การไฟฟ้านครหลวง
Metropolitan Electricity Authority

อาคารวัฒนวิภาส เลขที่ 1192 ถนนพระรามที่ 4
แขวงคลองเตย เขตคลองเตย
กรุงเทพมหานคร 10110
โทร : 0-2348-5000
โทรสาร : 0-2256-3675
www.mea.or.th

ใบเสนอราคา (จัดซื้อวิธีคัดเลือก)

เลขที่ จจ.(ช)/รพ.2/007/2568 ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า การไฟฟ้านครหลวง

วันที่ 31 มกราคม 2568

เรียน .....(ใส่ชื่อ บจก./บมจ./หจก.ผู้เสนอราคา)

ด้วย การไฟฟ้านครหลวงมีความประสงค์จะซื้อสิ่งของตามจำนวนและรายการข้างล่างนี้ หากท่านประสงค์จะขายโปรดกรอกราคาให้ชัดเจน พร้อมลงนามและประทับตราในเอกสารที่แนบแล้ว ใส่ซองปิดผนึกส่งไปยัง แผนกจัดซื้อจัดจ้าง ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า อาคาร 2 ชั้น 8 การไฟฟ้านครหลวงเขตธนบุรี **(ในเวลาทำการ 07.30 น. - 15.30 น.) ได้ตั้งแต่วันที่รับใบเสนอราคา ถึงวันที่ 7 เดือน กุมภาพันธ์ พ.ศ. 2568 เวลา 11.00 น.** โปรดจ่าหน้าซองว่าเสนอราคาตามใบเสนอราคาเลขที่ดังกล่าว ใบเสนอราคาที่ส่งคืนภายหลังกำหนดนี้จะไม่ได้รับการพิจารณา

ในกรณีที่มีการเสนอราคาแยกเป็นหลายรายการ การไฟฟ้านครหลวงจะใช้ราคารวมทั้งสิ้นเป็นเกณฑ์ในการพิจารณาคัดเลือก

ฐ

แผนกจัดซื้อจัดจ้าง

ลำดับ	รายการ	จำนวน	ราคาต่อหน่วย		ราคารวม		ราคากลาง (รวม VAT)	
			บาท	สต.	บาท	สต.	บาท	สต.
1.	Unit Substation พร้อมหม้อแปลงไฟฟ้า ขนาด 1000 kVA, 24 kV - 416 V และอุปกรณ์ประกอบ ตามรายละเอียดลักษณะงานที่แนบ ซึ่งถือเป็นส่วนหนึ่งของใบเสนอราคาฉบับนี้	2 SET					8,147,850	47
<u>สำหรับใช้งานที่</u> โรงพยาบาลราชวิถี <u>สถานที่ส่งมอบพัสดุ</u> โรงพยาบาลราชวิถี <u>กำหนดส่งมอบพัสดุภายใน 180 วัน</u>		เป็นเงิน ภาษีมูลาเพิ่ม 7 % รวมเป็นเงินทั้งสิ้น					8,147,850 570,349 8,718,200	47 53 00

(จำนวนเงินเป็นตัวอักษร) .....

ข้าพเจ้าขอเสนอราคาขายสิ่งของตามราคาในบัญชีรายการข้างบนนี้ กำหนดยืนราคาภายใน 60 วัน นับถัดจากวันที่เปิดซองเสนอราคาและกำหนดส่งมอบพัสดุภายใน 180 วัน นับถัดจากวันที่ลงนามในสัญญา

ลงนาม.....ผู้เสนอราคา

แผนกจัดซื้อจัดจ้าง ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า (.....)

โทร.0-2878-5331 โทรสาร. 0-2878-5312 ตำแหน่ง.....

<u>หมายเหตุ</u> ในกรณีที่มีการแก้ไขข้อความ หรือ จำนวนเงิน ให้ขีดฆ่า และลงนามพร้อมประทับตรายาง (ถ้ามี) กำกับไว้ทุกแห่ง

ขอบเขตของงาน (Term of Reference : TOR)
งานจัดซื้อ Unit Substation พร้อมหม้อแปลงไฟฟ้า ขนาด 1000 kVA, 24 kV -416 V
และอุปกรณ์ประกอบ จำนวน 2 ชุด สำหรับใช้งานที่โรงพยาบาลราชวิถี
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1. ความเป็นมา

ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า การไฟฟ้านครหลวง เป็นหน่วยงานที่มีหน้าที่ให้บริการด้านงานระบบวิศวกรรมต่างๆ มีความประสงค์จะซื้อ Unit Substation พร้อมหม้อแปลงไฟฟ้า ขนาด 1000 kVA, 24 kV-416 V และอุปกรณ์ประกอบ จำนวน 2 ชุด สำหรับใช้งานที่โรงพยาบาลราชวิถี

2. วัตถุประสงค์

เพื่อนำไปใช้งานติดตั้งและปรับปรุงระบบไฟฟ้า

3. คุณสมบัติของผู้เสนอราคา

ผู้เสนอราคาจะต้องมีคุณสมบัติดังต่อไปนี้

3.1 มีความสามารถตามกฎหมาย

3.2 ไม่เป็นบุคคลล้มละลาย

3.3 ไม่อยู่ระหว่างเลิกกิจการ

3.4 ไม่เป็นบุคคลซึ่งอยู่ระหว่างถูกระงับการยื่นข้อเสนอหรือทำสัญญากับหน่วยงานของรัฐไว้ชั่วคราว เนื่องจากเป็นผู้ที่ไม่ผ่านเกณฑ์การประเมินผลการปฏิบัติงานของผู้ประกอบการตามระเบียบที่รัฐมนตรีว่าการกระทรวงการคลังกำหนดตามที่ประกาศเผยแพร่ในระบบเครือข่ายสารสนเทศของกรมบัญชีกลาง

3.5 ไม่เป็นผู้ที่ถูกระบุชื่อไว้ในบัญชีรายชื่อผู้ทิ้งงานของทางราชการและได้แจ้งเวียนชื่อให้เป็นผู้ทิ้งงานของหน่วยงานของรัฐในระบบเครือข่ายสารสนเทศของกรมบัญชีกลาง ซึ่งรวมถึงนิติบุคคลที่ผู้ทิ้งงานเป็นหุ้นส่วน ผู้จัดการ กรรมการผู้จัดการ ผู้บริหาร ผู้มีอำนาจในการดำเนินงานในกิจการของนิติบุคคลนั้น หรือไม่เป็นผู้ที่ได้รับผลของการสั่งให้นิติบุคคลหรือบุคคลอื่นเป็นผู้ทิ้งงานตามระเบียบของทางราชการ

3.6 มีคุณสมบัติและไม่มีลักษณะต้องห้ามตามที่คณะกรรมการนโยบายการจัดซื้อจัดจ้างและการบริหารพัสดุภาครัฐกำหนดในราชกิจจานุเบกษา

3.7 เป็นบุคคล หรือนิติบุคคลผู้มีอาชีพขายพัสดุที่เสนอราคาดังกล่าว

3.8 ไม่เป็นผู้มีผลประโยชน์ร่วมกันกับผู้ยื่นข้อเสนอรายอื่นที่เข้ายื่นข้อเสนอให้แก่การไฟฟ้านครหลวง หรือไม่เป็นผู้กระทำการอันเป็นการขัดขวางการแข่งขันอย่างเป็นธรรมในการเสนอราคาครั้งนี้

3.9 ไม่เป็นผู้ได้รับเอกสิทธิ์หรือความคุ้มกัน ซึ่งอาจปฏิเสธไม่ยอมขึ้นศาลไทย เว้นแต่รัฐบาลของผู้เสนอราคาได้มีคำสั่งให้สละเอกสิทธิ์ความคุ้มกันเช่นว่านั้น

3.10 ผู้เสนอราคาต้องมีมูลค่าสุทธิของกิจการ ดังนี้

(1) กรณีผู้เสนอราคาต้องเป็นนิติบุคคลที่จัดตั้งขึ้นตามกฎหมายไทยซึ่งได้จดทะเบียนเกินกว่า 1 ปี ต้องมีมูลค่าสุทธิของกิจการ จากผลต่างระหว่างสินทรัพย์สุทธิหักด้วยหนี้สินสุทธิที่ปรากฏในงบแสดงฐานะทางการเงินที่มีการตรวจรับรองแล้ว ซึ่งจะต้องแสดงค่าเป็นบวก 1 ปีสุดท้ายก่อนวันยื่นข้อเสนอ

(2) กรณีผู้ยื่นข้อเสนอเป็นนิติบุคคลที่จัดตั้งขึ้นตามกฎหมายไทย ซึ่งยังไม่มีการรายงานงบแสดงฐานะการเงินกับกรมพัฒนาธุรกิจการค้า ให้พิจารณาการกำหนดมูลค่าของทุนจดทะเบียน โดยผู้เสนอราคาจะต้องมีทุนจดทะเบียนที่เรียกชำระหุ้นมูลค่าหุ้นแล้ว ณ วันที่ยื่นข้อเสนอ ดังนี้

(เช่น ไม่ต่ำกว่า 1 ล้านบาท เลือกระบุตามมูลค่าการจัดซื้อจัดจ้างจาก 2.1-2.9 ใส่เฉพาะตัวเลข)

(2.1) มูลค่าการจัดซื้อจัดจ้างไม่เกิน 1 ล้านบาท ไม่ต้องกำหนดทุนจดทะเบียน

(2.2) มูลค่าการจัดซื้อจัดจ้างเกิน 1 ล้านบาท แต่ไม่เกิน 5 ล้านบาท ต้องมีทุนจดทะเบียนไม่ต่ำกว่า 1 ล้านบาท

(2.3) มูลค่าการจัดซื้อจัดจ้างเกิน 5 ล้านบาท แต่ไม่เกิน 10 ล้านบาท ต้องมีทุนจดทะเบียนไม่ต่ำกว่า 2 ล้านบาท

(2.4) มูลค่าการจัดซื้อจัดจ้างเกิน 10 ล้านบาท แต่ไม่เกิน 20 ล้านบาท ต้องมีทุนจดทะเบียนไม่ต่ำกว่า 3 ล้านบาท

(2.5) มูลค่าการจัดซื้อจัดจ้างเกิน 20 ล้านบาท แต่ไม่เกิน 60 ล้านบาท ต้องมีทุนจดทะเบียนไม่ต่ำกว่า 8 ล้านบาท

(2.6) มูลค่าการจัดซื้อจัดจ้างเกิน 60 ล้านบาท แต่ไม่เกิน 150 ล้านบาท ต้องมีทุนจดทะเบียนไม่ต่ำกว่า 20 ล้านบาท

(2.7) มูลค่าการจัดซื้อจัดจ้างเกิน 150 ล้านบาท แต่ไม่เกิน 300 ล้านบาท ต้องมีทุนจดทะเบียนไม่ต่ำกว่า 60 ล้านบาท

(2.8) มูลค่าการจัดซื้อจัดจ้างเกิน 300 ล้านบาท แต่ไม่เกิน 500 ล้านบาท ต้องมีทุนจดทะเบียนไม่ต่ำกว่า 100 ล้านบาท

(2.9) มูลค่าการจัดซื้อจัดจ้างเกิน 500 ล้านบาทขึ้นไป ต้องระบุต้องมีทุนจดทะเบียนไม่ต่ำกว่า 200 ล้านบาท

(3) สำหรับการจัดซื้อจัดจ้างครั้งหนึ่งมีวงเงินเกิน 500,000 บาทขึ้นไป กรณีผู้เสนอราคาเป็นบุคคลธรรมดา โดยพิจารณาจากหนังสือรับรองบัญชีเงินฝากไม่เกิน 90 วันก่อนวันยื่นข้อเสนอ โดยต้องมีเงินฝากคงเหลือในบัญชีธนาคารเป็นมูลค่า 1 ใน 4 ของมูลค่างานจ้างทั้งโครงการหรือรายการที่ยื่นข้อเสนอในแต่ละครั้ง และหากเป็นผู้ชนะการจัดซื้อจัดจ้างหรือเป็นผู้ได้รับการคัดเลือกจะต้องแสดงหนังสือรับรองบัญชีเงินฝากที่มีมูลค่าดังกล่าวอีกครั้งหนึ่งในวันลงนามในสัญญา

(4) กรณีที่ผู้เสนอราคาไม่มีมูลค่าสุทธิของกิจการหรือทุนจดทะเบียน หรือมีแต่ไม่เพียงพอที่จะเข้ายื่นข้อเสนอ ผู้เสนอราคาสามารถขอวงเงินสินเชื่อ โดยต้องมีวงเงินสินเชื่อ 1 ใน 4 ของมูลค่างานจ้างทั้งโครงการหรือรายการที่ยื่นข้อเสนอในแต่ละครั้ง (สินเชื่อที่ธนาคารในประเทศ หรือบริษัทเงินทุนหรือบริษัทเงินทุนหลักทรัพย์ที่ได้รับอนุญาตให้ประกอบกิจการเงินทุนเพื่อการพาณิชย์ และประกอบธุรกิจค้าประกันตามประกาศของธนาคารแห่งประเทศไทย ตามรายชื่อบริษัทเงินทุนที่ธนาคารแห่งประเทศไทยแจ้งเวียนให้ทราบ โดยพิจารณาจากยอดเงินรวมของวงเงินสินเชื่อที่สำนักงานใหญ่รับรองหรือที่สำนักงานสาขารับรอง (กรณีได้รับมอบอำนาจจากสำนักงานใหญ่) ซึ่งออกให้แก่ผู้เสนอราคา นับถึงวันยื่นข้อเสนอไม่เกิน 90 วัน)

(5) กรณีตาม (1)-(4) ยกเว้นสำหรับกรณีดังต่อไปนี้

(5.1) กรณีที่ผู้เสนอราคาเป็นหน่วยงานของรัฐ

(5.2) นิติบุคคลที่จัดตั้งขึ้นตามกฎหมายไทยที่อยู่ระหว่างการฟื้นฟูกิจการตามพระราชบัญญัติล้มละลาย (ฉบับที่ 10) พ.ศ. 2561

4. เงื่อนไขการเสนอราคา

4.1 ผู้เสนอราคาจะต้องเสนอราคาในแบบฟอร์มเสนอราคา โดยจะต้องแจกแจงราคาในแต่ละรายการให้ครบถ้วนทุกรายการ ซึ่งราคาในใบเสนอราคาดังกล่าว การไฟฟ้านครหลวงขอสงวนสิทธิ์ใช้เป็นราคาอ้างอิงในการปรับเพิ่มหรือลดงาน (ถ้ามี) และการไฟฟ้านครหลวงขอสงวนสิทธิ์ ไม่จัดซื้อในรายการที่เห็นว่าราคาไม่เหมาะสม

4.2 ผู้เสนอราคาจะต้องส่งเอกสารงบแสดงฐานะทางการเงิน ตามข้อ 3.10 ในกรณีที่การไฟฟ้านครหลวงมีการร้องขอ

4.3 ผู้เสนอราคาจะต้องแจ้งชื่อผลิตภัณฑ์ รุ่น และประเทศที่ผลิต พร้อมแนบเอกสารบรรยายคุณลักษณะ (Specification) และ Catalog ของอุปกรณ์/ระบบที่เสนอ ให้ครบถ้วนเพียงพอต่อการพิจารณา หากมีข้อความชี้แจงเพิ่มเติมให้แนบท้ายไปพร้อมข้อเสนอด้านเทคนิคได้ มิฉะนั้นอาจจะไม่ได้รับการพิจารณา

5. ข้อกำหนดรายละเอียดคุณลักษณะเฉพาะของอุปกรณ์

- ข้อกำหนดสำหรับการจัดซื้อ Unit Substation พร้อมอุปกรณ์ประกอบ สำหรับงานลูกค้า

6. ขอบเขตของงานและแบบรูปรายการ

ในการดำเนินการสำหรับการเสนอราคาครั้งนี้ ผู้เสนอราคาต้องดำเนินงานจัดหาและส่งมอบพัสดุเป็นของใหม่ทั้งหมด ไม่เคยผ่านการใช้งานมาก่อน โดยพัสดุดังกล่าวจะต้องครอบคลุมตามที่ระบุไว้ในขอบเขตงานนี้หรือสามารถเพิ่มเติมจากขอบเขตงานนี้ได้ หากการไฟฟ้านครหลวงพิจารณาแล้ว เห็นว่ายังอยู่ในวิสัยที่สามารถดำเนินการให้ดีกว่าที่ระบุไว้ในขอบเขตงานนี้ ทั้งนี้จะขึ้นอยู่กับความเป็นไปได้ทางหลักการใช้งานจริง

และผู้เสนอราคาจะต้องจัดหาเพิ่มเติมโดยค่าใช้จ่ายส่วนเพิ่มนั้น อยู่ในดุลยพินิจของการไฟฟ้านครหลวง ตามรายการดังต่อไปนี้

6.1 รายการแสดงปริมาณงาน (BOQ)

6.2 รายละเอียดคุณลักษณะเฉพาะของอุปกรณ์ที่แนบ

6.3 แบบรูปรายการ (ถ้ามี)

6.4 เงื่อนไขเพิ่มเติม (ถ้ามี)

7. การส่งมอบ

7.1 กำหนดเวลาในส่งมอบพัสดุ **ภายใน 180 วันนับถัดจากวันที่ลงนามในใบสั่งซื้อ/สัญญา**

7.2 พัสดุทั้งหมดต้องส่งมอบที่โรงพยาบาลราชวิถี โดยเอกสารผ่านแผนกระบบไฟฟ้า 2 กองธุรกิจระบบไฟฟ้า 1 ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า

7.3 ผู้ขายต้องดำเนินการจัดเก็บเข้าสถานที่ที่การไฟฟ้านครหลวงกำหนดให้เรียบร้อย โดยใช้ยานพาหนะและแรงงานของผู้ขายทั้งหมด โดยไม่มีค่าใช้จ่ายเพิ่มเติม

8. การตรวจรับ

8.1 เมื่อการไฟฟ้านครหลวงได้ตรวจรับสิ่งที่ส่งมอบ และเห็นว่าถูกต้องครบถ้วนตามสัญญาแล้ว การไฟฟ้านครหลวงจะลงนามรับมอบสิ่งของไว้เพื่อผู้ขายนำมาเป็นหลักฐานประกอบการขอรับเงินค่าสิ่งของนั้น

8.2 ถ้าผลของการตรวจรับปรากฏว่า สิ่งของที่ผู้ขายส่งมอบไม่ตรงตามสัญญา การไฟฟ้านครหลวงสงวนสิทธิ์ที่จะไม่รับสิ่งของนั้น โดยผู้ขายต้องรีบนำสิ่งของนั้นกลับคืนโดยเร็วที่สุดเท่าที่จะทำได้ และนำสิ่งของมาส่งมอบให้ใหม่หรือต้องทำการแก้ไขให้ถูกต้องตามสัญญาด้วยค่าใช้จ่ายของผู้ขายเอง และระยะเวลาที่เสียไปเพราะเหตุดังกล่าว ผู้ขายจะนำมาอ้างเป็นเหตุขอขยายเวลาทำการตามสัญญาหรือของดหรือลดค่าปรับไม่ได้

ในกรณีที่ผู้ขายส่งมอบสิ่งของถูกต้องแต่ไม่ครบจำนวน หรือส่งมอบครบจำนวนแต่ไม่ถูกต้องทั้งหมด การไฟฟ้านครหลวงจะตรวจรับเฉพาะส่วนที่ถูกต้อง โดยจะลงนามรับมอบไว้ให้เฉพาะส่วนนั้นก็ได้ หรือสิ่งของที่ส่งมอบตามข้อความข้างต้น เมื่อคณะกรรมการตรวจรับพัสดุพิจารณารับไว้แล้ว และถ้ารับไว้แล้วปรากฏเป็นเหตุทำให้การใช้งานนั้นไม่สมบูรณ์ คณะกรรมการตรวจรับพัสดุ ขอสงวนสิทธิ์ที่จะไม่รับสิ่งของดังกล่าวนั้นทั้งหมด จนกว่าผู้ขายจะส่งมอบสิ่งของที่ถูกต้องตามข้อกำหนด และครบตามจำนวน ทั้งนี้หากเกินกำหนดระยะเวลาส่งมอบสิ่งของ ผู้ขายจะนำเอามาเป็นเหตุขอขยายระยะเวลาตามสัญญาไม่ได้

