In case of the foreign manufacturers having experience of more than twenty (20) years in design, manufacture and sell spaced aerial cables, PEA will accept type test report(s) conducted by the manufacturer's laboratory or other independent laboratories without qualification mentioned in (1) or (2). Documents showing the manufacturer's experience such as reference list shall be submitted with the bid for consideration.

The bidders or manufacturers who prefer to carry out the type tests of the spaced aerial cables with the laboratories or by the manufacturer themselves without the qualification mentioned above, the detail of the test facilities of the laboratories or the manufacturer shall be submitted to PEA for approval before proceeding the tests and before the bid closing date. PEA reserves the right to send representatives to inspect and witness the tests with the cost of the bidders or manufacturers.

The type test report done by the laboratories in Thailand or local manufacturers shall be valid within five (5) years counted from the issued date in the test report to the bid closing date.

The costs of all tests and reports shall be borne by the Contractor.

1e.2 Acceptance tests

The proposed spaced aerial cables shall be passed the acceptance tests in accordance with the relevant TIS standards by the test items shown in **1e.1 Type tests** except capacitance and power factor test and accelerated water absorption test are not require.

The Test Form for Acceptance test is according to **Annex 1**.

For item b) Test for determining the mechanical properties of insulation and jacket before and after ageing, PEA will accept a test report which is carried out before acceptance tests process.

PEA reserves the right to have the acceptance test made by the supplier's factory or by acknowledge independent testing laboratories.

The costs of all tests and reports shall be borne by the Contractor.

Three (3) sets of test reports shall be submitted at the time of delivery.

Number of sample

Number of reels per lot	Number of sample for acceptance test
1 to 100	1
101 to 200	2
201 to 300	3
301 to 400	4
401 to 500	5
More than 501	6

C2 Material and packing data of the spaced aerial cables

The following critical documents and details shall be submitted with the bid:

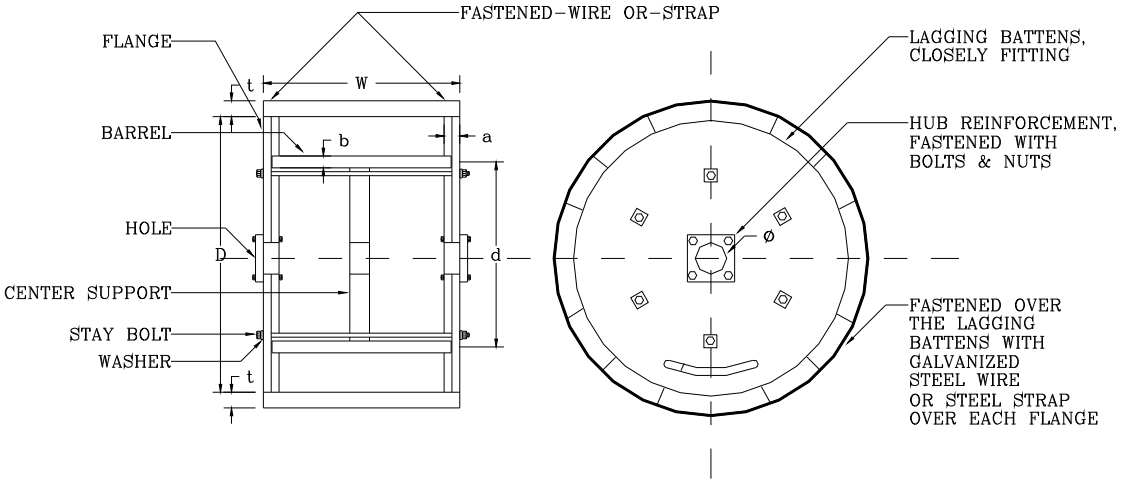
Critical documents of the proposed spaced aerial cables shall be submitted with the bid for each item offered:

Item	Description of document	Confirmation	Reference (Page No./folder)
1	Guarantee performance data of spaced aerial cables (See Pages 10 of 11 to 11 of 11)	☐ Yes ☐ No	
2	Type test certification and/or type test reports	☐ Yes ☐ No	
3	Illustration of the cable	☐ Yes ☐ No	
4	Packing detail	☐ Yes ☐ No	

Note:

The bidders who do not submit all critical documents mentioned in the above table with the bid shall be rejected.

