Lithium Batteries
- UL 1741, Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- UL 9540: Standard for Energy Storage System and Equipment
- IEEE/ASHRAE 1635: Ventilation, exhaust, thermal management and mitigation of the generation of hydrogen or other hazardous or combustible gases or fluids
- NFPA 1: Fire Code
- NFPA 2001: Clean Agent Fire Extinguishing Systems
- NFPA 70: National Electrical Code.
- NFPA 72: National Fire Alarm Code.
- NFPA 75: Standard for the Fire Protection of Information Technology Equipment.
- NFPA 76: Standard for the Fire Protection of Telecommunications Facilities.
- NFPA 110: Standard for Emergency and Standby Power Systems
- NFPA 111: Standard for Stored Electrical Energy Emergency and Standby Power Systems
- NFPA 855: Standard for the Installation of Stationary Energy Storage System
- EGAT's Standard Design Manual of Fire Protection and Suppression for Substation. (คู่มือมาตรฐานการออกแบบเพื่อป้องกันและระงับอัคคีภัยสถานี่ไฟฟ้าแรงสูงการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย)
- IEEE Std 979: IEEE Guide for Substation Fire Protection
- NFPA 850: Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Substations

53. Design and construction of outdoor fire protection system

- 53.1 Fire protection system for the switchyard to meet the requirement as specified in IEEE Guide for Substation Fire Protection: IEEE Std 979, all requirements of NFPA 850 and EGAT’s Standard Design Manual of Fire Protection and Suppression for Substation (คู่มือมาตรฐานการออกแบบเพื่อป้องกันและระงับอัคคีภัยสถานีไฟฟ้าแรงสูงการไฟฟ้าฝ่ายผลิตแห่งประเทศไทย).
- 53.2 Fire Pump System, conforming to NFPA 14, 20, 24, 72
- 53.3 250 cu.m water storage tank, fire pump, and jockey pump shall have trouble and operation visual and audible signals (environmental monitoring), which indicate change of state of any connected devices, shown and recorded at control room. The installation practice shall be in accordance with the latest edition of NFPA 72.
- 53.4 There shall be one graphic annunciator which displays alarm, discharge and trouble signals of fire alarm system of fire pump houses, battery energy storage fire protection system at the building where control room locates.
- 53.5 Fire protection system circuits for buildings, switchyards, and containers: notification appliance circuits, and signaling line circuits, shall be class A circuit. Initiating device circuits can be class B circuit.
- 53.6 For Control System Logic as shown on specification 3001-13.4 item 4.1 shall be changed to the new detail below. Signals of outdoor battery energy storage system fire protection system shall be sent to local CCS, GCC, RCC, and NCC in a manner similar to following details;



53.7 There shall be only one subcontractor engaging in design, supply and installation of Fire Protection System for Buildings and Switchyard.

- 53.8 Water supply system.
54. Construction of outdoor fire protection system
- 54.1 Fire pump house.
  - 54.2 Cabinet with 2x50 lbs wheel fire extinguisher.
  - 54.3 Water storage tank for fire protection system (capacity not less than 250 cu m).
55. All design works and the fabrication drawings for all steel structures shall be submitted to EGAT for approval.
56. All design, construction and testing shall be in accordance with Specification No. 3001: Civil and Architectural Work.
57. Bored hole for soil investigation shall conform to Specification No. 3001. The position shall be submitted to EGAT for approval.
58. In case of soil layer is soft clay, consolidation test shall be performed from clay of one bored hole only. The position shall be submitted to EGAT for approval.
59. All foundations shall be as specified in layout drawing. Except the result of soil investigation shows that the specified foundations are not appropriate, the Contractor shall design the proposed foundations.
60. The Contract price shall be adjusted (added or reduced) in case that the soil investigation results to be used for the design works is different from the layout and standard drawings.
61. Dynamic load test (DLT) according to ASTM D4945-89 shall be applied to at least 2% of driven piles (if driven pile type is required) except for driven pile of fence and lamp post.
62. Seismic load test (sonic integrity test) according to ASTM D5882-96 shall be applied to all bored piles (if bored pile type is required).
63. Plate bearing test according to ASTM D1194-94 shall be submitted to EGAT for approval. (if pad type foundation is required).
64. The Contractor shall remove all debris from construction material and other works in order to make the site clean and be in the condition acceptable to EGAT.
65. According to the Contract Document Section G-3: Contractor's Office and Other Construction Facilities; the detail in paragraph 3 shall be changed as follows: the Contractor shall provide for EGAT an office container at the site during construction with a minimum space of 36 sq.m for office area, 24 sq.m for conference room which shall both be air-conditioned and 4 sq.m for toilet. The facilities as shown on the section G-3 are required for 2 sets.



**Other work**

66. Removal of all debris, construction materials, and other works as required after the project is completed so that the site is in a clean and orderly condition acceptable to EGAT.
67. Test and commissioning of all equipment as required for ensuring the proper functioning of the substation.
68. Modification of the existing metering structure for the installation of fuses and terminations (for station service transformer).
69. Modification to 22 kV bus supporting structure (BS202).
70. Testing and commissioning of all equipment required to make the BESS function properly.
71. Supply and installation of cabling from the marshalling control cubicle (MC002) to the associated equipment.

**Work not included in this Contract**

The Work not included in this Contract shall be as shown on the drawings and as follows:

1. Supply and installation of 115/22 kV transformer “KT3A”.
2. Supply of 115 kV equipment e.g. disconnecting switch, power circuit breaker, CT, CVT, bus pole structure, take-off structure and etc. as indicated drawing.
3. Supply of the Remote Terminal Unit (RTU) D20 cards for 115 kV part