9. การปรับตามสัญญา

หากผู้ขายไม่สามารถส่งของได้ตามกำหนดเวลา ผู้ขายจะต้องชำระค่าปรับให้แก่การไฟฟ้านครหลวง เป็นรายวัน ในอัตราร้อยละ 0.2 (ศูนย์จุดสอง) ของราคาสิ่งของที่ยังไม่ได้รับมอบ นับถัดจากวันครบกำหนดตามสัญญาจนถึงวันที่ผู้ขายได้นำสิ่งของมาส่งมอบให้แก่การไฟฟ้านครหลวงจนถูกต้องครบถ้วนตามสัญญา

การคิดค่าปรับในกรณีสิ่งของที่ตกลงซื้อขายประกอบกันเป็นชุด แต่ผู้ขายส่งมอบเพียงบางส่วนหรือขาดส่วนประกอบส่วนหนึ่งส่วนใดไปทำให้ไม่สามารถใช้การได้โดยสมบูรณ์ให้ถือว่ายังไม่ได้ส่งมอบสิ่งของนั้นเลย และให้คิดค่าปรับจากราคาสิ่งของเต็มทั้งชุด

10. การจ่ายเงิน

การไฟฟ้านครหลวงจะจ่ายเงินค่าพัสดุ เต็มจำนวน ของมูลค่าตามใบสั่งซื้อ/สัญญา เมื่อผู้ขายส่งมอบพัสดุทั้งหมด และคณะกรรมการตรวจรับพัสดุได้ตรวจรับเรียบร้อยแล้ว

11. การงดหรือลดค่าปรับ หรือการขยายเวลาส่งมอบพัสดุ

ในกรณีที่มีเหตุเกิดจากความผิดหรือความบกพร่องของการไฟฟ้านครหลวง หรือเหตุสุดวิสัยหรือเกิดจากพฤติการณ์อันหนึ่งอันใดที่ผู้ขายไม่ต้องรับผิดชอบตามกฎหมาย หรือเหตุอื่นตามที่กำหนดในกฎกระทรวงซึ่งออกตามความในกฎหมายว่าด้วยการจัดซื้อจัดจ้างและการบริหารพัสดุภาครัฐ ทำให้ผู้ขายไม่สามารถส่งมอบพัสดุให้แล้วเสร็จตามเงื่อนไขและกำหนดเวลาแห่งสัญญานี้ได้ ผู้ขายจะต้องแจ้งเหตุหรือพฤติการณ์ดังกล่าวพร้อมหลักฐานเป็นหนังสือให้การไฟฟ้านครหลวงทราบ เพื่อของดหรือลดค่าปรับ หรือขยายเวลาส่งมอบออกไปภายใน 15 (สิบห้า) วันนับถัดจากวันที่เหตุนั้นสิ้นสุดลง หรือตามที่กำหนดในกฎกระทรวงดังกล่าวแล้วแต่กรณี

ถ้าผู้ขายไม่ปฏิบัติให้เป็นไปตามความในวรรคหนึ่ง ให้ถือว่าผู้ขายได้สละสิทธิเรียกร้องในการที่จะของดหรือลดค่าปรับ หรือขยายเวลาส่งมอบพัสดุออกไปโดยไม่มีเงื่อนไขใดๆ ทั้งสิ้น เว้นแต่กรณีเหตุเกิดจากความผิดหรือความบกพร่องของการไฟฟ้านครหลวงซึ่งมีหลักฐานชัดแจ้งหรือการไฟฟ้านครหลวงทราบดีอยู่แล้วตั้งแต่ต้น

การงดหรือลดค่าปรับ หรือขยายกำหนดเวลาทำงานตามวรรคหนึ่ง อยู่ในดุลพินิจของการไฟฟ้านครหลวงที่จะพิจารณาตามที่เห็นสมควร

12. การรับประกันความชำรุดบกพร่อง

ผู้ขายตกลงรับประกันความชำรุดบกพร่องหรือขัดข้องของสิ่งของตามสัญญานี้ เป็นเวลา 2 (สอง) ปี นับถัดจากวันที่ผู้ซื้อได้รับมอบสิ่งของทั้งหมดไว้โดยถูกต้องครบถ้วนตามสัญญา โดยภายในกำหนดเวลาดังกล่าว หากสิ่งของ ตามสัญญานี้เกิดชำรุดบกพร่องหรือขัดข้องอันเนื่องมาจากการใช้งานตามปกติ ผู้ขายจะต้องจัดการซ่อมแซมหรือแก้ไขให้อยู่ในสภาพที่ใช้การได้ดีดังเดิม ภายใน 15 (สิบห้า) วัน นับถัดจากวันที่ได้รับแจ้งจากผู้ซื้อ โดยไม่คิดค่าใช้จ่ายใด ๆ ทั้งสิ้น หากผู้ขายไม่จัดการซ่อมแซมหรือแก้ไขภายในกำหนดเวลาดังกล่าว ผู้ซื้อมีสิทธิที่จะทำการนั้นเองหรือจ้างผู้อื่นให้ทำการนั้นแทนผู้ขาย โดยผู้ขายต้องเป็นผู้ออกค่าใช้จ่ายเองทั้งสิ้น

ในกรณีเร่งด่วนจำเป็นต้องรีบแก้ไขเหตุชำรุดบกพร่องหรือขัดข้องโดยเร็ว และไม่อาจรอคอยให้ผู้ขายแก้ไขในระยะเวลาที่กำหนดไว้ตามวรรคหนึ่งได้ ผู้ซื้อมีสิทธิเข้าจัดการแก้ไขเหตุชำรุดบกพร่องหรือขัดข้องนั้นเอง หรือให้ผู้อื่นแก้ไขความชำรุดบกพร่องหรือขัดข้อง โดยผู้ขายต้องรับผิดชอบชำระค่าใช้จ่ายทั้งหมด

การที่ผู้ซื้อทำการนั้นเอง หรือให้ผู้อื่นทำการนั้นแทนผู้ขาย ไม่ทำให้ผู้ขายหลุดพ้นจากความรับผิดตามสัญญา หากผู้ขายไม่ชดใช้ค่าใช้จ่ายหรือค่าเสียหายตามที่ผู้ซื้อเรียกร้องผู้ซื้อมีสิทธิบังคับจากหลักประกันการปฏิบัติตามสัญญาได้

13. หลักเกณฑ์การพิจารณา

การไฟฟ้านครหลวงจะพิจารณาตัดสินโดยใช้หลักเกณฑ์ราคาในการพิจารณา

14. หลักประกันสัญญา

ผู้ขายต้องวางหลักประกันสัญญาเป็นจำนวนร้อยละ 10 (สิบ) ของมูลค่าสิ่งของตามสัญญา โดยหลักประกันจะต้องมีระยะเวลาการค้ำประกันตั้งแต่วันที่เริ่มต้นสัญญาไปจนถึงวันสิ้นสุดการรับประกันผลงาน โดยใช้หลักประกันอย่างใดอย่างหนึ่ง หากหลักประกันไม่เป็นไปตามข้อกำหนดดังต่อไปนี้จะไม่ได้รับการพิจารณา

- เงินสด ให้ติดต่อขอรับแบบฟอร์มชำระเงินที่แผนกจัดซื้อจัดจ้าง กองสนับสนุนธุรกิจ ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า อาคาร 2 ชั้น 8 การไฟฟ้านครหลวงเขตธนบุรี
- เช็คที่ธนาคารพาณิชย์ในประเทศไทยรับรอง และขีดคร่อมสั่งจ่ายให้แก่การไฟฟ้านครหลวง (แคชเชียร์เช็ค) โดยเป็นเช็คลงวันที่ที่ลงนามในสัญญาไม่เกิน 3 วันทำการ
- หนังสือค้ำประกันของธนาคารพาณิชย์ในประเทศไทย ตามแบบหนังสือค้ำประกันที่การไฟฟ้านครหลวงกำหนด โดยการไฟฟ้านครหลวงจะคืนให้ภายหลังวันสิ้นสุดการรับประกันผลงาน

หลักประกันที่ผู้ขายนำมามอบไว้นี้ การไฟฟ้านครหลวงจะคืนให้แก่ผู้ขายโดยไม่มีดอกเบี้ย เมื่อผู้ขายพ้นจากข้อผูกพันและความรับผิดทั้งปวงตามสัญญานี้ แล้ว

15. นโยบายด้านสิทธิมนุษยชน

ผู้ขายต้องให้ความสำคัญกับการดำเนินงานอย่างมีจริยธรรมควบคุมดูแลด้านอาชีวอนามัยและความปลอดภัยในการทำงาน รักษาสิ่งแวดล้อม และปฏิบัติตามกฎหมายแรงงานและเคารพในหลักสิทธิมนุษยชน โดยไม่สนับสนุนหรือดำเนินการใดๆ ที่จะเป็นการเกี่ยวข้องกับละเมิดสิทธิมนุษยชน

รายการแสดงปริมาณงาน (BOQ)

จัดซื้อ Unit Substation พร้อมหม้อแปลงไฟฟ้า ขนาด 1000 kVA, 24 kV -416 V และอุปกรณ์ประกอบ จำนวน 2 ชุด

สำหรับใช้งานที่โรงพยาบาลราชวิถี

ลำดับ	รายการที่จัดซื้อ/ลักษณะงาน	ปริมาณ	หน่วย	ค่าวัสดุ		ค่าแรง		รวมเป็นเงิน
				ราคา/หน่วย	รวม	แรงงาน/หน่วย	รวม	
1	24 kV Unit Substation supplied with 24 kV 16 kA RMU	2	SET					
	and 24 kV 1,000 kVA Less-Flammable Transformer shall							
	consist of the followinge :-							
	a) Unit Substation 16 kA and Low voltage							
	Switchgear with a three pole Air Circuit Breaker							
	at incoming feeder and outgoing feeder according to							
	"SPECIFICATION NO.105 (BQD) : 12/24 kV UNIT SUBSTATION							
	FOR CUSTOMER USER ONLY"							
	ให้ผู้เสนอราคาแจ้งรายละเอียด ดังนี้							
	ยี่ห้อ.....							
	รุ่น.....							
	ชื่อผู้ผลิต.....							
	ประเทศผู้ผลิต.....							
	b) 24 kV 16 kA SF6 -insulated Ring Main Unit with two cable							
	feeder switches and motor operated and DMS system and							
	one transformer feeder circuit breaker							
	according to "SPECIFICATION NO.108 (01-2024) : 12&24 kV							
	SF6 Insulated Ring Main Unit with DMS system"							
	The following cable connector for each set of ring main							
	unit shall also be supplied :-							
	i) Cable connecter for cable feeder for connecting to							
	240 mm2 cable - 6 single phase sets (single cable							
	connection type)							
	il) Cable connecter for transformer feeder for connecting							
	to 70 mm2 cable - 3 single phase sets (single cable							
	ให้ผู้เสนอราคาแจ้งรายละเอียด ดังนี้							
	ยี่ห้อ.....							
	รุ่น.....							
	ชื่อผู้ผลิต.....							
	ประเทศผู้ผลิต.....							
	c) 24 kV 1,000 kVA Less-Flammable Transformer cu/cu							
	HV/LV winding according to "SPECIFICATION NO.236 (02-2020)							
	Conventional type three phase less-flammable liquid							
	filled transformer							
	ให้ผู้เสนอราคาแจ้งรายละเอียด ดังนี้							
	ยี่ห้อ.....							
	รุ่น.....							
	ชื่อผู้ผลิต.....							
	ประเทศผู้ผลิต.....							
							รวม	
							ภาษีมูลค่าเพิ่ม 7%	
							รวมเป็นเงินทั้งสิ้น	

ข้อกำหนดสำหรับการจัดซื้อ Unit Substation พร้อมอุปกรณ์ประกอบ

สำหรับงานลูกค้า

แก้ไขครั้งที่				โดย	วันที่
จัดทำโดย	ตรวจสอบโดย	ชฝธค.	ผฝธค.	ชวก.	รผธ.
วันที่ 9/12/59	วันที่ 9/12/59	วันที่ 23/12/59	วันที่ 9/2/60	วันที่ 16กพ60	วันที่

สารบัญ

1. SPECIFICATION NO.105 (BQD) 12/24 kV UNIT SUBSTATION FOR CUSTOMER USED ONLY	15	แผ่น
2. SPECIFICATION NO.108 12/24 kV SF_6 – INSULATED RING MAIN UNIT	20	แผ่น
3. SPECIFICATION NO.236 CONVENTIONAL TYPE THREE PHASE LESS-FLAMMABLE LIQUID FILLED TRANSFORMER	14	แผ่น
4. TECHNICAL PROPOSAL	15	แผ่น
5. DEVIATION FROM MEA'S SPECIFICATION FORM	1	แผ่น

SPECIFICATION NO.105 (BQD)
12/24 kV UNIT SUBSTATION FOR CUSTOMER USE ONLY

A Scope

A1 This specification describes the requirement which shall be met in order to supply the 12/24 kV unit substation to the Metropolitan Electricity Authority (MEA). The unit substation shall be used by MEA's customer whose system connected to either 12 kV or 24 kV, 3 phase 3 wire, 50 Hz underground distribution system having the neutral solidly grounder at the distribution substation, where the fault level of the outgoing feeders is 16 kA, 8 kA at system voltage of 12 kV, 24 kV respectively.

A2 The following attached drawing is a part of this specification :-

Drawing No. 050627 : Earthing diagram for unit substation

Drawing No. BQDSPEC105 Sheet 1 to 3 : Dimension for Unit Substation

Drawing NO.BQDSPEC1051: Single Line Diagram for Unit Substation

B Site and Service Conditions

The unit substation shall be installed in the Bangkok Metropolis, Thailand. The service conditions are as follows :-

a) Installation site : Outdoor under direct sunlight and still air.

b) Altitude : approximately at mean sea level.

c) Maximum ambient temperature : 40°C

d) Average ambient temperature in any one year : 30°C

e) Average relative humidity in any one year : 79°C

f) Average maximum relative humidity in any one year : 94°C

g) Maximum ambient temperature inside the enclosure : 45°C

The unit substation shall be suitable for use in tropical climatic area and shall be capable of operating at its full ratings without any derating factors whatever in the service conditions mentioned above.

C Reference Standard

Except otherwise specified elsewhere in the specification, the unit substation and equipment required by MEA shall manufactured and tested in conformity with the standard listed below :-

International Electrotechnical Commission (IEC)

62271-202(2006)	:	High-voltage/Low-voltage prefabricated Substation
60947-2(2003)	:	Low- voltage switchgear and controlgear Part2-Circuit-breakers

NOTE

1. The equipment tested in accordance with the later version of the above standards is also accepted.
2. The equipment tested in accordance with older version (or draft version) of the above standards is also accepted provided that the test is conformed to standard and year mentioned above.
3. The equipment complies to other national standards having similar characteristics and providing equal performance and/or quality to that specified may be proposed. In this case the complete ENGLISH language copies of the standards shall be submitted with the quotation, otherwise such offer may not be considered
4. If there are any minor parts deviated from the standards, they shall be clearly mentioned in the "DEVAITION FROM MEA'S SPECIFICATION FROM" attached herewith.

D Inspection and tests

D1 All equipment proposed in the unit substation shall have successfully passed all the type tests or design in according with the applicable standards. The test reports of the proposed equipment are required. All test reports shall be attached to the bid or be submitted to MEA within 15 (fifteen) days after opening date. If the type test report are not delivered to MEA within 15 (fifteen) days after the opening date, MEA will not consider such offer.

D2 The unit substation shall have successfully passed the internal arc test according to IEC publication 62271-202 annex A accessibility type with IAC-AB classified. The internal arc test shall be performed by KEMA (Netherland), HVPL (Japan), CERDA (France), CESI (Italy), Intertek ASTA (UK), PEHLA

(Germany), FGH (Germany), COFRAC/EDF (France), VOLTA (France) or SATS (Norway) or test station which is member of STL.

The test current shall be 16 kA (minimum) or equivalent. The duration of test shall be 1 sec.

The internal arc test of unit substation shall be done as follows :-

1) Use ring main unit having IAC classified. The unit substation shall be tested by initiating arc in switching compartment. For the design that has different gas flow in cable compartment and in switching compartment of ring main unit, the additional test by initiating arc in cable compartment is required.
2) Use ring main unit without IAC classified. The unit substation shall be tested by initiating arc in switching compartment and cable compartment.

For those who have already supplied unit substation to MEA and the internal arc tests do not meet the above requirements, the internal arc test shall be retested and submitted before delivery. Before the test, the details shall be submitted for MEA approval.

Note Transferability of test result can be extended to another one, provided that the original test was more onerous and the latter design can be considered as similar to the one tested in all following respects :

- same arc current and arcing time ;
- same layout and direction of gas flow from internal arc ;
- same volume or larger than the tested unit substation ;
- same structure and strength of the enclosure ;
- same ventilation grids ;
- same performance of the pressure release device, if any.

The calculation and details to demonstrate the internal arc fault withstand performance shall be provided to MEA within 15 (fifteen) days after opening date; otherwise unit substation shall not be accepted.

D3 Routine tests as stated in the relevant reference standards shall be performed for each individual equipment. If any tests required the agreement between the purchaser and the manufacturer, the test methods shall be proposed by the manufacturer and approved by MEA before such tests can

be proceeded. The list of routine test which the manufacturer will perform of each equipment shall be attached to the bids.

D4 MEA reserves the right to send the representatives at his expense to inspect and witness tests of the material and equipment during manufacture, at the time of shipment or at any time he deems necessary. The supplier shall provide free access to the facilities where the equipment is being manufactured, and shall satisfy the representative that the material and equipment are in accordance with this specification and the purchase contract.

D5 Prior to shipment of the equipment from the factory, the supplier shall airmail to MEA the complete and certified reports of all tests made in 4 (four) copies. These reports shall contain all data required for their complete understanding such as : diagram, methods, instruments, constants and values used in the tests and results obtained. If MEA has his own inspector, the inspector himself shall certify all the above test reports and submit to MEA.

E Drawing and Instructions

E1 Four copies each of following items must be attached with the bid :-

a) Catalogue of all supplied equipment showing specifications and operating characteristics.

b) Preliminary drawings showing the details of equipment layout, equipment grounding, details of cable entries, and foundation requirement.

c) Other documents as required in the specification.

E2 Supplier shall furnish 4 (four) copies each of the following items as soon as possible for the design approval by MEA.

a) Single line diagram.

b) Complete arrangement drawings showing the details of equipment lay-out, equipment grounding, dimensions, weight, and lifting facilities and details of primary and secondary cable entries.

c) Complete assembly drawings of all equipment.

d) Complete foundation details.

e) All nameplate and rating plate drawing.

f) Detailed drawings, specifications and operating characteristics of all equipment to be supplied.

g) Complete interlocking diagram.

h) All other drawings considered necessary for the successful installation, operating and maintenance of the equipment.

If any of the drawings and data mentioned above are not submitted to MEA within 30 (thirty) days after the effective date of contract, the supplier shall be penalized at Bath 1,000.00 (one thousand only) per day until the date the supplier submits the above documents.

Generally, if the drawings require no more detail, they will be returned to the supplier within 45 (forty-five) days after receipt by MEA. If drawings for approval are not submitted within the time as mentioned above or MEA has to request for additional information, supplier cannot regard lost time as reason for extending delivery time without penalty.

E3 Supplier shall airmail 4 (four) copies each and 1 (one) transparent reproducible copy each of followings drawing and documents, at least 15 (fifteen) days prior to the first shipment of the equipment.

a) Final certified copies of all drawings listed in clause E2.

b) Complete installation, operating and maintenance instructions of all equipment.

c) Complete part lists of each equipment.