WOODEN REELS



Reel size mm	D mm	d (min) mm	W mm	a (min) mm	b (min) mm	t (min) mm	∅ mm	Number of stay bolts (min.)
1,000	980-1,020	500	660-700	50	19	25	75-100	6
1,400	1,380-1,420	710	875-915	63	25	38	75-100	6
1,800	1,780-1,820	965	880-920	75	35	38	75-100	6
1,900	1,880-1,920	*	*	75	35	38	75-100	6

Note:

1. Minimum clearance between cable and the lagging battens shall not be less than 25 mm.
2. Both ends of barrel battens shall be embedded in the flanges.
3. If PEA requests, the bidders have to state the reel manufacturer's name; and PEA reserves the right to observe the manufacturing process from time to time.
4. *According to manufacturer's design.

Invitation to Bid No.:

Guarantee performance data of spaced aerial cables

Manufacturer's name					
Country of origin					
Applied standard, publication number and year					
Type/Model/Catalogue No.	-				
Nominal cross-sectional area	mm^2	50	95	120	185
Rated voltage, phase to phase	kV r.m.s.				
Design for highest system voltage	kV r.m.s.				
Rated frequency	Hz				
Number of cores	-				
Rated current, in free air ($40^{O}C$)	A				
Conductor					
Material	-				
Actual cross-sectional area	mm^2				
Minimum number of wires	-				
Diameter of wires	mm				
Stranding	-				
Maximum volume resistivity at $20^{O}C$	Ω-mm^2/m				
Maximum d.c. resistance at $20^{O}C$	Ω/km				
Conductor shield					
Material	-				
Average thickness	mm				
Thickness at any place, not less than	mm				
Maximum DC volume resistivity at $90^{o}C$	Ω-cm				

Invitation to Bid No.:

Guarantee performance data of spaced aerial cables (Continue)

Insulation					
Material	-				
Cross-linking agent (peroxide, silane, etc)	-				
Curing process (steam, nitrogen, etc.)	-				
Average thickness	mm				
Thickness at any place, not less than	mm				
Dielectric constant, measured at a conductor temperature of 90^{O}C	-				
Power factor, measured at a conductor temperature of 90^{O}C	-				
Range of diameters over insulation	mm				
Jacket					
Material	-				
Average thickness	mm				
Thickness at any place, not less than	mm				
Overall diameter	mm				
AC test voltage for 5 minutes	kV				
Packing					
Length per reel	m				
Gross weight	kg				
Net weight	kg				
Name of wood preservative	-				

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
1	1020050000		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 50 mm^2, for system voltage 22 kV 50 Hz.
2	1020050001		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 95 mm^2, for system voltage 22 kV 50 Hz.
3	1020050002		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 120 mm^2, for system voltage 22 kV 50 Hz.
4	1020050004		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 185 mm^2, for system voltage 22 kV 50 Hz.
5	1020050100		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 50 mm^2, for system voltage 33 kV 50 Hz.
6	1020050101		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 95 mm^2, for system voltage 33 kV 50 Hz.
7	1020050102		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 120 mm^2, for system voltage 33 kV 50 Hz.
8	1020050104		Spaced aerial cable, XLPE insulation and jacket, single-core, aluminium conductor size 185 mm^2, for system voltage 33 kV 50 Hz.

Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 22 kV ขนาด 50 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	21.7-23.8	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	7.92-8.08	mm.					
		No. of wire in conductor	Min. 6	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 4.37	mm.					
			Average 4.85	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.641	Ω/km					
(f)	**HV dielectric**	Test at 38 kVac for 5 min	No Breakdown	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	No Failure	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			**PASS**						

Witness By 1. _____

2. _____

3. _____

4. _____

Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 22 kV ขนาด 95 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	25.1-27.1	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	11.33-11.56	mm.					
		No. of wire in conductor	Min. 6	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 4.37	mm.					
			Average 4.85	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.320	Ω/km					
(f)	**HV dielectric**	Test at 38 kVac for 5 min	No Breakdown	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	No Failure	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			**PASS**						

Witness By 1. _____

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Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 22 kV ขนาด 120 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	21.7-23.8	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	7.92-8.08	mm.					
		No. of wire in conductor	Min. 6	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 4.37	mm.					
			Average 4.85	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.641	Ω/km					
(f)	**HV dielectric**	Test at 38 kVac for 5 min	No Breakdown	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	No Failure	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			**PASS**						