The transparent reproducible copy is not required for item b).

E4 In addition to the above, one complete set of installation and operating instructions including any precaution notes shall be firmly attached to or boxed with each set of the equipment at the time of shipment.

E5 All drawings except standard shop drawings, characteristic curves and installations instruction shall have the contract number marked thereon.

E6 All drawing and instructions shall be in **ENGLISH.** Information on drawing shall be engineering. Instruction manuals shall be machine printed or typed.

E7 All drawing shall be provided with both horizontal and vertical zone markings on the frames of the drawings for the sake of quick reference when locating some particular position on them. The zone markings on the horizontal frame are preferred to be numbers and those on the vertical frame are preferred to be alphabets. The zone identification on the drawings shall then, for example, be A5, D7 etc.

E8 All measurements and quantities shall be expressed in the units of **METRIC SYSTEM.** If they are expressed in other system, the metric equivalent shall also be shown.

F Ratings and Features

The unit substation shall have the following minimum ratings and features.

F1 High voltage switchgear as specified in the attached detailed specification No. 108 : 24 kV SF_6 **–insulated Ring Main Unit except the** followings :

- Requirement for internal arc test of ring main unit in specification no. 108 is not required (see clause D2)
- Requirement for front panel cover in specification no. 108 clause 108H2 is not required for outgoing feeder.

Protection class of high voltage switchgear : IP43 or better Section enclosure

F2 Distribution transformer as specified in attached Detailed Specification No. 236: Conventional Type Three Phase Less-flammable Liquid Filled Transformer.

Note that : Clause 236P : Additional Requirements for Marking and Packing Shall not be applied for the purchasing of unit substations

kVA rating : As specified in price proposal

Protection class of distribution transformer section enclosure for totally enclosed unit substation : IP33 or better

F3 Low voltage switchgear

Rated operational voltage (U_e) : Suitable for 230/400 V, 3 phase system, neutral solidly earthed

Incoming circuit breaker

- Rated current (I_n) : as shown in Sing Line Diagram
- Rated ultimate short-circuit breaking capacity (I_{cu}) : at 400 V as shown in Single Line Diagram

Outgoing circuit breaker

- Number of outgoing circuit breaker : as shown in Single Line Diagram
- Rated current (I_n) number and cable size : as shown in Single Line Diagram

Rated ultimate short-circuit Breaking capacity (I_{cu}) : at 400 V as shown in Single Line Diagram

Protection class of low voltage Switchgear section enclosure : IP43 or better

Rated frequency : 50 Hz

Note The circuit breaker shall be rated for 45°C application. The tripping current shall be able to be set to match the transformer ratings.

G General Design Requirements

G1 The unit substation shall consist of three main sections as follows.

A) High voltage switchgear section.

B) Distribution transformer section.

C) Low voltage switchgear section.

All equipment in each section above shall be enclosed in a separate compartment having weatherproof enclosure. The three sections shall be integrated to form the unit substation factory assembled on a common base frame as one piece, easily transported without any special tool. All parts and any necessary installation materials such as cable clamps, cable terminals, cable heads, fixing hardwares etc. Shall be completely furnished so that the unit substations can be put into operation when arrived at site and the primary and secondary cable are connected.

G2 The unit substation shall be arranged in such a way that the high voltage and low voltage compartment are on each end of the substation.

G3 The design and construction of the unit substation shall be weatherproof, fully tropicalized suitable for outdoor use in a humid saliferous tropical climate and it shall be unaffected by moisture, dust, condensation or any other ambient condition. The enclosure shall be able to prevent detrimental dust from entering into the substation, but careful attention shall be paid to provide adequate ventilation for the equipment enclosed. Proper ventilation windows can be provided in the side walls of the enclosure. The enclosure shall be vermin proof.

G4 Access door(s) shall be provided for each compartment. The door to different compartment shall be equipped with separate handles, locks and be able to be latched in the open position. All hinges and pins shall be stainless steel.

All locks shall be provided with master keys and duplicate keys. Preferable to be the same as previously supplied.

G5 The substation shall be provided with suitable lifting facilities and shall have construction frame structure sufficiently strong to be handled be the lifting facilities.

G6 Cable glands or equivalent shall be furnished at every cable entries so that the dust protected and vermin proof properties of the enclosure can be retained.

G7 The unit substation shall require minimum or no maintenance. No high voltage live parts shall accessible.

G8 All primary and secondary cables shall enter the substation from below. Proper cable fixing provisions shall be furnished. The sizes and numbers of cables are specified elsewhere in this specification.

G9 All special tools necessary for the installation, operation and maintenance of the unit substation shall be supplied. Tool list indicating the names and sketches, if possible, and the quantities to be supplied shall be attached. The price of each tool in the list shall be indicated.

G10 Except otherwise specified all metal surface including transformer tank shall be treated to protect them against corrosion and finished with final coat of top quality paint in light grey or factory standard color. The painting process shall be described in the bid and subjected to MEA approval. The manufacture shall be able to prove that the selected process can protect the surface against corrosion when exposed to humid, polluted big city sea coast atmosphere. It shall also possess excellent surface adhesion and reasonably immune to abrasion and external impact.

G11 The unit substation are intended to be installed outdoor in the tropical climate, therefore, means to prevent condensation inside the enclosure shall be provided such as installation of anti-condensation heater in some compartment where considered necessary.

G12 The minimum of three earthing points shall be provided for each substation. One each in high voltage compartment, low voltage compartment and at transformer tank. The earthing point shall be made of non-corrosive material throughout such as stainless steel. Earthing of unit substation and all

equipment shall be according to drawing for grounding schematic for unit Substation.

G13 Nameplate shall contain all essential information including the corresponding purchase contract number.

G14 Height of all live parts inside unit substation shall be not less than 1000 mm above base level of unit substation. The level of flooding, that unit substation can be energized, shall be marked on outside of the enclosure.

I Specific Requirements for Unit Substation

I1 All equipment in the unit substation including the transformer shall be contained in the steel enclosure. For safe protection of environment even under transformer leakage conditions the housing shall have a base pan made of oil-tight welded steel sheets with hot dip galvanized, powder coated and bituminized or oil-tight welded stainless steel. The base pan shall be able to take 100% amount of coolant of transformer to the maximum size of transformer (capacity) which was specified for each type of unit substation. This base shall be suitable for mounting on concrete pad or foundation. The concrete pad or foundation shall be constructed by MEA and shall be limited to those portions which required to be cast in site only.

I2 The substation enclosure and sheet steel parts shall be made from first class cold rolled galvanized sheet steel having the thickness of not less than 2 mm gauge and coated by an electrostatic plastic powder coating. Stainless steel with suitable painting method is also acceptable. The thickness of stainless steel shall be not less than 1.5 mm, however it shall be not less than those of the tested unit. The size of the enclosure of every unit substation shall be ample in order that the enclosure can enclose also the ring main unit of 2 transformer feeders. The bidder shall state the final colors available which MEA shall select before signing the contract.

I3 The unit substation shall be installed in the public area such as crowded side-walk. Public safety and attractive design are also the main points in bid consideration. The substation enclosure shall be strong enough to retain the protective function of the enclosure against access of the live parts of the transformer and switchgears in case of external impact.

J Low voltage Switchgear

J1 The incoming and outgoing feeder shall be equipped with a three pole molded case circuit breaker (MCCB) or Air Circuit Breaker (ACB) having overload and short circuit protection as show in single line diagram.

J2 Each outgoing cable will be installed in 5 inch rigid steel conduit. Neutral bar shall also be provided and be suitable for connection of insulated neutral conductors of all low voltage outgoing feeders and neutral of transformer.

J3 The copper busbar and all live parts shall be fully insulated or shrouded to IP20 protection class. During all normal operation, the operator shall be well protected against accidental contact with live part. The busbar shall have ample size for the maximum connected transformer rating and prevailing temperature conditions.

J4 Three ammeters complete with appropriate current transformer class 1 accuracy shall be provided to measure the incoming feeder current. The scale shall be selected to suit transformer rating. The ammeter shall also be fitted with maximum demand indicator with 15 minute delay.

J5 One voltmeter with appropriate scale and voltmeter selector switch shall be provided for measuring line to line and lines to neutral bus voltage.

J6 Tag (Nameplate) shall be provided at each low voltage outgoing circuit breaker to show the feeder number for example xxx01, xxx02, ect.

J7 All live part in low voltage compartment shall be covered with flame-retardant and self-extinguishing material to prevent accidentally contact when front door is open.

K Additional Requirements for Marking and Packing

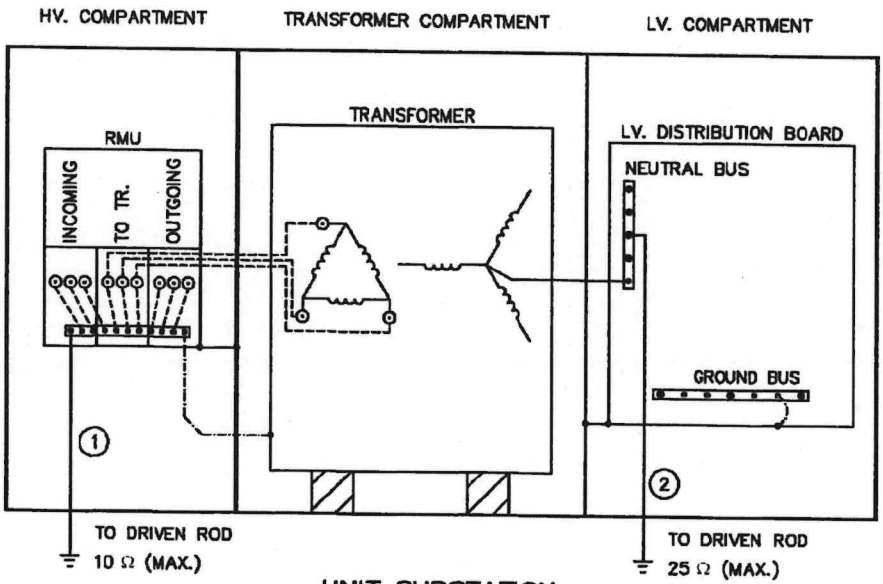
K1 The unit substation shall be shipped completely assembly and filled with insulating liquid if it is liquid filled type. The packing shall be seaworthy and substantially strong enough to withstand rough handling.

K2 MEA Serial No. of the supplied unit substation shall be specified in every invoice of partial shipments.

K3 All spare parts of every rating shall be shipped together with the first shipment of unit substation of that rating in order to enable MEA to replace the parts which may be damaged during transit. The invoice, packing list and

bill of lading covering the spare parts shall be separated from those of the unit substation.

K4 If any parts are packed in the cartons for containerized shipment, the cartons shall be arranged into pallets so as to facilitate their movement by forklift trucks.



UNIT SUBSTATION

⊙ = ELBOW CONNECTOR

----- = SHIELD WIRE

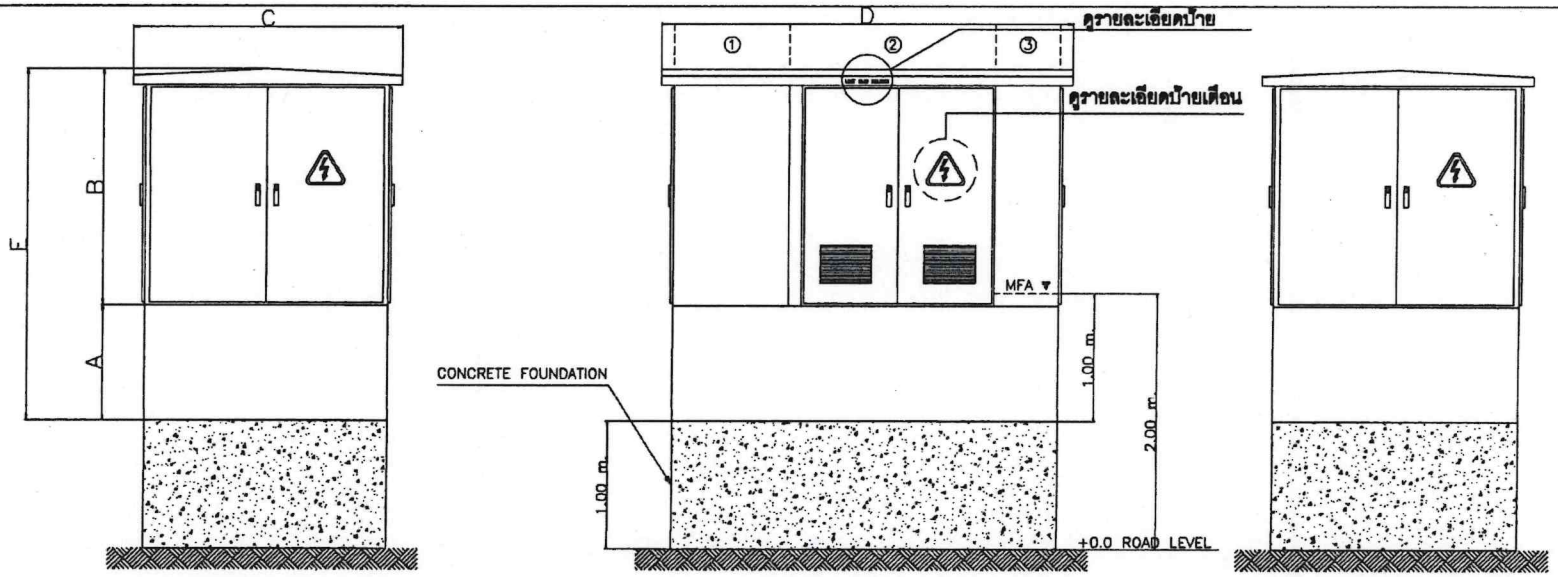
——— = BOND WIRE, 70 mm² (MIN.) CU. INSULATED

(1) = HV. SHIELD WIRE GROUND, 70 mm² CU. INSULATED

(2) = LV. SYSTEM GROUND, 70 mm² (MIN.) CU. INSULATED

REV.NO.	DESCRIPTION OF REVISIONS	BY	DATE

DR. Anant ENGR.	METROPOLITAN ELECTRICITY AUTHORITY	SCALE NONE
CHF.SEC.	EARTHING DIAGRAM FOR UNIT SUBSTATION	SUPERSEDING
CHK.		SH.NO. 1 OF 1
DIR.DIV.		DWG. NO. 050627
DATE 4/8/2557		

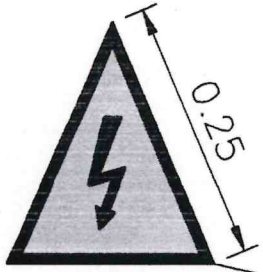


HV. COMPARTMENT FRONT VIEW

SIDE VIEW

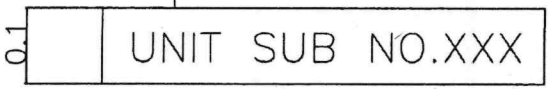
LV. COMPARTMENT FRONT VIEW

① HIGH-VOLTAGE COMPARTMENT
② TRANSFORMER COMPARTMENT
③ LOW-VOLTAGE COMPARTMENT



รายละเอียดป้ายเตือน

ป้ายชื่อทำจาก วัสดุสแตนเลสเกรด 304 หนา 2 มิลลิเมตร พื้นสีดำกัดด้วยกรด



ป้ายเตือนทำจาก วัสดุสแตนเลสเกรด 304 หนา 2 มิลลิเมตร พื้นสีดำกัดด้วยกรด

DIMENSION

DIMENSION FOR UNIT SUBSTATION		
ITEM	MAX. (DIMENSION)	REMARK
A	900 mm.	
B	1800 mm.	
C	1680 mm.	
D	3000 mm.	
E	2700 mm.	

NOTE

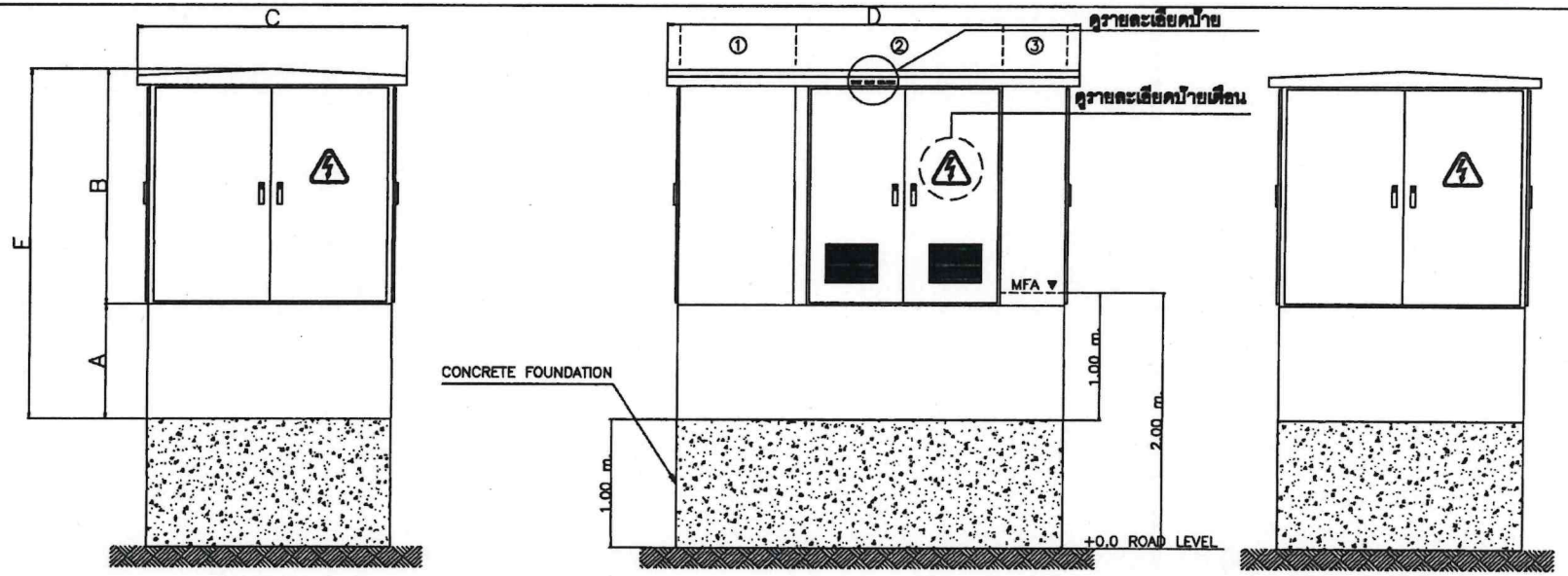
1. THIS DRAWING SHALL BE GUIDLINE ONLY. THE UNIT SUBSTATION DIFFERING FROM THE DRAWING SHALL PROPOSED FOR MEA's APPROVAL.
2. THE NAME PLATE FOR EACH COMPARTMENT SHALL BE PROVIDE.
3. MFA (Maximum Flooding Allowed)
4. THE DRAWING FOR FOUNDATION SHALL BE SUBMIT WITH TENDER.
5. THE DIMENSION ARE IN METER.
6. THE DIMENSION OF UNIT SUBSTATION SHALL NOT BE LARGER THAN THE LIMIT ON EVERY DIMENSION AS SHOWN IN DWG.NO.BQDSPEC105

คลังที่	วันที่	รายละเอียดการแก้ไข	ออกแบบ	ตรวจ

การไฟฟ้านครหลวง

งานบริการลูกค้าแรงสูง 1-3	งานบริการลูกค้า 1	ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า

เขียน ตรวจ		มาตราส่วน 1:50 A4
ออกแบบ		วัน 25 / 10 /59
หัวหน้าแผนก	DIMENSION FOR UNIT SUBSTATION 500 kVA	แผ่นที่ 1 ของจำนวน 3 แผ่น
ผู้อำนวยการ		แบบเลขที่ BQDSPEC105
ผู้อำนวยการ		

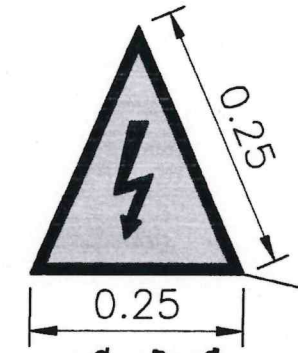


HV. COMPARTMENT FRONT VIEW

SIDE VIEW

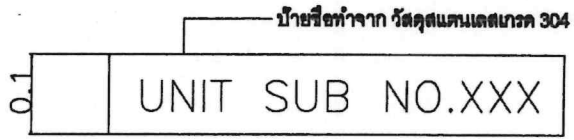
LV. COMPARTMENT FRONT VIEW

① HIGH–VOLTAGE COMPARTMENT
② TRANSFORMER COMPARTMENT
③ LOW–VOLTAGE COMPARTMENT



รายละเอียดป้ายเตือน

ป้ายเตือนทำจาก วัสดุสแตนเลสเกรด 304 หนา 2 มิลลิเมตร พื้นสีดำทัดด้วยเกรด



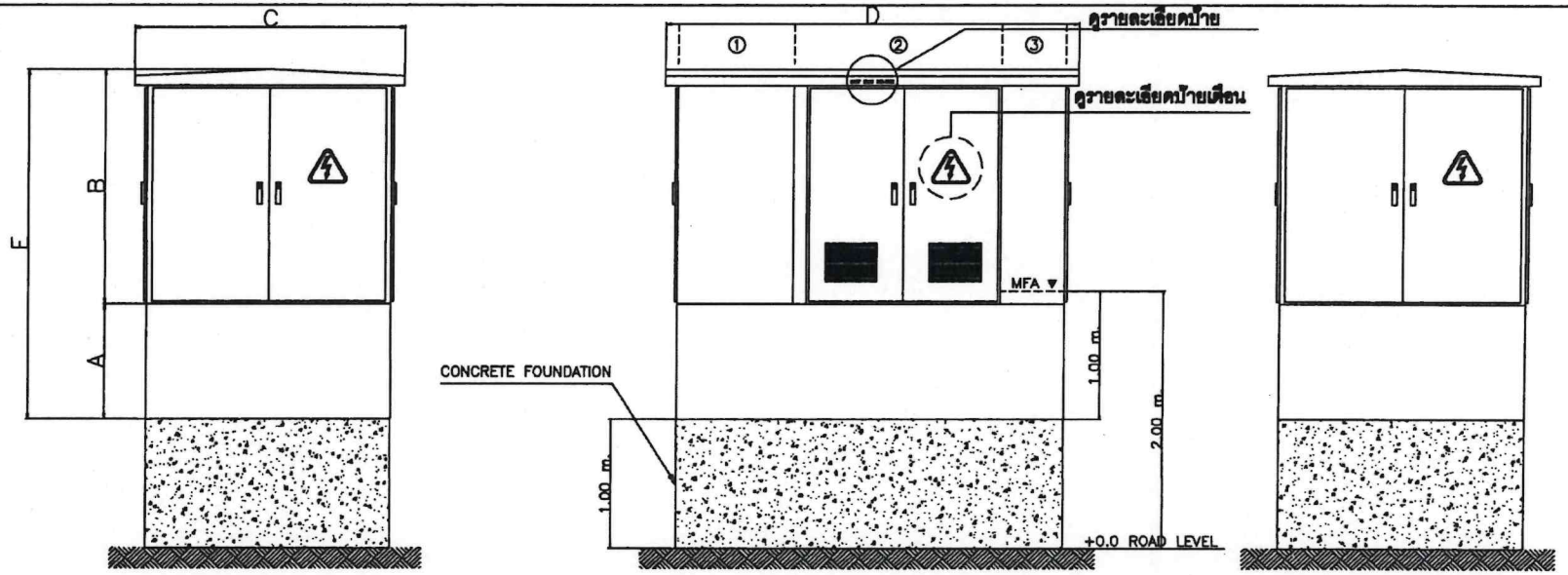
DIMENSION

DIMENSION FOR UNIT SUBSTATION		
ITEM	MAX. (DIMENSION)	REMARK
A	900 mm.	
B	1950 mm.	
C	2300 mm.	
D	3310 mm.	
E	2850 mm.	

NOTE

1. THIS DRAWING SHALL BE GUIDLINE ONLY. THE UNIT SUBSTATION DIFFERING FROM THE DRAWING SHALL PROPOSED FOR MEA's APPROVAL.
2. THE NAME PLATE FOR EACH COMPARTMENT SHALL BE PROVIDE.
3. MFA (Maximum Flooding Allowed)
4. THE DRAWING FOR FOUNDATION SHALL BE SUBMIT WITH TENDER.
5. THE DIMENSION ARE IN METER.
6. THE DIMENSION OF UNIT SUBSTATION SHALL NOT BE LARGER THAN THE LIMITTATION ON EVERY DIMENSION AS SHOWN IN DWG.NO.BQDSPEC105

ครั้งที่	วันที่	รายละเอียดการแก้ไข	ออกแบบ	ตรวจ
การไฟฟ้านครหลวง				
งานบริการลูกค้าแรงสูง 1-3		งานบริการลูกค้า 1	ฝ่ายธุรกิจบริการและคุณภาพไฟฟ้า	
เขียน ตรวจ			มาตราส่วน 1:50 A4	
ออกแบบ			วัน 25 / 10 /59	
หัวหน้าแผนก		DIMENSION FOR UNIT SUBSTATION	แผ่นที่ 2ของจำนวน 3แผ่น	
ผู้อำนวยการกอง		501-1600 kVA	แบบเลขที่ BQDSPEC105	
ผู้อำนวยการฝ่าย				

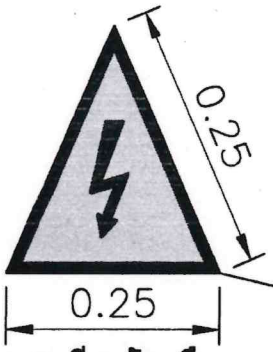


HV. COMPARTMENT FRONT VIEW

SIDE VIEW

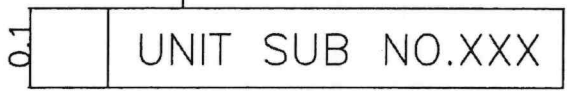
LV. COMPARTMENT FRONT VIEW

① HIGH--VOLTAGE COMPARTMENT
② TRANSFORMER COMPARTMENT
③ LOW--VOLTAGE COMPARTMENT



รายละเอียดป้ายเตือน

ป้ายเตือนทำจาก วัสดุสแตนเลสเกรด 304 หนา 2 มิลลิเมตร พื้นสีดำกัดด้วยกรด



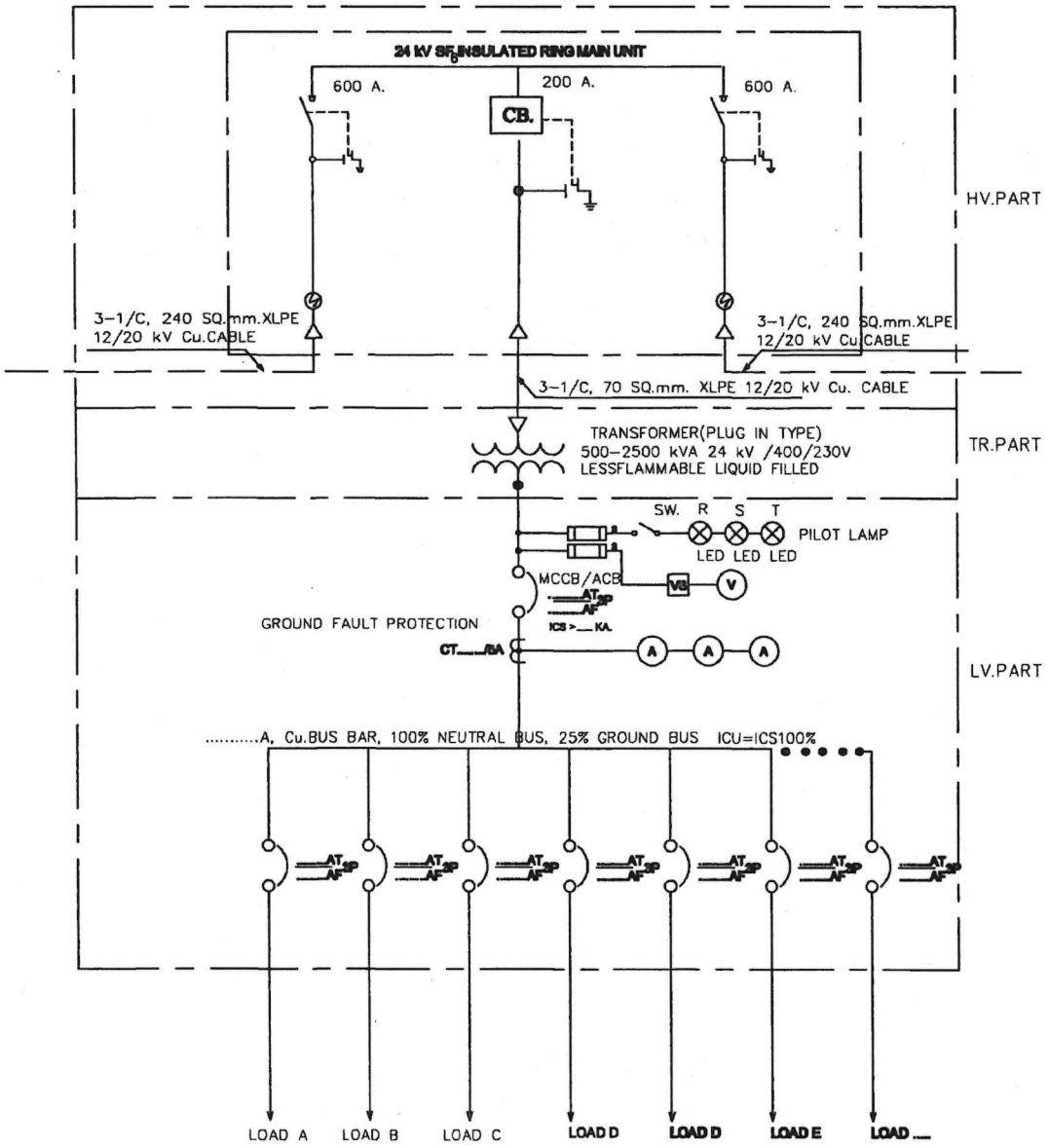
DIMENSION

DIMENSION FOR UNIT SUBSTATION		
ITEM	MAX. (DIMENSION)	REMARK
A	900 mm.	
B	2050 mm.	
C	2420 mm.	
D	3480 mm.	
E	2950 mm.	

NOTE

1. THIS DRAWING SHALL BE GUIDLINE ONLY. THE UNIT SUBSTATION DIFFERING FROM THE DRAWING SHALL PROPOSED FOR MEA's APPROVAL.
2. THE NAME PLATE FOR EACH COMPARTMENT SHALL BE PROVIDE.
3. MFA (Maximum Flooding Allowed)
4. THE DRAWING FOR FOUNDATION SHALL BE SUBMIT WITH TENDER.
5. THE DIMENSION ARE IN METER.
6. THE DIMENSION OF UNIT SUBSTATION SHALL NOT BE LARGER THAN THE LIMITTATION ON EVERY DIMENSION AS SHOWN IN DWG.NO.BQDSPEC105

ครั้งที่	วันที่	รายละเอียดการแก้ไข	ออกแบบ	ตรวจ
การไฟฟ้านครหลวง				
งานบริการลูกค้าแรงสูง 1-3		งานบริการลูกค้า 1	ฝ่ายอุทิศบริการและคุณภาพไฟฟ้า	
เรียน ตรวจ			มาตราส่วน 1:50 A4	
ออกแบบ			วัน 25 / 10 /59	
หัวหน้าแผนก		DIMENSION FOR UNIT SUBSTATION	แผ่นที่ 3ของจำนวน 3แผ่น	
ผู้อำนวยการกอง		1601-2500 kVA	แบบเลขที่ BQDSPEC105	
ผู้อำนวยการฝ่าย				



NOTE

FAULT INDICATOR

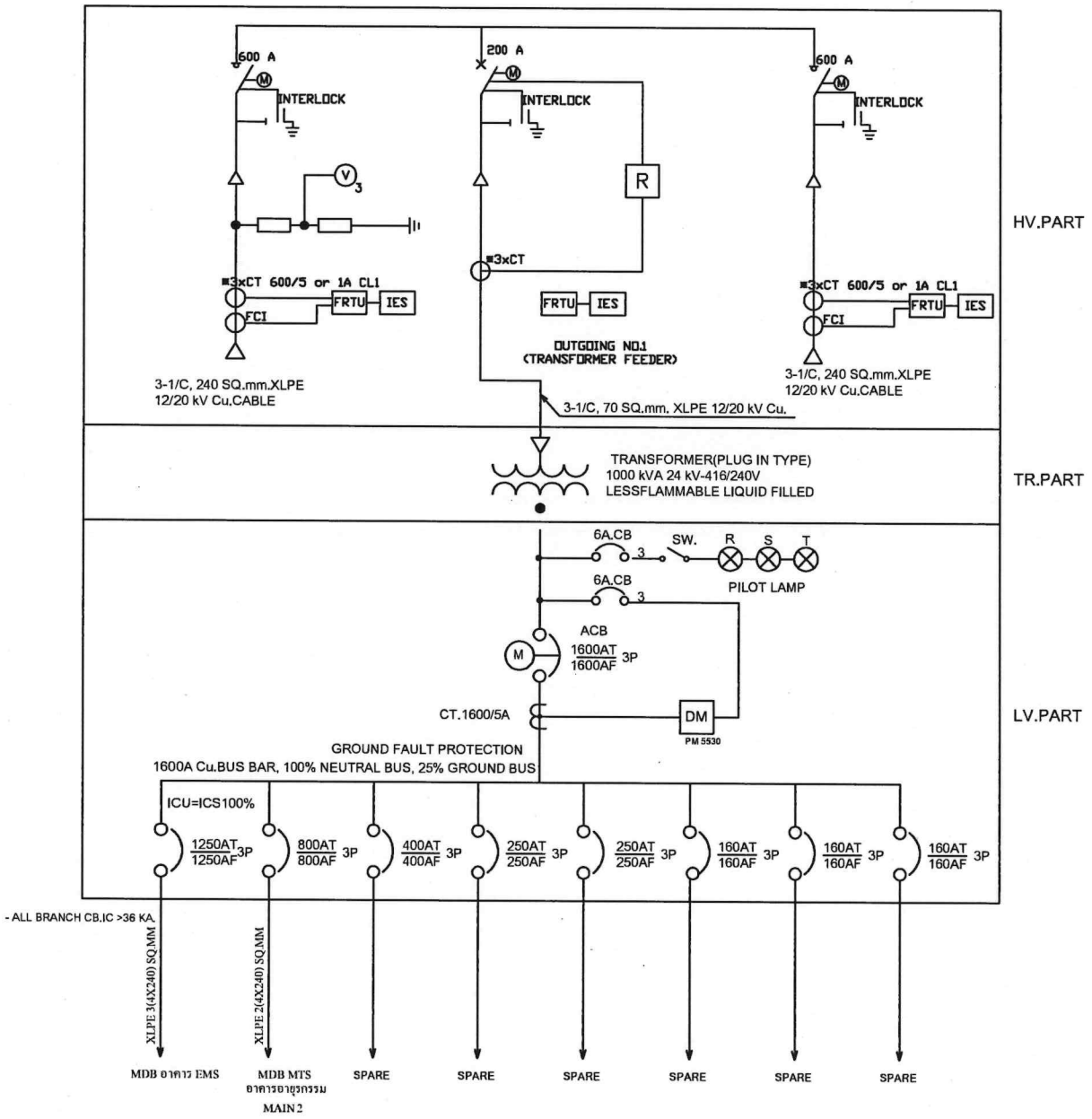
- ALL BRANCH CB.ICS >35 KA. at 400 V.
- EXACT RATINGS AND NUMBER OF LOW VOLTAGE CIRCUIT BREAKER SHALL BE SPECIFIED FOLLOWING CUSTOMER REQUIREMENT.

REV.No.	DESCRIPTION OF REVISIONS	BY	DATE

Metropolitan Electricity Authority
Better Care Service and Power Quality Department

A4

DRN.	SINGLE LINE DIAGRAM FOR UNIT SUBSTATION	SCALE 1:100
CHK.		DATE 20/9/16
ENGR.		DIM. CENTIMETER.
CHF. OF SECT.		SH.No. 1 OF
DIR. OF DIV.		DWG. No. BQDSPEC105
DIR. OF DEPT.		



LEGENDS

- FRTU — FEEDER REMOTE TERMINAL UNIT
- IES — INDUSTRIAL ETHERNET SWITCH
- R — RELAY
- CURRENT TRANSFORMER
- MOTOR DRIVE
- VOLTAGE SENSOR
- FCI — FAULT CURRENT INDICATOR

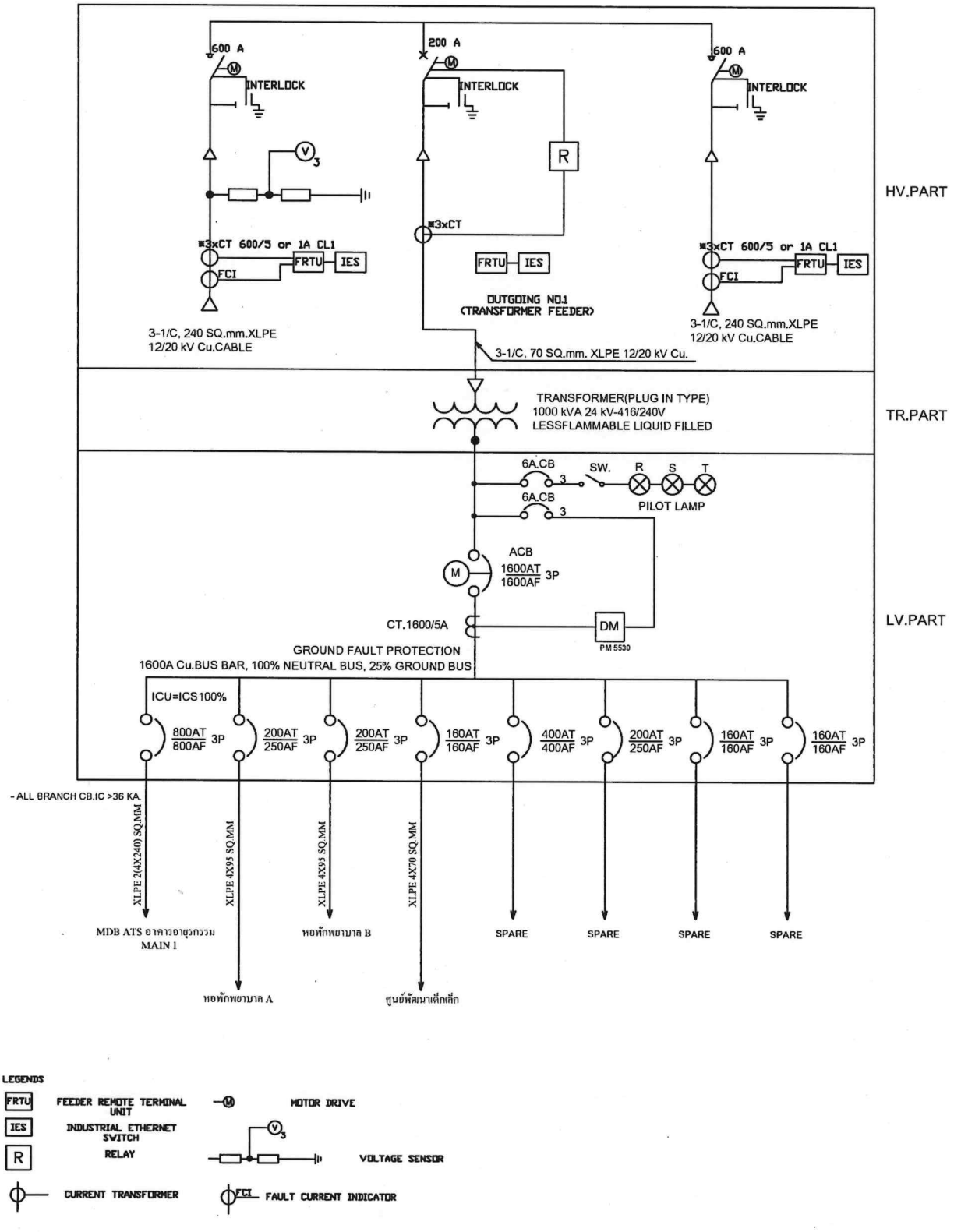
REV.No.	DESCRIPTION OF REVISIONS	BY	DATE

Metropolitan Electricity Authority

Better Care Service and Power Quality Department

A4

DRN.	SINGLE LINE DIAGRAM	SCALE 1:75
CHK.	UNIT SUBSTATION STATION 1000 kVA	DATE 12/12/24
ENGR.	อาคาร EMS โรงพยาบาลราชวิถี	DIM. CENTIMETER.
CHF. OF SECT.		SH.No. 2 OF 2
DIR. OF DIV.		DWG. No.
DIR. OF DEPT.		