Witness By 1. _____

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Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 22kV ขนาด 185 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	29.6-31.8	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	15.82-16.14	mm.					
		No. of wire in conductor	Min. 30	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 4.37	mm.					
			Average 4.85	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.164	Ω/km					
(f)	**HV dielectric**	Test at 38 kVac for 5 min	**No Breakdown**	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	**No Failure**	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			**PASS**						

Witness By 1. _____

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Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 33 kV ขนาด 50 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	26.3-28.3	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	7.92-8.08	mm.					
		No. of wire in conductor	Min. 6	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 6.462	mm.					
			Average 7.18	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.641	Ω/km					
(f)	**HV dielectric**	Test at 49 kVac for 5 min	No Breakdown	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	No Failure	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			PASS						

Witness By 1. _____

2. _____

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Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 33kV ขนาด 95 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	26.3-28.3	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	12.82-13.07	mm.					
		No. of wire in conductor	Min. 6	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 6.462	mm.					
			Average 7.18	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.641	Ω/km					
(f)	**HV dielectric**	Test at 49 kVac for 5 min	No Breakdown	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	No Failure	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			**PASS**						

Witness By 1. _____

2. _____

3. _____

4. _____

Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 33 kV ขนาด 120 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	26.3-28.3	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	12.82-13.07	mm.					
		No. of wire in conductor	Min. 6	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 6.462	mm.					
			Average 7.18	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.641	Ω/km					
(f)	**HV dielectric**	Test at 49 kVac for 5 min	No Breakdown	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	No Failure	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			**PASS**						

Witness By 1. _____

2. _____

3. _____

4. _____

Annex 1

Test Form for Acceptance test

รายงานผลการตรวจรับสาย SAC ระดับแรงดัน 33 kV ขนาด 185 mm^2

Factory ..... **Contract No.** ..... **Date** .....

No.	Description		Requirement	Reel No. / Unit	1	2	3	4	5
Physical Properties									
(a)	**Marking Durability**	Rub with cloth 10 time	Durable	-					
(b)	**Tensile strength of insulation**	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of insulation	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
	Tensile strength of jacket	Before Aging	Min. 12.5	N/mm^2					
		After Aging	-	N/mm^2					
			Min. 75	% of unaged					
	Elongation of Jacket	Before Aging	Min. 250	%					
		After Aging	-	%					
			Min. 75	% of unaged					
(c)	**Hot creep for Insulation**	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
	Hot creep for jacket	Under Load at 150°C at 15 min	Max. 175	%					
		Elongation After Cooling	Max. 10	%					
Dimension Properties									
(d)	**Dimension cable**	Overall diameter (D)	34.2-36.2	mm.					
		Material Conductor	Al Compact	-					
		Conductor diameter (d)	15.82-16.14	mm.					
		No. of wire in conductor	Min. 30	mm.					
		Conductor screen Thinkness	Min. 0.07	mm.					
			Average 0.3	mm.					
		Material Insulation	XLPE	-					
		Insulation Thinkness	Min. 6.46	mm.					
			Average 7.18	mm.					
		Material Jacket	XLPE	-					
		Jacket Thinkness	Min. 1.58	mm.					
			Average 1.75	mm.					
Electrical Properties									
(e)	**Conductor resistance**	Resistance at 20 °c	Max. 0.164	Ω/km					
(f)	**HV dielectric**	Test at 49 kVac for 5 min	No Breakdown	-					
(g)	**Insulation resistance**	Test at 500 Vdc at 15.6 °C	$IR = 6100log_{10}\frac{D}{d}$	MΩ-km					
(h)	**Tracking Jacket**	Test at 2kVac test 10 cycle	No Failure	-					
(i)	**Volume conductor shield**	at least 30 min at 90 °C	Max. 50,000	Ω-cm					
สรุปผลการทดสอบ			**PASS**						

Witness By 1. _____

2. _____

3. _____

4. _____

2.4.3 Termination Kit

for 22 kV

Invitation to Bid No. :

Specification No. : RCBL-033/2548

C Material, equipment, and specifications for CABLE TERMINATION KITS FOR 22 kV AND 33 kV XLPE CABLES

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed :

1a Scope

These specifications cover outdoor and indoor cable termination kits to be used with underground cable 22 kV & 33 kV single-core copper conductor, cross-linked polyethlene insulated, copper wires screen and polyethylene or polyvinyl chloride sheath.