LEGENDS

- FRTU — FEEDER REMOTE TERMINAL UNIT
- IES — INDUSTRIAL ETHERNET SWITCH
- R — RELAY
- CURRENT TRANSFORMER
- MOTOR DRIVE
- VOLTAGE SENSOR
- FCI — FAULT CURRENT INDICATOR

REV.No.	DESCRIPTION OF REVISIONS	BY	DATE

Metropolitan Electricity Authority

Better Care Service and Power Quality Department

A4

DRN.	SINGLE LINE DIAGRAM	SCALE 1:75
CHK.	UNIT SUBSTATION STATION 1000 kVA	DATE 12/12/24
ENGR.	อาคาร อายุรกรรม โรงพยาบาลราชวิถี	DIM. CENTIMETER.
CHF. OF SECT.		SH.No. 1 OF 2
DIR. OF DIV.		DWG. No.
DIR. OF DEPT.		

SPECIFICATION NO. 108

12&24 kV SF_6-INSULATED RING MAIN UNIT

108A **Scope**

108A1 This specification describes the requirement which shall be met in order to supply the 12 & 24 kV SF_6-insulated ring main unit to the Metropolitan Electricity Authority (MEA). The equipment shall be connected to 12 or 24 kV 3 phase, 3 wire, solidly grounded neutral system, 50 Hz underground distribution feeders where the maximum fault level is 16 kA and 20 kA for 12 kV system and 8 kA for 24 kV system.

108A2 The following attached drawing No. 920615 is intended to be as guide line only. The single line diagram of other kinds if fulfill the same function and performance of the single line diagram shown in the attached drawing is accepted.

108A3 The following drawings are part of this specification:-

a) Drawing no. 920615 sheet no. 1 of 2	:	Single Line Diagram for Ring Main Unit
b) Drawing No. 920615 sheet no. 2 of 2	:	Single Line Diagram for Ring Main Unit, primary selective and motor operated
c) Drawing No. 000402 sheet no. 2 of 2	:	Single Line Diagram for Ring Main Unit, primary selective and motor operated (DOUBLE CABLE INCOMING)
d) Drawing no. 150512 sheet no. 1 of 1	:	Conceptual design for RMU with DMS system

108B **Site and Service Conditions**

The ring main unit shall be installed in the Bangkok Metropolis, Thailand. The service conditions are as follows:-

a) Installation site : indoor or outdoor with metal enclosure.

b) Altitude : approximately mean sea level.

c) Maximum ambient temperature : 40° C

d) Average ambient temperature in any one year : 30° C

e) Average relative humidity in any one year : 79 %

f) Average maximum relative humidity in any one year : 94 %

The ring main unit shall be suitable for use in tropical climatic area and shall be capable of operating at its full ratings without any derating factors whatsoever in the service conditions mentioned above.

108C **Reference Standard**

Except otherwise specified elsewhere in the specification, the equipments required by MEA shall be manufactured and tested in conformity with the standards listed below:-

International Electrotechnical Commission (IEC) :

IEC 62271-200(2003) : AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV

Note

1. The equipment tested in accordance with the later version of the above standards is also accepted.
2. The equipment tested in accordance with older version (or draft version) of the above standards is also accepted provided that the test is conformed to standard and year mentioned above.
3. The equipment complies to other national standards having similar characteristics and providing equal performance and/or quality to that specified may be proposed. In this case the complete ENGLISH language copies of the standards shall be submitted with the quotation, otherwise such offer may not be considered.

If there are any minor parts deviated from the standards, they shall be clearly mentioned in the "DEVIATION FROM MEA'S SPECIFICATION FORM" attached herewith.

108E **Test, Inspection and Test report**

108E1 The proposed ring main unit shall have successfully passed at least the following tests:-

Complete switchgear

- Dielectric tests.
- Temperature rise test and measurement of the resistance of circuits.
- Short time withstand current and peak withstand current tests.
- Internal arc test. Ring main unit shall pass all the type tests including internal arc test according to IEC publication 62271-200 annex A with at least IAC AFL classified. The internal arc test shall be performed by KEMA (Netherlands), HVPL (Japan), CERDA (France), CESI (Italy), Intertek ASTA

(UK), PEHLA (Germany), FGH (Germany), COFRAC/EDF (France), VOLTA (France), SATS (Norway) or test station which is member of STL. The initiate arc shall be at least in switch compartment (SF_6 compartment) and cable compartment (incoming feeder).

For those who have already supplied ring main unit to MEA and do not have internal arc test in cable compartment, the test shall be done and submitted before delivery.

Switching device

- Verification of making and breaking capacities for load break switch, circuit breaker, combination fuse and switch.

Note MEA will accept the deviation of the proposed ring main unit compared to the submitted test report on the following conditions:-

a) Number of incoming and outgoing is different i.e. 2 in 1 out and 2 in 2 out etc.

b) The transformer outgoing feeder is difference i.e. circuit breaker and fuse-switch. In this case additional test for circuit breaker or (fuse-switch) making and breaking capacity shall be done.

c) For internal arc test, the tested unit shall be the standard 2 in 1 out type and the outgoing can be fuse-switch or circuit breaker.

Except otherwise specified elsewhere in the specification, all test reports shall be attached to the bid, otherwise MEA will not consider such offer.

The proposed RMU, which has been already supplied to MEA and has been accepted all above test report by MEA, is not required to submit the type test report with the proposal provided that it is the same type, same electrical rating and same manufacturer.

108E2 Routine test as stated in the relevant reference standards shall be performed for each individual equipment. If any tests require agreement between the purchaser and the manufacturer, the test method shall be proposed by the manufacturer and approved by MEA before such tests can be proceeded.

108E3 MEA reserves the right to send representatives at his expense to inspect and witness tests of the material and equipment during manufacturing, at the time of shipment or at any time he deems necessary. The supplier shall provide free access to the facilities where the equipment are being manufactured and shall

satisfy the representatives that the material and equipment are in accordance with this specification and the purchase contract.

108E4 Prior to shipment of the material and/or equipment from the factory, the supplier shall submit to MEA the complete and certified reports of all tests made in 6 (six) copies. The test report shall contain all data required for their complete understanding such as; diagrams, methods, instruments, constants and values used in the tests and the results obtained. If MEA has his own inspector, the supplier shall submit all the above test reports to the inspector and the inspector himself shall certify and/or review those test reports and submit to MEA.

108F **Drawings and Instructions**.

108F1 Four copies each of the following items must be attached with the bid:-

a) Catalogue of all supplied equipment showing specifications and operating characteristics.

b) Preliminary drawings showing the details of equipment layout, equipment grounding, details of cable entries and method of anchorage the ring main unit.

c) Other documents as required in the specification.

108F2 Supplier shall furnish 6 (six) copies each of the drawings listed below for approval by MEA within 30 (thirty) days after the effective date of contract. Generally, if no more details are required, they will be returned to the supplier within 45 (forty-five) days after receipt by MEA. If the drawings for approval are not submitted within the time mentioned above or the drawings are incomplete and MEA has to request for additional information, supplier can not regard the lost time as an excuse for extending the delivery time without penalty.

a) Single line diagram.

b) Complete arrangement drawings showing the details of equipment layout, equipment grounding and dimensions, details of cable entries.

c) Complete assembly drawings of all equipment.

d) Complete foundation details.

e) All nameplates and rating plate drawings.

f) Detailed drawings, specifications and operating characteristics of all equipment to be supplied.

g) Complete internal connection and elementary diagram of all control,

monitoring and supervising circuits (AC schematic) of every equipment.

h) Complete interlocking diagram.

i) All other drawings considered necessary for the successful installation, operating and maintenance of the equipment.

108F3 Supplier shall submit the following drawings and documents, according to the quantity stated below, at least 30 (thirty) days prior to the first shipment of the equipment.

a) 6 (six) copies and 1 (one) transparent reproducible copy of final certified copies of all drawings listed in clause 108F2.

b) 6 (six) copies of complete installation, operating and maintenance instructions of all equipment.

c) 6 (six) copies and 1 (one) transparent reproducible copy of complete part lists of each equipment.

108F4 In addition to the above, four complete sets of installation and operating instructions shall be attached with the equipment at the time of delivery. The precaution notes shall be attached to each set of the equipment.

108F5 All drawings except standard shop drawings, characteristic curves and installation instructions shall have the contract number marked thereon.

108F6 All drawings and instructions shall be in ENGLISH. Information on drawing shall be engineering lettering. Instruction manuals shall be machine printed or typed.

108F7 All drawings shall be provided with both horizontal and vertical zone markings on the frames of the drawings for the sake of quick reference when locating some particular position on them. The zone markings on the horizontal frame are preferred to be numbers and those on the vertical frame are preferred to be alphabets. The zone identification on the drawings shall then, for example, be A5, D7 etc.

108F8 All measurements and quantities shall be expressed in the units of METRIC SYSTEM. If they are expressed in other system, the metric equivalent shall also be shown.

108G **Ratings and Features**

The ring main unit shall have the following ratings:-

Rated voltage	24 kV	12 kV
Rated impulse withstand voltage	125 kV	95 kV
Rated power frequency withstand voltage	50 kV	28 kV
Rated normal current, cable feeder	600 A	
Rated normal current, transformer feeder	as indicated in Description of Supplies	
Rated short time current (1 sec)	as indicated in Description of Supplies	
Rated short circuit making current	2.5 time of rated short time current	

108H **Construction of Ring Main Unit**

108H1 The ring main unit shall be self-supported, floor mounted type.

108H2 The ring main unit shall be metal-enclosed type hermetically sealed in SF_6-filled container and completely independent from atmospheric influence. All high voltage live parts except fuse compartment shall be enclosed to meet IP 65 protection class. SF_6 gas shall be used as insulating medium and interrupting medium, however circuit breaker can be either SF_6 or vacuum interrupter. Solid insulated plug-in busbars is acceptable for extendable type SF_6 insulated ring main unit.

All cables shall be connected to ring main unit in the front of switchgear in cable compartment with the separated front panel covers.

108H3 All metal surfaces shall be treated to protect against corrosion and finished with final coat of top quality paint in light grey or factory standard color. The painting process shall be described in the bid.

108H4 The switch container shall be gastight and shall be strong enough to withstand internal pressure and mechanical loads even in extreme condition or rough transport and handling.

108H5 The switch for cable feeder shall be on load type. Unless other specified, the mechanism shall be spring-charge manual-operated with mechanical switch position indicator. The switch for cable feeder shall have provisions for remote on-off operation in the future. The method of remote on-off operation shall be attached for consideration.

For ring main unit with motor operated at cable feeder switch (as specified in description of supply), additional control switch for operating switch shall be provided on the front panel of ring main unit and power supply for motor shall be 230 Vac. Except for motor for DMS system shall be 24 Vdc.

The earthing switch shall have mechanical position indicator and shall have rated short circuit making current of not less than the value specified in clause 108G.

108H6 The transformer feeder using circuit breaker, or switch with fuses shall be suitable for short circuit of the three phase transformer 12/24 kV delta to 416Y/240 V.

108H7 All of the following feature are required for fuse protection:-

a) The mechanism shall have stored energy to open the switch when any of the fuses blow. The mechanism shall be used in order that the opening operation is always prepared for fuse tripping when the switch is closing in. The mechanism shall be of the type which requires no lubrication.

b) The fuse compartment shall be enclosed to meet at least IP40 protection class and suitable for the DIN standard fuse.

c) Fuse shall be HRC fuse under DIN standard, suitable for interruption fault at both 12 and 24 kV and having not so high switching voltage to damage 12 kV transformer, and equipped with striker pin for three phase tripping. The dimensions of fuses shall comply with standard DIN 43.625 having the length of 442 mm.

d) The fuse compartment cover shall be interlocked in such a way that it can not be opened unless the transformer feeder switch has already been opened and the associated earthing switch closed.

e) On-load switch with fuses shall meet the requirements in test duty No. 4 of IEC 60420.

f) On-load switch with fuses shall be able to break transfer current according to IEC 62271-105(2002).

g) The fuse to be supplied shall be suitable to protect the 12 kV transformer.

h) Fuse selecting table shall be provided and sticked to the front of ring main unit. The table shall show fuse ratings suitable for each size of protected transformer.

i) The design of externally mounted fuses on ring main unit attached to the bushing in the cable compartment directly without fuse compartment is not acceptable.

108H8 For the ring main unit that transformer feeder(s) using circuit breaker the protection circuit shall meet the following functions:-

a) The protective relay shall require no auxiliary power source.

b) The protective relay employed shall be coordinated with the down stream fast-acting LV circuit breaker(s) and also with the upstream protection relay in substation.

c) The protective relay shall have the following functions:-

c1) Instantaneous phase and earth fault overcurrent.

c2) Time delay phase and earth fault overcurrent.

c3) The instantaneous tripping (for both phase and earth fault) shall be not more than 1,200 A.

MEA reserves the right to specify the capacity of the transformer to be protected for each ring main unit i.e. the range of capacity of transformer shall be submitted for approval.

108H9 The following interlocks and padlocks are required.

a) The ring main unit for primary selective cable feeder shall have mechanical interlock and key interlock so that only one cable feeder switch can be closed at a time, the other ring main unit shall be prepared to have such interlock in the future. In case the switch is motor operated, Electrical interlock of the same function shall also be supplied.

b) The cable feeder switches and associated earthing switches, the transformer feeder switch and associated earthing switch shall have mechanical interlock so that the operator cannot close and earth at the same time.

c) The earthing switch and associated cable compartment opening cover shall have mechanical interlock so that the operator cannot open the cover unless the earthing switch is closed.

d) Padlock for each load break switch and earthing switch to enable locking in either "open" or "closed" position.

e) Necessary interlocks and padlocks for personnel safety and prevent misoperation.

108H10 The cable feeder will be connected to 12/20 kV single core copper cable of 400 mm^2, 240 mm^2 or 70 mm^2 and the current rating of the cable connector system shall be 600 A.

The transformer feeder(s) shall be connected to 70 or 240 mm^2 single core cable only.

Cable connectors for all feeders shall be supplied. The number and size shall be according to those specified in description of supply in price proposal.

All parts required for cable connection shall be furnished. Cable connections of the ring main unit shall meet the following requirements:-

a) Having cable compartment for personal safety and being free from vermin by installation of bottom plate and cable glands. The cable connection shall be touchable type. The cable compartment shall be arranged so that access to cable can be from the front only. Cable connection from the side of ring main unit is not acceptable.

b) Be disconnected and then reconnected without damaging any part of the connection systems, compatible with EN 50181 standard. The connectors for cable feeder shall be bolt-on type only.

c) Being suitable for 12/20 kV copper cable, cross-linked polyethylene insulated, copper wire screen and PE jacketed having the size and dimension as shown below.

Size (mm^2)	400 mm^2	240 mm^2	70 mm^2
Conductor diameter (mm)	23.16-23.62	18.29-18.65	9.63-9.83
Dia. Over insulation (mm)	35.4-38.9	30.5-33.4	21.7-23.9
Overall diameter (mm)	44.5-48.0	39.7-42.2	28.0-30.0

108H11 The ring main unit shall be furnished as the follows:-

a) Fault indicator(s) with automatic indication resetting on each phase of the incoming feeders. The recommended trip current shall be proposed for approval. The fault indicator shall prevent false tripping due to inrush conditions caused by operation of substation breakers. The position of the indicator(s) shall be shown at the front of the ring main unit.

In addition, each fault indicator(s) for DMS system shall be provided at least 1 (one) auxiliary contact or provided Modbus/RS485 for connecting with FRTU.

b) Facilities to make applied voltage test at the cable feeders.

c) Facilities to check whether the gas container is suitable for operation and interruption or not. If liquid-filled pressure gauge is supplied, it shall be of the type with pressure compensation film for installation in high temperature transformer room or equal.

For DMS system, the facilities to check SF_6 gas container shall be pressure gauge. Each pressure gauge shall be provided at least 1 (one) auxiliary contact or provided Modbus/RS485 for connecting with FRTU.

108H12 Each phase of cable feeder shall be provided with voltage indicating lamps to indicate whether it is live or dead.

108H13 The minimum of two earthing points shall be provided for each ring main unit. All parts shall be earthed to these points. The earthing points shall be made of non-corrosive material throughout, such as stainless steel.

108H14 The ring main unit shall be provided with suitable lifting facilities.

108I Specific Requirement for Automatic Transfer Function (ATF) (If specified)

108I1 Two types of automatic transfer function are defined as follows:-

Type ATF-I

Type ATF-II

The type of ATF shall be as specified in the description of supplied. Guarantee period of automatic transfer function shall not be less than 2 (two) years.

108I2 Specific requirement for ATF-I automatic transfer function shall be as follows:-

a) The automatic transfer function shall automatically transfer load from unhealthy feeder to healthy feeder with time delay adjustable between 1 - 5 seconds. Loss of voltage shall be detected from one of any three phases. Adjustable delay time means delay time only not including operating time of switch.

ATF shall have no preferred feeder switching position.

b) Facilities for manual operation (both mechanical and electrical operation) in case of the automatic transfer system fails to function shall be provided.

c) The automatic transfer function shall be blocked when the fault occurs at load side.

d) The auxiliary power supply for control circuit, motor for spring-charged mechanism of load break switch shall be 230 Vac 50 Hz single phase from MEA's secondary system. Other facilities for convert power supply to suit above equipment shall be provided.

In case an uninterruptible power supply(UPS) is required as specified in price proposal, UPS shall meet the following requirement:-

- UPS type : voltage and frequency independent (on line).
- UPS rating : not less than 1,000 VA, 50 Hz.
- Output wave form : sine wave, 230 Vac ± 2%.
- Output harmonic distortion : < 3% for linear load
- Back up time at full load not less than 5 minutes.
- Battery type : sealed lead acid maintenance free.

e) The alarm indicator and alarm contact used for AC. power supply loss indication and signal shall be provided.

f) All wiring between the ring main unit and ATF control circuit shall be completed from the factory. Terminal blocks shall be provided for these wirings. Wiring diagram for ATF control circuit shall be provided at ring main unit.

g) Automatic transfer control circuit shall be provided in the control box with the following switches and indicators at the front of control box:-

g1) 3 position selector switch OFF / MANUAL / AUTO.

OFF – switch off all auxiliary power for motor control circuit.

MANUAL – disable automatic transfer function.

AUTO – enable automatic transfer function

g2) ON / OFF push button switch for each incoming feeder. (Manual mode only).

g3) Switch position indicator for each incoming feeder [OPEN(green) and CLOSE(red)].

h) The automatic transfer function having different characteristics from above requirement may be proposed but subjected to MEA's approval.

108I3 ATF-II automatic transfer function shall be the same as ATF-I except the following:-

a) The mechanism shall automatically transfer load from preferred feeder to an emergency feeder having time delay adjustable between 0.1-5.0 seconds when the loss in any phase of the preferred feeder voltage occurs. It shall return the load to the preferred having time delay adjustable between 5-120 seconds when the voltage in all phases is restored.

b) There shall be no interruption of supply or voltage down event when the switch return the load to the preferred feeder (by closing the preferred feeder switch before emergency feeder switch is opened).

c) The auxiliary power supply for control circuit, motor for spring-charged mechanism of load break switch shall be 230 Vac 50 Hz single phase from MEA's secondary system. Other facilities for convert power supply to suit above equipment shall be provided. The UPS as specified in clause 108I2 d) shall be supplied with every ring main unit.

d) The preferred line shall be selectable from either feeders.

e) The automatic transfer function shall be blocked when the fault occurs at load side or the emergency feeder voltage is absent.

108J **General Requirements**

108J1 Sufficient SF_6 gas, all cable sealing end materials and other materials required for installation and initial operation of the ring main unit shall be furnished and delivered at the same time as the ring main unit.

108J2 All special tools and accessories required for the installation, normal operation, maintenance and if necessary, functional testing of equipment shall be furnished and shall be quoted as schedule in the Description of Supplies.

108J3 The ring main unit may be installed outdoors in metal enclosure exposed to direct sunlight. Protective relays provided shall be of the type suitable for such installation.

108J4 Maximum dimensions and weight of the ring main unit shall be as follows:-

Dimension and weight for RMU including motor operating mechanism

type	width (mm)	depth* (mm)	height (mm)	Weight* (kg)
2 IN, 1 FUSE	1220	850	1760	370
2 IN, 2 FUSE	1700	850	1760	485
2 IN 1 CB (200 A)	1220	850	1760	565
2 IN 2 CB (200 A)	1700	850	1760	565
2 IN 1 CB (400 A)	1220	850	2100	565
2 IN 2 CB (400 A)	1700	850	2100	875

Note * For double cable termination, the depth and weight of RMU can be more than those specified in the table.

Dimension and weight for RMU excluding motor operating mechanism

Type	width (mm)	depth (mm)	height (mm)	weight (kg)
2 IN, 1 FUSE	1220	850	1760	350
2 IN, 2 FUSE	1700	850	1760	470
2 IN 1 CB (200 A)	1220	850	1760	550
2 IN 2 CB (200 A)	1700	850	1760	550
2 IN 1 CB (400 A)	1220	850	2000	550
2 IN 2 CB (400 A)	1700	850	2000	860

Dimension for RMU with Automatic Transfer function

type	width (mm)	depth (mm)	height (mm)
2 IN 1 CB (200 A, 400 A)	2000	1100	2000

108J5 Nameplate shall contain all essential information including the corresponding purchase contract number.

108K **Additional Requirement for Packing**

If any parts are packed in the cartons for containerized shipment, the cartons shall be arranged into pallets so as to facilitate their movement by forklift trucks.

108L **Additional Requirement for Responsibility**

If any ring main unit is damaged within the guaranteed period, the manufacturer shall promptly investigate, repair or replace it. The replacement shall reach MEA within 180 days after being first informed otherwise the performance security shall be forfeited.

108M **Additional Requirement for Outdoor Type Enclosure (For Ring Main Unit with Outdoor Enclosure) (If required)**

108M1 The ring main unit shall be totally installed in the enclosure, the enclosure shall be designed such that MEA can lift the total unit (ring main unit and enclosure) without deformation i.e. the outdoor enclosure shall be provided with suitable base frame, lifting facilities and fastening means for fastening the unit to platform or foundation. Degree of protection for the enclosure shall not be less than IP54. The RMU shall be factory assembled in the enclosure. All parts and any necessary installation materials shall be completely furnished.

108M2 The enclosure shall be made of galvanized steel or equal. The thickness shall be not less than 2.5 mm for rear, side and door, 3 mm for main frame and 4 mm for foundation frame. The structure of enclosure shall be strong enough to support the gross weight of all equipment. All metallic parts shall be grounded.

108M3 The enclosure shall be provided with suitable base frame for fixing RMU.

108M4 The roof of the enclosure shall be inclined to drain the rain to the front of enclosure and shall be removable type.

108M5 All metal surface shall be treated to protect them against corrosion and finished with final coat of top quality paint in light grey RAL 9002 or equivalent. The painting process shall be described in the bid. The manufacturer shall be able to prove that the selected process can protect the surface against corrosion when exposed to humid, polluted big city sea coast atmosphere. It shall also possess excellent surface adhesion and reasonably immune to abrasion and external impact.

108M6 The enclosure shall be provided with warning sign according to figure 1 at the front door.

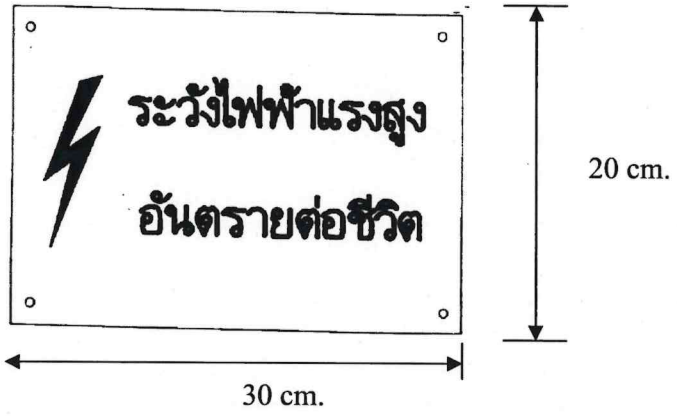


Figure 1

108M7 The enclosure shall be supplied with master key for all doors and all supplied enclosures. Preferable to be the same as previously supplied.

108M8 The earthing point shall be provided and shall be made of non-corrosive material.

108M9 Cable glands or equivalent shall be furnished at every cable entries so that the dust protected and vermin proof properties of the enclosure can be retained.

108N **Additional Requirement for ring main unit with DMS system**

The additional accessories shall be supplied as the followings:-

a) Voltage sensor shall be provided for each phase of the incoming feeder and shall be able to send the voltage value to the FRTU. Voltage sensor shall be resistive type with 1% accuracy or better according to IEC 61869-7. Voltage sensor shall be installed with bolt-on type cable connector only; otherwise such offer shall not be considered.

b) Current transformer according to IEC 61869-2 or current sensor according to IEC 61869-8 shall be provided for each phase of the incoming and outgoing feeder and shall be able to send the current value to the FRTU. The accuracy shall be 1% or better.

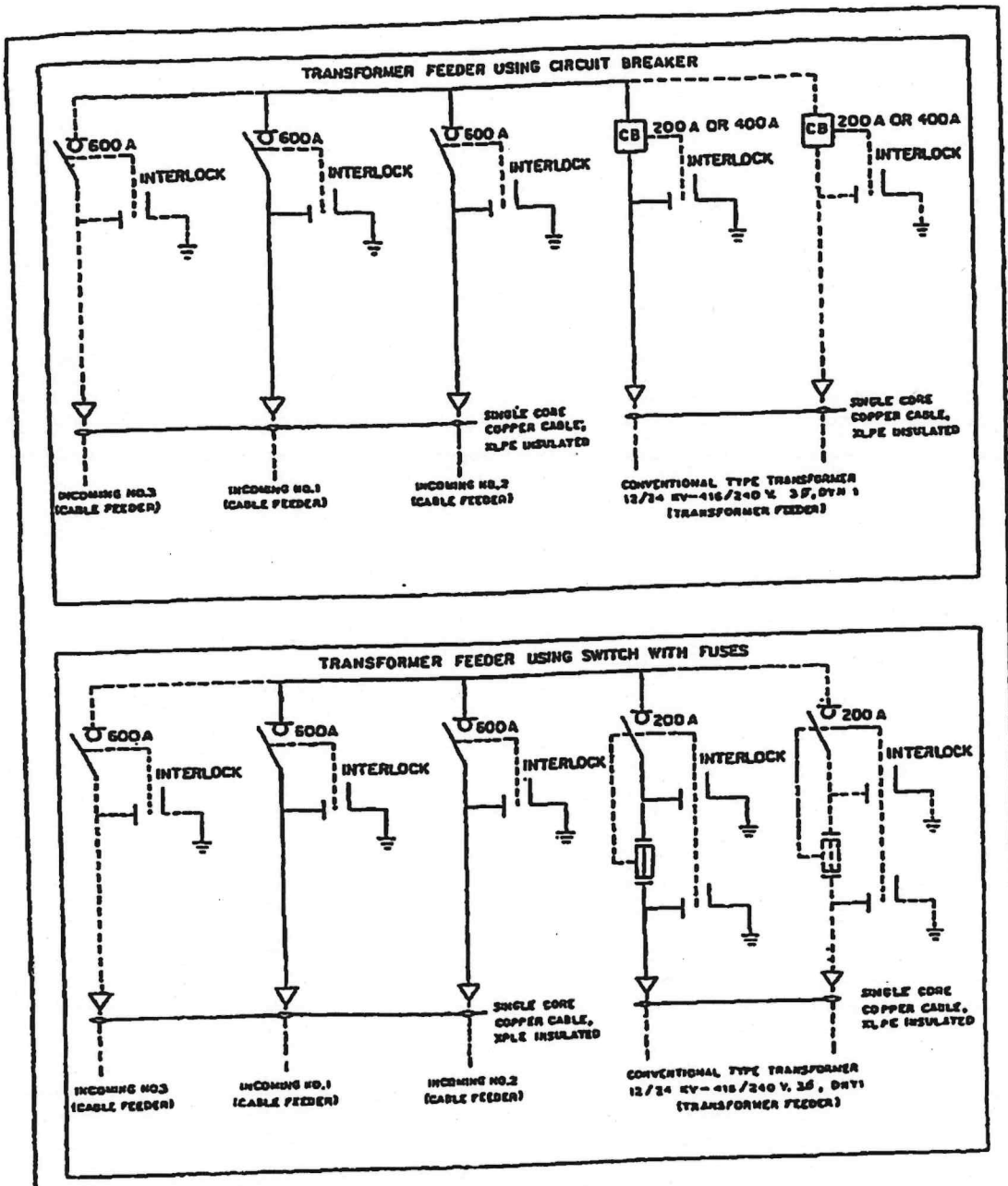
c) UPS shall be provided and shall meet the minimum following requirement:-

- UPS type : DC UPS.
- Voltage input/output : 230 Vac/24 Vdc.
- Current output : 20 A or better.
- Back up time at full load : not less than 5 minutes.

- Back up time at partial load (100 VA) : not less than 2 hours.
- Battery type : Lithium-ion or Ni-MH with at least 2 years service life at 50°C. The battery charger shall be suitable for each type of battery and help extend battery service life.
- UPS shall be able to send alarm signal to FRTU when battery nears end it of life.

d) Feeder remote terminal unit (FRTU) (see FRTU specification).

All accessories and wiring shall be completed from the factory except the equipment will be installed while terminating cable simultaneously. Terminal blocks shall be provided for these wirings. Wiring diagram shall be provided at ring main unit.



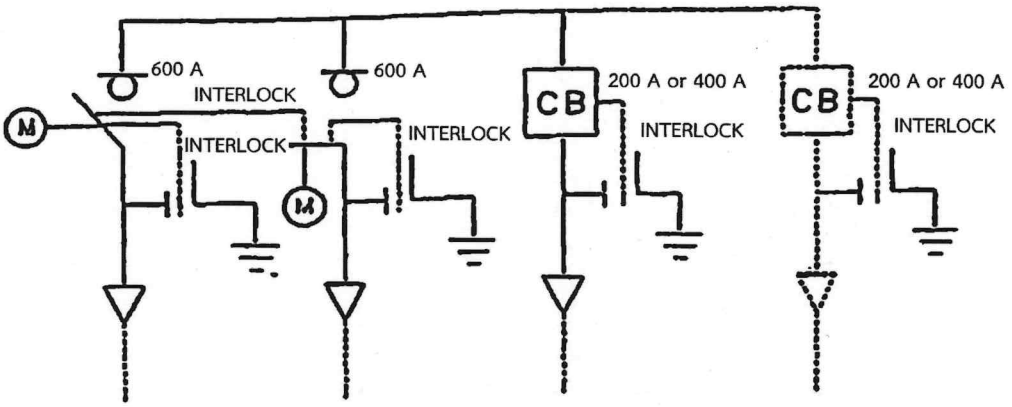
NOTES 1. EXACT NUMBER OF CABLE FEEDER AND TRANSFORMER FEEDER IS INDICATED IN CLAUSE 5.2 PRICE PROPOSALS.

2. RATED CURRENT OF TRANSFORMER FEEDER CIRCUIT BREAKER IS INDICATED IN CLAUSE 5.2;PRICE PROPOSALS.

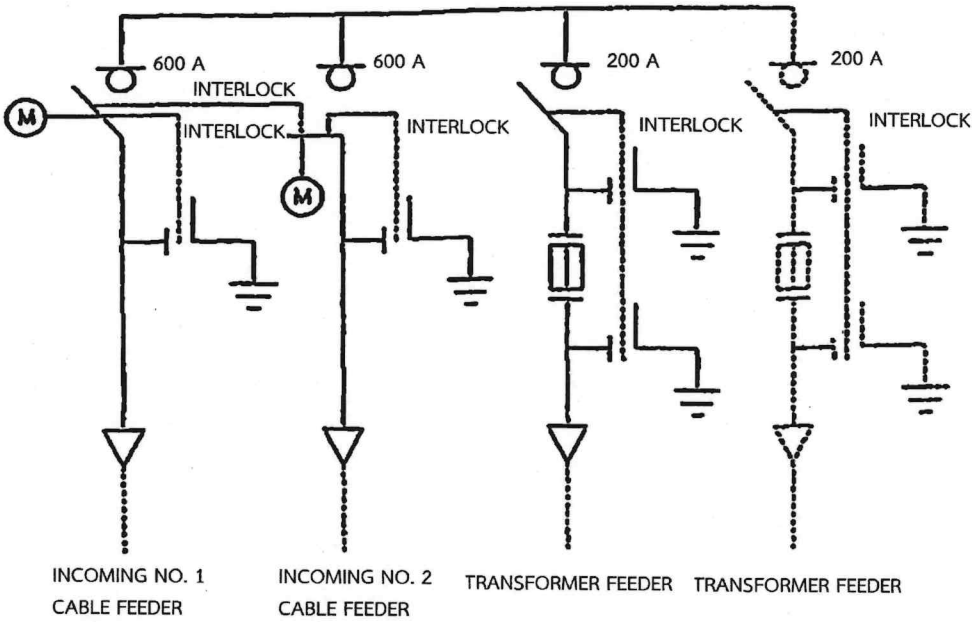
REV. NO.	DESCRIPTION OF REVISIONS	BY	DATE
1	CHANGED CB RATED CURRENT AND ADDED NOTE 2		15/11/36

DR.	CHK.	METROPOLITAN ELECTRICITY AUTHORITY	SCALE
DIV. CHIEF			SUPERSEDING
EXC. MGR.		SINGLE LINE DIAGRAM FOR RING MAIN UNIT	SH. NO. 1 OF 2
DTY. GEN. MGR.			DWG NO. 920615
DATE			

RING MAIN UNIT USE CIRCUIT BREAKER AS TRANSFORMER FEEDER

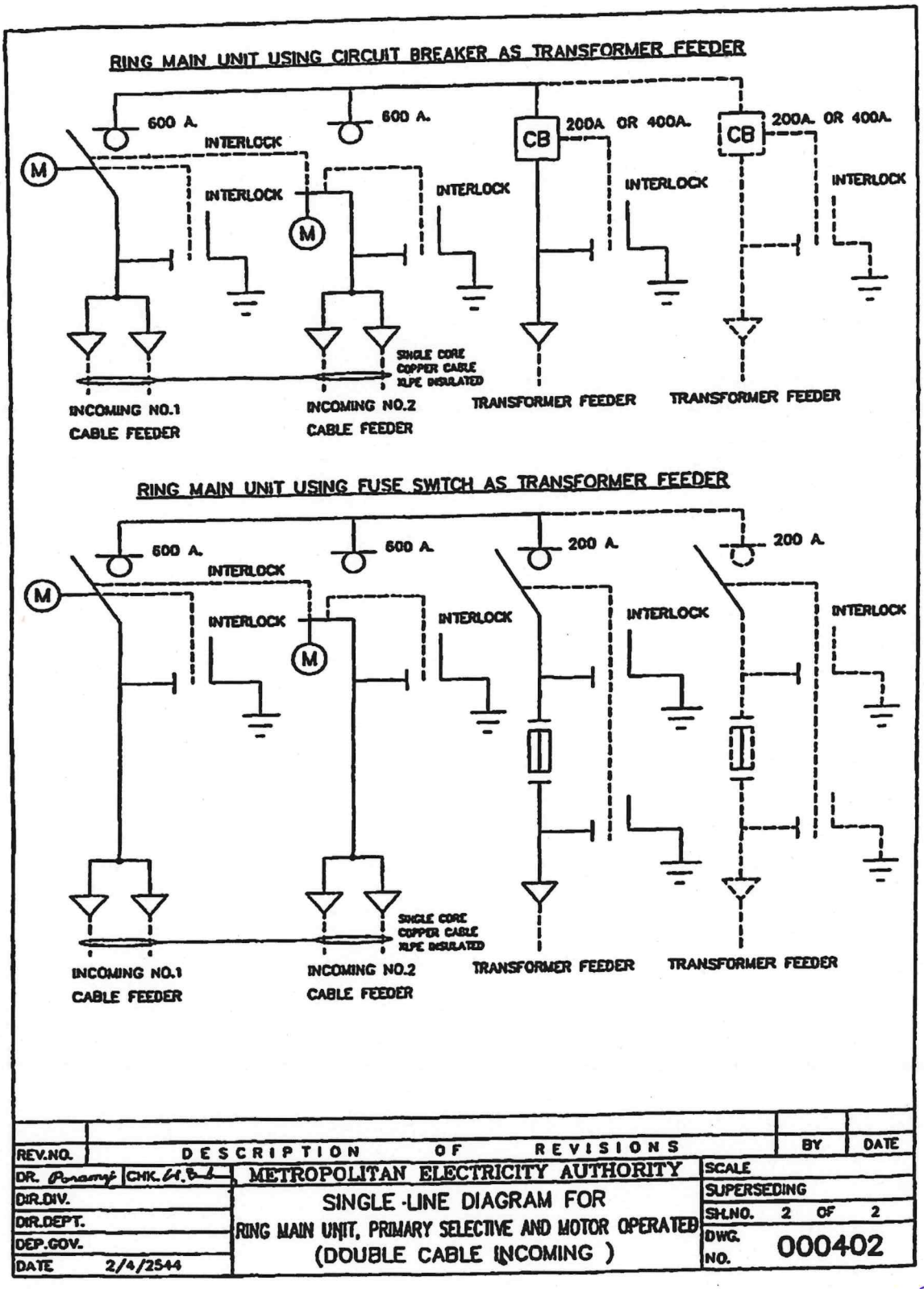


RING MAIN UNIT USE FUSE SWITCH AS TRANSFORMER FEEDER

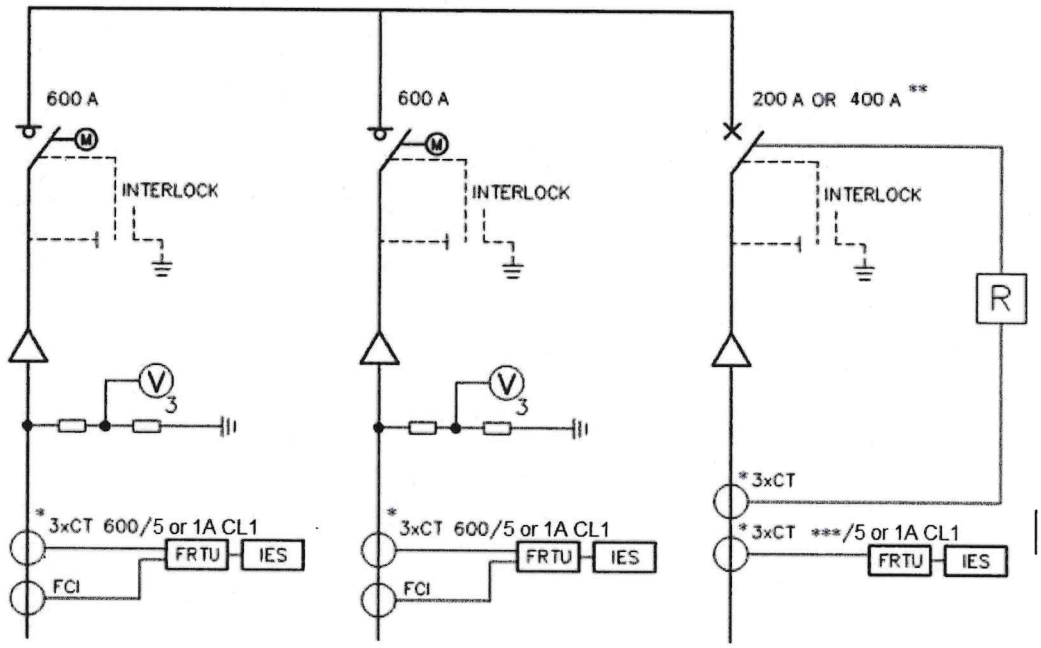


NOTES 1. SIZE OF CABLE AND NUMBER OF TRANSFORMER FEEDER SHALL BE AS SPECIFIED IN DESCRIPTION OF SUPPLIES.
2. RATED CURRENT OF TRANSFORMER FEEDER CIRCUIT BREAKER IS INDICATED IN DESCRIPTION OF SUPPLIES.

REV.NO.	DESCRIPTION OF REVISIONS	BY	DATE
DR. / CHK.	METROPOLITAN ELECTRICITY AUTHORITY	SCALE	NONE
DIR.DIV.	SINGLE LINE DIAGRAM FOR RING MAIN UNIT, PRIMARY SELECTIVE AND MOTOR OPERATED	SUPERSEDING	
DIR.DEPT.		SH.NO.	2 OF 2
DEP.GOV.		DWG. NO.	920615
DATE			


RING MAIN UNIT USING CIRCUIT BREAKER AS TRANSFORMER FEEDER
600 A.
600 A.
CB
200A OR 400A.
CB
200A. OR 400A.
INTERLOCK
INTERLOCK
INTERLOCK
INTERLOCK
INTERLOCK
M
M
SINGLE CORE
COPPER CABLE
XLPE INSULATED
INCOMING NO.1
CABLE FEEDER
INCOMING NO.2
CABLE FEEDER
TRANSFORMER FEEDER
TRANSFORMER FEEDER
RING MAIN UNIT USING FUSE SWITCH AS TRANSFORMER FEEDER
600 A.
600 A.
200 A.
200 A.
INTERLOCK
INTERLOCK
INTERLOCK
INTERLOCK
INTERLOCK
M
M
SINGLE CORE
COPPER CABLE
XLPE INSULATED
INCOMING NO.1
CABLE FEEDER
INCOMING NO.2
CABLE FEEDER
TRANSFORMER FEEDER
TRANSFORMER FEEDER
REV.NO.
DESCRIPTION OF REVISIONS
BY
DATE
DR. Pornsuk
CHK. Wirat
DIR.DIV.
DIR.DEPT.
DEP.GOV.
DATE 2/4/2544
METROPOLITAN ELECTRICITY AUTHORITY
SINGLE-LINE DIAGRAM FOR
RING MAIN UNIT, PRIMARY SELECTIVE AND MOTOR OPERATED
(DOUBLE CABLE INCOMING)
SCALE
SUPERSEDING
SH.NO. 2 OF 2
DWG. NO. 000402

SINGLE LINE DIAGRAM OF RING MAIN UNIT (2 IN – 1 OUT)****



LEGENDS

FRTU	FEEDER REMOTE TERMINAL UNIT	M	MOTOR DRIVE
IES	INDUSTRIAL ETHERNET SWITCH	V3	VOLTAGE SENSOR
R	RELAY	FCI	FAULT CURRENT INDICATOR
	CURRENT TRANSFORMER		

NOTE: * RATED BURDEN SHALL BE SUITABLE FOR ALL CONNECTING DEVICE OR CURRENT SENSORS ARE ALSO ACCEPTABLE.

** DETAILS OF RATED CURRENT (CIRCUIT BREAKER OR SWITCH WITH FUSE) IS INDICATED IN DESCRIPTION OF SUPPLIES.

*** CT RATIO FOR OUTGOING FEEDER SHALL BE SUBMITTED FOR APPROVAL.

**** NUMBER OF INCOMING AND OUTGOING MAY BE DIFFERENT I.E. 2 IN 1 OUT, 2 IN 2 OUT OR 3 IN 1 OUT ETC.

1	Change CT rating	Sompong	7/6/2018
REV.NO	DESCRIPTION OF REVISION	BY	DATE
DR. Ratchakorn / CHK.	METROPOLITAN ELECTRICITY AUTHORTITY	SCALE : -	
DIV.CHIEF	Conceptual design for RMU with DMS system	SUPERSEDING	
EXC.MGR.		SH.NO. 1 of 1	
DTY.GEN.MGR.		DWG. NO.	150512
DATE : 12/05/2015			

Specification
for
Feeder Remote Terminal Unit (FRTU)
in Underground Distribution System

1. General Requirement

The FRTUs shall behave IED (Intelligent Electronic Device) for distribution automation, which is a fully digitalized and microprocessor-based control device. Basic functions of the FRTUs are controlling of RMU (Ring Main Units), status monitoring, and measuring of electric values. All these functions are performed from remote Distribution Management System (DMS) control center through communication.

The FRTUs shall acquire inputs from and issue output (control) commands to power system devices located on MEA's RMUs. Analog input, status input, and control output interfaces shall be provided, where the primary application is DMS control of the LBSs to be provided by others. In this regard, there shall be one FRTU per RMU, such that the FRTU can be used to open and close the switch as well as monitor LBS analog and status signals representing the condition of the RMU and the primary power system. The FRTU input and output signals shall be wired to the terminal blocks and completely installed within RMU.

The FRTU must be of the latest, state-of-the-art design and microprocessor-based with at least 16 (sixteen) bits addressing and 16 (sixteen) bits data capability. It shall be possible to conduct all the routine FRTU management functions remotely from the master station; visits to the FRTU site shall be required only for hardware reconfiguration, upgrade and expansion, and for repair. It shall be possible to remotely run diagnostics, and download operational parameters, such as analog reporting deadbands. It shall also be possible for the master station to upload the configuration parameters of the FRTU and information on its operational status.

The FRTU shall automatically start or restart, without need for human intervention at either the FRTU itself or from the master station, after it is powered up or after a power outage. An appropriate message shall be sent to the master station when the FRTU completes its startup. The reason for the startup shall be indicated in the message.

All FRTUs shall be built of all new material of the best industrial grade. All components shall be of current production from reliable component manufacturers. To facilitate expansion and maintenance, modularity shall be employed in the design of the equipment; all major subassemblies shall carry permanent labels which provide cross reference with the Contractor supplied documentation. Materials that may promote the growth of fungus or are susceptible to corrosion shall not be used.

All equipment shall be designed, manufactured, fabricated, assembled, finished, and documented with workmanship of the highest production quality and shall conform to all applicable quality control standards of the original manufacturer and the Contractor. All goods and materials shall be new, unused, and of the most recent or current model. The FRTUs shall incorporate all recent improvements in design and materials.

The central processing module shall handle all protocol emulation, perform data acquisition, and execute control requests. It shall accept commands from the DMS master station, perform address recognition, assemble response messages in accordance with the received command messages, and transmit these messages to the DMS masterstation. The central processing module shall also provide interfaces for a time standard.

The central processing module shall manage communications between all other functional modules of the FRTU and shall determine the integrity of the FRTU. The processor shall provide diagnostic information in the message structure that the DMS shall monitor. A flag shall be set if the FRTU performs a restart for any reason including power failure.

Each I/O module shall be capable of interfacing with analog inputs, digital inputs, control output points, and combinations of point types. I/O modules shall be replaceable without reprogramming, redefinition of configuration parameters, or rewiring.

The FRTU shall have an internal clock for data collection coordination and time tagging. This shall include support for feeder fault detection and disturbance data reporting. The resolution of internalshall be 1 (one) millisecond or better, and the clock shall drift by no more than 250 (two-hundred fifty) milliseconds per day. In addition, the FRTU internal clock time shall be maintained within 10 (ten) millisecond. The FRTU shall be able to synchronize its internal clock with the DMS master station.

The FRTUs shall be designed to prevent false control actions from being executed and erroneous data from being transmitted due to communication channel errors.This shall include error control to ensure that the probability of undetected bit errors is no greater than $10^{-10}$for data and $10^{-14}$for control when the channel is operating within the limits of less than or equal to 1 (one) bit error in 10^4 bits.

In addition, the FRTUs shall incorporate the following fail-safe design criteria in their control output logic:

1. No false output shall result from a single point of failure in any FRTU
2. No false output shall result during power up or power down of the FRTUs.
3. No false output shall result from inadvertently inserting a circuit card into a wrong slot within the FRTUs.

MEA prefer FRTU designs that do not require periodic preventive maintenance and inspections. If periodic maintenance is required, it shall be possible to perform all such work in the field without dismounting the FRTUs and without requiring that the associated medium or high voltage circuit be de-energized.

The electrical and electronic components of the FRTUs shall satisfy the requirements for insulation, isolation, and electrical immunity stated in this sub-clause.
The FRTUs shall meet or exceed the requirements contained in Table 1.

Table 1: MINIMUM INSULATION REQUIREMENTS

Characteristics	Exposed Equipment Terminals	Controlled Exposure Equipment Terminals	Non Exposed Equipment Terminals
Rated Insulation Voltage	500 V	63 V	As Required
Dielectric Test Voltage (IEC 60255-27)	2.0 kV rms	1 kV rms	As Required
Dielectric Test Voltage between Open Contacts (IEC 60255-27)	1.0 kV rms	0.5 kV rms	-
Insulation Resistance Test	Required	Required	-
Impulse Voltage Test (IEC 60255-27)	5 kV 1.2/50µs	1 kV 1.2/50µs	-

Exposed equipment terminals shall be intrinsically designed to meet the insulation requirements.

All FRTU electronic equipment shall meet the requirements for immunity from electrical disturbances according to IEC 60255-22-1, test severity levels shown in Table 2, at all terminals, including data ports that will have permanent connections in service. This requirement does not apply to those terminals used for interconnecting modules located in the same metallic cabinet or housing.

Table 2: Test voltages for the Equipment Under Test (EUT) ports

Port under test	Test voltage (kV peak ±10%) Oscillation frequency 1 MHz	
	Common mode test	Differential mode test
Auxiliary power supply	2.5	1
Input and output [a)]	2.5	1
Communication	1	0
Functional earth	0	0
[a)] In more severe environments, a differential test voltage of 2.5 kV may be required for current and voltage transformer inputs.		

Immunity from electromagnetic disturbances shall be tested according to IEC 61000-4-4 and IEC 60255-22-3 with test severity Class 3. High data-rate communication ports shall be demonstrated to withstand this test without permanent corruption of data.

Immunity of FRTU electronic equipment from discharges shall be demonstrated by testing according to IEC 60255-22-2 Severity Class 3 (8 kV discharge).

In accordance with the latest version of ANSI/IEEE C37.1, IEC 60255-22-3, or equivalent standard, the operation of the FRTUs shall not be affected by the narrow band radiated fields from portable radio transmitters or digital radio telephones of up to 35 (thirty five) V/m

2. Communication Interfaces

MPLS network shall be used for Master-FRTU communications for most the FRTU sites. MEA will supply and install the Remote Front-Ends and necessary network equipment (such as Industrial Ethernet Switches) at the MEA's districts and the Contractor will supply and install Industrial Ethernet Switches (IES) for each FRTU.

The particular type of FRTUs proposed and supplied by the Contractor shall also be available to support the Digital Trunked Radio Communication Systems or GSM which may be chosen on a case-by-case basis for communications between the master station and the FRTUs. These radio systems may be used for communications with FRTUs which are difficult to access with the Fiber Optic Cables.

The FRTUs shall be provided with multiple ports for data communications with external devices. These ports shall be assignable to different data categories, such as IEDs as well as the DMS, and shall be capable of supporting options for RJ45, RS232 and RS485 interfaces. A minimum of 1 (one) RJ45 port, 2 (two) RS232 ports and 1 (one) RS485 port (option) are required.

Each FRTU shall include at least 1 (one) RJ45 Ethernet port for Industrial Ethernet Switches (IES) and 1 (one) RS232 port for backup communications using digital trunked radio. The port shall include RJ45 Ethernet port interface to the communications equipment. The Contractor shall supply his equipment and all of necessary communication devices for connection with MEA provided fiber optic cable, which shall be connected to the IES and to the FRTU via the RJ45 Ethernet portinterface. Another 1 (one) RS232 port or Ethernet port shall be used as configuration port while 1 (one) RS485 port (option) is reserved for interface with IED.

The communications data rate shall be selectable. Each serial data port shall be individually selectable for operation at 1200 to 19,200 bits per second, and for communications in either synchronous or asynchronous data formats. The ports shall function independently such that the performance of each port shall not be degraded by simultaneous activity on all other ports. As a minimum the following data rates shall be available: 1200, 2400, 4800, 9600, 14,400 and 19,200 bits per second.

The FRTUs shall communicate with their respective DMS master station via MPLS system and DTRS system.

The FRTUs shall communicate with the DMS Master using the protocol IEEE 1815 (DNP3) protocol. Both DNP3 over IP and DNP3 serial shall be supported by the FRTU.

Bidders shall provide the completed IEEE 1815 (DNP3) Device Profile Document and Implementation Table to MEA in the bid proposal.

The IEEE 1815 (DNP3) Subset Level 1 or higher Conformance Certificate shall be submitted to MEA before the equipment have been delivered to MEA. The IEEE 1815 (DNP3) Subset Level 1 or higher Conformance Certificate shall be issued ONLY by the DNP Users Group's Authorized Testing Authorities, i.e.:-

1 **Advanced Control Systems (Georgia, USA)**
2 **Reltronics(CANADA)**
3 **Subnet Solutions (Calgary, CANADA)**
4 **Other authorized testing authorities.**

The additional IEEE 1815 (DNP3) requirements over the Subset Level 1 shall be implemented by the contractor during the project implementation.IEEE 1815 (DNP3) masters and outstations shall implement the authentication mechanism specified in the IEEE 1815 (DNP3) Specification, Volume 2, Supplement 1, Secure Authentication, Version 1.00, dated 3 February 2007.

The contractor shall provide all necessary equipment required to implement an Ethernet Fiber Optic Network for communication between supplied FRTU to MEA's existing DMS Front-End Processor (FEP). The communication between DMS FEP and FRTUs will be either over point-to-point or point-to-multi-point IP-based communication channels. Fiber Optic Industrial Ethernet Switches (IES) shall be provided for each FRTU, and shall be fully compatible and integrated with the MEA's fiber optic cables, MEA's communication topology and MEA's existing IES network and IES Network Management System (IES-NMS). If a Bidder offers to supply the following IES, MEA reserve the right to accept the following IES without performing the compatibility and interoperability test with the existing NMS during the technical evaluation.

1) Siemens RuggedCom (RS900)
2) Moxa (PT500)
3) GE (ML810)
4) Hirschmann (RS20)
5) Kyland (SICOM3000-2S6T-SC40-L2-L2)

The Integration and network expansion of new supplied IES shall not be in anyway, degraded the system performance and functionalities of MEA's existing IES Network and associated IES-NMS. The Integration of new IES into MEA's existing IES network shall be demonstrated as part of the Full Functional Test (FFT).

Addition, Adaption and/or Modification required for MEA's existing IES-NMS shall be responsibility of the contractor.

The IES shall meet the Specification in table 3.

Table 3: Industrial Ethernet Switches Requirements

IES Requirements	
1. Industrial type	IEC 61850, IEEE 1613 and FCC Certified
2. Ethernet switch type	Managed with SNMP supported
3. Ethernet protocol supported	IEEE 802.3 and IEE 802.3u
4. Network operation topology	redundant rings
5. Interface	At least 6 RJ45 & 2 singlemode fiber (ITU G.652 and ITU G.652D)
5.1 RJ45 ports	10/100BaseTX
5.2 Fiber optic port speed	100BaseFX
5.3 Fiber optic port wavelength	1310 nm
5.4 Fiber singlemode optimal	9/125 um
5.5 Fiber Max. distance	15 to 40 km
6. Maximum switches in ring	At least 50 switches
7. Power input 8. Optical Power: Receiver Saturation Power 9. Optical Output Level	At least 1 (one) set of DC power input At least -12 dBm At least -12 dBm
10. Receiver Sensitivity Level	At maximum -26 dBm
11. Fiber Optic Connector	SC
12. Operating Temperature Range	0 °C to 70 °C

To implement the redundant rings topology the Industrial Ethernet Switches (IES) shall support the Rapid Spanning Tree Protocol (RSTP) standard defined in IEEE 802.1w

3. Input/Output Requirement

The following types of I/O are required:

- AC analog inputs
- DC analog inputs
- Status (contact) inputs
- Control (contact) outputs
- Pulse accumulator inputs

FRTUs shall provide as minimum the number of hardwire points (calculated points not included) specified in table 4 to table 6.

The FRTUs shall also include spare I/O points that are fully configured and available for MEA's use. At least 10% (ten percent) of the number of as built points shall be spare. The spare points shall be distributed in approximately equal fashion among all I/O point types implemented in the I/O module (i.e., approximately 10% of the status points shall be spare, 10% of the control outputs shall be spare).
Spare control points shall include external auxiliary control relays (if required for the proposed FRTUs).

The spare points shall be wired from the FRTU I/O card to the associated terminal strips in the controlled device. Additional I/0 points on the I/O card beyond that needed to satisfy the requirement for spare points need not be wired to the control cabinet terminal strips.
It shall be possible to expand the FRTUs by an additional 10% (ten percent) of the initially delivered (including spare) I/O points by merely adding circuit cards and terminations.

The FRTUs shall be able to report both status and analog data either by exception or completely, as requested by the master station. For reporting by exception, an acknowledgment mechanism is required to ensure that change flags are not reset before receipt of the changes is acknowledged by the master station.

AC ANALOG INPUTS

AC analog inputs will be used for most of the power system telemetry as shown in table 4.

Table 4 AC Analog inputs

Analog Input	**Incoming** No. 1	**Incoming No. 2**	**Outgoing No.1**	**Outgoing** No.2	**Total**
Phase Voltage	3	3		-	6
Current	3	3	3	3	12
Temperature					1
					19

The FRTU shall support the use of both CT and current sensor but only the use of voltage sensor. The contractor shall provide an FRTU designed to use transducerless inputs or IEDs with sufficient isolation and protection against switching surge and transient introduced from the power line which may jeopardize other complicated electronic part of the FRTU .The minimum precision of the analog to digital converter shall be at least 12-bit.

The AC analog input units of FRTUs shall be designed for operation with voltage sensors, current sensors and CTs. Many measurements will be taken from 230/400 volt LV circuits, and the AC inputs shall impose a low burden that is commensurate with the capabilities of CTs and PTs designed for LV circuits. The AC analog input units of FRTUs shall be designed for operation with post sensors

The FRTUs shall support the ring type CTs which have rated burden 5 VA in each phase and ratio 600 : 5 class 5P10 or current sensor according to IEC 61869-8.

The FRTUs shall support the voltage sensors according to IEC 61869-7.

The FRTUs shall use these inputs to calculate true RMS, 50 Hz phasor,

a. Three phase volts (RMS)
b. Three phase and neutral current (RMS)
c. kW, kVAr, kWh, kVArh, by phase and total
d. Power factor
e. Direction of current flow

The FRTUs shall accept current input signals with normal signal ranges of 0 (zero) to 5 (five) amps ac. In addition, the FRTUs shall be able to read current signals as high as 20 (twenty) times the maximum normal signal for up to 1 (one) second in order to detect fault current. The FRTUs shall be able to read voltage signals up to 125% (one hundred and twenty five percent) of the maximum normal voltage signal.

The burden imposed by the FRTU analog input circuit shall not exceed 1 volt-ampere for current inputs and 10 volt-ampere for voltage inputs.

The FRTUs shall report analog values to the DMS by exception. The FRTUs shall report all analog values that have changed by more than a programmable deadband from the last value that was successfully reported to the DMS. The deadband shall be specified for each point individually.

DC ANALOG INPUTS

DC analog inputs shall be used to monitor 1-phase currents and available to support measuring telemeter ambient and transformer oil temperature which employed in the future.

The FRTU shall accept analog inputs in the range of ±1 mA, ±10 mA, 4-20 mA and ±5 volts. For current inputs, the input impedance shall be such that the voltage across the input terminals does not exceed 10 (ten) volts with full scale input current, and no damage shall occur for sustained 100% (one hundred percent) overcurrent. For voltage inputs, the input impedance shall not be less than 10 (ten) mega ohm. With only minor hardware changes it shall be possible to adapt each individual analog input terminal for any of these input ranges.

Analog to digital conversion shall be with a resolution of 12 bits, including the sign bit for bipolar conversion. The following performance requirements shall be met throughout the range of operating conditions specified for the FRTU:

a. A/D conversion linearity	1/2 LSB
b. A/D quantizing error	1/2 LSB
c. Overall accuracy, from input terminal to digital value ±0.005% /°C temperature error	≤ 0.1% of full scale at 25°C with less than
d. Common mode rejection	90 db, dc to 50 Hz
e. Normal (differential) mode rejection	60 db, at 50 Hz

In the definition of accuracy above, "full scale" is the maximum positive or negative reading.

Each FRTU shall be equipped with an accuracy and auto calibration feature with precise reference inputs at 0 and ± 90 % of the full scale analog input. The long term stability of the references shall be better than 0.1% of full scale over the specified range of the operating environment. The references shall be used for auto calibration of the input and analog-to-digital conversion circuitry, and the converted analog values shall also be available to the master station. Analog reference points are *not* included in the count of analog points.

STATUS INPUTS

Status inputs or digital input (DI) are shown in table 5

Table 5 Digital Input (DI)

DI	Incoming no. 1	Incoming no. 2	Outgoing no. 1	Outgoing no. 2	Total
Status Switch (Double Bit)	2	2		-	4
Status CB (Double Bit)	-	-	2	2	4
Control Mode Remote/Local (Double Bit)	-	-		-	2
Control Inhibit Status	-	-		-	1
SF6 Gas Low Pressure	-	-		-	1
Fault Indicator (per phase, non-directional)	3	3	3	3	12
Battery Alarm (common)	-	-		-	1
AC Status	-	-		-	1
Enclosure Door Open	-	-		-	1
					27

The Contractor shall supply the necessary sensing voltage, current limiting, input isolation, and bounce filtering for all status inputs. The debounce time period for each status input shall be individually configurable. The input circuits of the status input modules shall be optically isolated from the external signal. In addition, each input circuit shall include an LED indicator next to the circuit terminations to show the status of the associated input contact. Alphanumeric display(s) (with keypads or buttons) to indicate input circuit and module information are acceptable.

The wetting voltage for each input contact shall be 12 (twelve) Vdc or 24 (twenty four) Vdc. The state of each status point shall be reported to the DMS on an exception basis. That is, a

status point shall not be reported to the DMS unless the point state has changed from the last scan. The FRTU shall also report the state of selected status points upon receipt of a demand scan request from the DMS.

A free-contact will be provide by MEA for each digital input while the wetting current shall be sourced from an internal DC supply in the FRTU. The contractor shall provide all necessary optical isolator and bounce filter components to protect against contact bounce and transients in the power system. The input shall also be filtered so that a change of state shall last a minimum of 10 (ten) milliseconds before being detected. In each point of digital input, FRTU shall have LED (Light Emitter Diode) or LCD (Liquid Crystal Display) indicator (with a keypad or buttons) next to the circuit terminations to show the status of the associated input contact. For the LCD indicator, the screen saver facilities shall be included.

Status inputs will be used to monitor the state of devices and alarms through the sensing of the state of contacts. All status input circuits shall include optical isolation of no less than 2000 (two thousand) volts. All status inputs shall be digitally filtered to avoid false indications by contact bounce. They shall be scanned once every 1 (one) millisecond and status changes shall be reported if, and only if, they last 10 (ten) milliseconds or more. Status points shall be immune to 50 (fifty) Hz noise of up to at least 3 (three) VAC.

It shall be possible to invert status inputs, on a per point basis, so that a "B" or normally closed contact can be reported as an "A" or normally open contact.

A multi-change detection (MCD) capability is required for reporting of multiple status changes that may occur at fast switching devices between master station scans. Polling rate may be slow at some locations. Therefore the FRTU shall be able to report at least up to 8 *(eight)* status changes that occurred at a status point between two scans. In case of MCD buffers overflow, the existing data shall not be over-written by the new ones and the overflow shall be reported to the master station. MCD information or change and status flags shall not be reset without acknowledgment that they were received by the master station.

The FRTUs shall include the following types of status input points:

1. Single Contact. Two-State Status: For single contact, two-state status points, a single contact shall represent both states of the monitored device. One position of the contact

shall indicate an alarm or failure condition, while the opposite state of the contact shall indicate the normal condition.

2. Double Contact. Two-State Status: For double contact, two-state status input points, separate contacts shall be provided for representing each state of the monitored device. One contact shall indicate an open condition of the monitored device. The other shall indicate a closed condition. The contacts shall be treated as a complimentary pair. Conflicting contact positions (e.g., one contact indicates CLOSED and the other indicates OPEN) shall be labeled INVALID.

3. Sequence-of-Events: The FRTUs shall include a sequence-of-events (SOE) reporting capability. It shall be possible to assign any status input point to SOE reporting in addition to normal status reporting. The FRTU shall detect changes in the state of SOE points, record the date and time of change with a resolution of plus or minus one millisecond (±1 ms) relative to the FRTU internal clock, inform the DMS that SOE data has been recorded, and report SOE data to the DMS upon request. To ensure that SOE data is not lost or overwritten until the DMS acknowledges receipt of the data, an FRTU buffer capable of storing aminimum of 512 (five-hundred and twelve) events shall be provided. The FRTU shall be able toretransmit stored SOEdata if requested by the DMS.

CONTROL OUTPUTS

Control outputs or digital outputs (DO) are shown in table 6.

Table 6 Digital Output (DO)

DO	Incoming no. 1	Incoming no.2	Outgoing no. 1	Outgoing no.2	Total
Control RMU Switch (Double Bit)	2	2	-	-	4
Control RMU CB (Double Bit) reserve	-	-	2	2	4

The FRTUs shall include the following types of control points to support control actions initiated from the DMS master stations:

On/Off Device Control: The FRTUs shall perform on/off control actions using complimentary pairs of contact outputs. One contact output shall perform the "On" control action, and a second output contact shall perform the "Off" control action. The FRTUs shall be designed such that only one output in a complimentary pair can be activated at a time.

To support the above capabilities, the FRTUs shall include momentary control outputs, latching control outputs, and analog control outputs, as required by the feeder device being controlled. Each momentary control output shall provide a contact closure (pulse) that shall have programmable pulse duration. The pulse duration shall be adjustable on an individual point basis from 0.1 to 60 (sixty) seconds in increments of 0.01 seconds. In contrast, latching, outputs shall remain in a given state until a subsequent command changes the control output state.

Control point selection shall be canceled at the FRTU if the operate command is not received within a programmable time period measured at the FRTU by a "Command Receipt" timer. The FRTU's Command Receipt timer shall be in addition to the "Select Verification" timer in the DMS. The Command Receipt timer shall be adjustable between 10 (ten) and 60 (sixty) seconds. The time period shall initially be set at 10 (ten) seconds.

MEA prefers that the FRTU control outputs be equipped with high power relays that are integral to the FRTU so that external auxiliary control relays are not required. The voltage rating of the control output contacts shall be 24 Vdc. All control outputs shall be capable of driving a load of 6 (six) amps at the primary control voltage. The output relays shall be designed for 10^6 operations. External auxiliary control relays are not preferred, but may be applied if integral relays do not satisfy the above ratings. These relays shall be supplied by the Contractor.

The operation time of each contact shall preferable be adjustable either at the Master Station and then downloading to the FRTU or alternatively be predefined in the FRTU's nonvolatile EEPROM memory or equivalent. In each point of digital output RTU shall have LEDs for indicating the active point. Alphanumeric display(s) (with keypads or buttons) to indicate input circuit and module information are acceptable.

A select-before-operate (SBO) procedure shall be employed between the master station and the FRTU, and the output relays shall be operated only upon confirmation by the master station of the correct selection of both the controlled point and the commanded state in the

FRTU. A complete SBO procedure is required for each control command sent to the FRTU, including commands associated with control procedures such as Raise/Lower, which may not require point reselection by the operator for each command. It shall be possible to operate only 1 (one) control point at a time in an FRTU; attempts to operate additional points shall be rejected. Point selection shall be cancelled after a control is executed. Selections shall also be automatically cancelled when no execution command is received within 10 (ten) seconds from the time that a point is selected. Circuitry to monitor relay drivers and prevent their unintentional closures due to failures of hardware is required, and no false outputs shall be possible due to the failure of a single component in an FRTU. Any test pulse for the detection of hardware failures shall be less than 1 (one) millisecond. The detection of hardware failures shall be reported to the master station.

A Control Disable switch mounted inside the FRTU shall inhibit all control outputs by disconnecting the power supply for the coils of the interposing relays; the inhibition shall not rely on electronic circuitry. The state of the Control Disable switch shall be monitored by 1 (one) of the status input points of the FRTU. If this Control Disable switch status input is **not** in the disable position, the local diagnostic test mode for the control output shall be inhibited and warning message should be displayed on the local diagnostic terminal.

4. Operating Condition

The FRTUs, including all Contractor supplied communications equipment, shall be designed for continuous operation under the following conditions:

a. **Outdoor FRTUs:** Ambient temperature of 0°C (zero degree Celsius) to +70°C (plus seventy degree Celsius), including operation in direct sun light, with relative humidity from 5% (five percent) to 95% (ninety five percent).

Fans or other electro-mechanical cooling devices shall not be used in the FRTUs.

In accordance with the latest version of ANSI/IEEE C37.1, IEC 60255-22-3, or equivalent standard, the operation of the DMS FRTUs shall not be affected by the narrow band radiated fields from portable radio transmitters or digital radio telephones of up to 35 (thirty five) V/m

5. Surge Withstand Capability

All external connections of the FRTU, including input and output terminals, communications lines, and power supply inputs and outputs including the contact sensing voltage supply output, shall be able to pass ANSI/IEEE Standard C37.90.1-2002 surge withstand tests without damage, interruption in operation, false control output, or loss of internal stored data and parameters and shall be designed to withstand the fast transient and surge voltage tests specified in ANSI/IEEE Standard C37.90.1-2002.

6. Training

Training is required to qualify MEA's personnel to assume full responsibility for the installation, maintenance, and repair of the FRTUs. All training shall be conducted at MEA's facilities in Bangkok, on equipment delivered by the Contractor. FRTU test systems, maintenance tools, and test equipment delivered by the Contractor or purchased from other sources on the Contractor's recommendation shall be used in the FRTU maintenance training. All training material shall be provided by the Contractor, and MEA shall be permitted to reproduce any of them and to video tape training sessions for internal use.
Two training sequences are required:

a. Field Maintenance Training

b. Repair Shop Training

Field Maintenance Training will be attended by up to 20 (twenty) trainees. To better accommodate this number of people, 2 (two) training sessions shall be conducted, and each session will be attended by approximately 10 (ten) trainees. Up to 8 (eight) people will attend the Repair Shop Training. The Repair Shop Training shall be scheduled after the Field Maintenance Training so that its participants can first attend the Field Maintenance Training in preparation for the Repair Shop Training classes.

SPECIFICATION NO. 236
CONVENTIONAL TYPE THREE PHASE LESS-FLAMMABLE LIQUID FILLED TRANSFORMER

236A Scope

This specification describes the requirements with which the manufacturer shall comply in order to supply the distribution transformers to the Metropolitan Electricity Authority (MEA). The transformer shall be connected to the 12/24 kV, 3 phase, 3 wire, 50 Hz distribution system having the neutral solidly grounded at the distribution substations, where the fault level of the outgoing feeders is 15 kA.

236B Site and Service Condition

The service condition are as follows : -

a) Installation site : Bangkok Metropolis, Thailand.

b) Altitude : approximately mean sea level.

c) Maximum ambient temperature : 40°C.

d) Average ambient temperature in any one year : 30°C.

e) Average relative humidity in any one year : 79%.

f) Average maximum relative humidity in any one year : 94%.

The transformers shall be suitable for use in tropical climatic area and shall be capable of operating at its full ratings in the service conditions mentioned above.

236C Reference Standard

Except otherwise specified elsewhere in the specification, all equipment required by MEA shall be manufactured and tested in conformity with the standards listed below:-

Thai Industrial Standards Institute (TISI) Publication: -

TIS 384-2000 : Standard for Power Transformers.

If there are any minor parts deviated from the standards, they shall be clearly mentioned in the "DEVIATION FROM MEA'S SPECIFICATION FORM" attached herewith.

Note

1. The equipment tested in accordance with the later version of the above standards is also accepted.

2. The equipment tested in accordance with older version (or draft version) of the above standards is also accepted provided that the test is conformed to standard and year mentioned above.

3. The equipment complies to other national standards having similar characteristics and providing equal performance and/or quality to that specified may be proposed. In this case the complete ENGLISH language copies of the standards shall be submitted with the quotation, otherwise such offer may not be considered.

236D (Blank)

236E Test, Inspection and Test Report

236E1 The type test of transformer shall be as follows:-

a) The proposed transformer shall have successfully passed at least the following tests:-

- Temperature rise test.
- Lightning impulse test.

Note The tested transformer shall be less flammable oil type only.

b) MEA will accept the deviation of the proposed transformer compared to the type tested transformer on the following conditions:-

1. Temperature rise is more than 50 ^{0}C but not exceed 65 ^{0}C.
2. Transformer is 12 kV, 24 kV or 12/24 kV and between 500 kVA to 1,000 kVA. In case the capacity (kVA) of tested transformer is less than the proposed transformer, the test report of mineral oil transformer having capacity not less that the proposed transformer is required.
3. The manufacturer of the proposed transformers shall have satisfactory experienced to have short circuit tested according to reference standard specified in clause 236C on his transformer. The test shall be done by members of Short Circuit Testing Liaison or other international acknowledge and reputable station subjected to MEA approval. Type and size of tested transformer qualified for rating of the proposed transformer shall be as follows:-

Test Transformer	Acceptable for proposed transformer rating
1ϕ	1ϕ
3ϕ	1ϕ and 3ϕ
11 or 12kV	12kV
22 or 24kV	12kV,24kV and 12/24kV
Any capacity within the range	Up to 250 kVA
Any capacity within the range	251kVA-1000kVA
Any capacity within the range	1001kVA-2000kVA
Except specified in the above table, if the proposed transformer is differed from the tested transformer, the test report can be accepted on condition that the proposed transformer and the tested transformer have the common characteristics according to Annex B of IEC 60076-5 (2006).	

Except otherwise specified elsewhere in the specification, all test reports shall be attached to the bid, otherwise MEA will not consider such offer.

236E2 Standard factory tests shall be made with routine tests, temperature rise test and lightning impulse test. Each rating of the transformer shall be tested consisting of at least the following items listed in Table II.

TABLE II

Test Items	Unit Tested	Units required for inspection (if any)	Units required for acceptance test
- measurement of winding resistance - measurement of voltage ratio and check of phase displacement - measurement of short circuit impedance - measurement of load loss - measurement of no load loss and current - dielectric tests consisting of a separate source AC withstand voltage test and induced AC voltage test	All units	Nearest lower Whole number to the cube root of purchase quantity.	Nearest 5% but not less than 2 per lot
- measurement of transformer weight - oil leak test - oil dielectric strength test			- - -
- temperature rise test - lightning impulse voltage withstand test (full and chopped wave)	1 1	- -	1 -

Note :

a) For dual primary voltage transformer. The above tests shall be done at 24 kV connection only except impulse test shall be done at 12 kV connection.

b) The serial numbers of the inspected units shall be specified.

c) The samples of transformers for the temperature rise test and impulse test shall be picked from the first shipment batch.

d) To prevent the transformer from unnecessary deteriorate from impulse wave, voltage and current measurement during impulse test shall be recorded at the same time. Method of repeating impulse for measurement of current or voltage is not accepted.

e) Number, sequence and method of impulse voltage withstand test (full and chopped wave) shall be according to IEC 60076-3.

f) In case the purchase quantity is less than 2 units, number required for acceptance test shall be one unit.

236E3 The routine test, temperature rise test and lightning impulse test report shall be sent before or together with the transformer's delivery, otherwise MEA shall regard as no delivery of transformers and claim for penalty on late shipment.

236E4 MEA reserves the right to send the representatives at his expense to inspect and witness tests of the material and equipment during manufacturing, at the time of shipment or at any time he deems necessary. The supplier shall provide free access to the facilities where the equipment is being manufactured and shall satisfy the representatives that the material and equipment are in accordance with this specification and the purchase contract.

236E5 Prior to the shipment, the supplier shall submit to MEA the complete and certified reports of all tests made in 6 (six) copies. The test reports shall contain all data required for their complete understanding such as; diagrams, methods, instruments, constants and values used in the tests and the results obtained. If MEA has his own inspector, the supplier shall submit all the above test reports to the inspector and the inspector himself shall certify the witnessed test report and review the remainder before submitting to MEA.

236E6 After the transformers delivery in each lot, MEA will sample the transformer for acceptance test according to table II, If the result does not correspond to the specification, all transformers will be rejected.

236F Drawings and Instructions

236F1 Supplier shall furnish 6 (six) copies each of the following items within 15 (fifteen) days after the effective date of contract for the design approval by MEA.

a) Nameplate drawing.

b) Outline drawing.

If any of the drawings and data mentioned above are not submitted to MEA within the specified date, the supplier shall be penalized at Baht 1,000.00 (one thousand only) per day until the date the supplier submits the above documents.

Generally, if the drawings require no more detail, they will be returned to the supplier within 15 (fifteen) days after receipt by MEA. If drawings for approval are not submitted within the time as mentioned above or MEA has to request for additional information, supplier cannot regard lost time as reason for extending delivery time without penalty.

236F2 Supplier shall furnish 6 (six) copies each of the following items, at least 15 (fifteen) days prior to the first shipment of the transformer in each rating.

a) Final certified nameplate drawing.

b) Final certified outline drawings.

c) Complete installation and maintenance instructions.

d) Complete part list.

236F3 In addition to the above requirements, one set of any special installation instruction shall be boxed with each transformer.

236F4 All drawings except standard shop drawings, characteristic curve and installation instructions shall have the contract number marked thereon.

236F5 All drawings and instructions shall be in ENGLISH. Information on drawings shall be engineering lettering. Instruction manual shall be machine printed or typed.

236F6 All measurements and quantities shall be expressed in the unit of METRIC SYSTEM. If they are expressed in other systems, the metric equivalent shall also be shown.