1b Standard

The cable termination kits shall be manufactured and tested in accordance with the latest revision of IEEE standard 48, DIN 57278/VDE 0278 or equivalent; unless otherwise specified in these specifications. The cable termination kits conforming to other national standards having similar characteristics and quality may be proposed.

1c Principal requirement

1c.1 General

The cable termination kits shall be suitable for use in tropical climatic area and highly contaminated atmosphere and shall be capable of operating at its full ratings in the following conditions mentioned.

Termination housing, modules or skirt shall be made of non-tracking, weather and ultra violet resistant materials. Stress control for cable shield terminus may be molded stress cone, voltage gradient tube, or stress grading pad. Stress control by tape wrapping shall not be accepted.

1c.2 Site and service conditions

The cable termination kits shall be designed and manufactured for installation and operation under the following conditions :

Altitude	:	up to 1,500 m above sea level
Ambient air terperature	:	70^{o} C, maximum
	:	35^{o} C, average on one (1) day
System voltage	:	3-phase, 22 kV & 33 kV solidly grounded neutral
Rated frequency	:	50 Hz

1c.3 Outdoor cable termination kit

The outdoor cable termination kit shall be Class 1 in accordance with IEEE Standard 48 or equivalent, and housing materials shall be Silicone rubber or EPDM rubber of premolded slip-on type, premolded shrinkable type (cold shrinkable), or heat shrinkable tubing type; but in case of being specified the particular type in the C3 Schedule of detailed requirement the bidder shall quote the same type as specified, otherwise the quotation shall not be considered.

The termination kit shall be provided with :

1) The cable lug at underground copper cable side, compression type, two-hole NEMA pad, made of copper or copper alloy with tin plated, suitable for connecting to copper conductor having diameter as specified in Table 1 and Table 2. The connector shall be furnished with mounting hardware : two (2) bolts, two (2) nuts, two (2) flat round washers, and two (2) spring lock washers of stainless steel.

2) The cable lug at bare aluminium conductor side, compression type, two-hole NENA pad, made of aluminium alloy suitable for connecting to aluminium conductor having diameter as specified in Table 3. If not required it shall be specified in C3 Schedule of detailed requirement.

3) Termination mounting bracket, for cross-arm section range of 100 mm x 100 mm to 120 mm x 120 mm (with carriage bolts of not less than 150 mm long). The bracket shall be similar to NEMA type, and hot-dip galvanized conforming to ASTM Designation A 153 or equivalent.

4) Installation materials ; such as :

- clamping device for fixing the cable and termination to the mounting bracket, if any, made of non-magnetic corrosion resistant material.
- grounding device for earthing.
- seal to prevent the entrance of the foreign particle and moisture into the cable.
- instruction and accessories.

1c.4 Indoor cable termination kit

The indoor cable termination kit shall be in accordance with IEEE standard 48, DIN 57278/VDE 0278, or equivalent, and may be premolded slip-on type, premolded shrinkable type (cold shrinkable) or heat shrinkable tubing type.

Each termination kit shall be provided with :

1) The cable lug at underground copper cable, compression type, 1-hole NEMA pad.

2) Grounding device for earthing, instruction, and accessories.

1c.5 Manufacturing Experience

The manufacturer of the required cable termination kits must have experience in producing the terminations which are in the same types as specified herein not less than five (5) years and which have successfully passed all the type tests and design tests according to the stated reference standard or any reputable standards.

As an evidence that all the foregoing requirements have been met, a bidder will provide the documents when submitting his bid.

1c.6 Tests and Test reports

The proposed cable termination kit shall have successfully passed all the type tests or design tests in accordance with the reference standards.

The test reports shall be submitted either prior to receipt of bids or fifteen (15) days from the bid closing date.

The above type tests may be omitted if a record of tests made on identical ones can be supplied.

Standard factory tests shall be made in accordance with routine tests stated in reference standards.

Three (3) sets of routine tests shall be submitted at the time of delivery.

1d Packing

The cable termination kits shall be packed individually with installation instructions and list of materials to be supplied for each termination kit.

If any part is packed in the cartons for containerized shipment, the cartons shall be arranged into pallets so as to facilitate their movement by fork lift trucks.

C2 **Material and packing data to be given by bidder**

2a **Technical proposals**

The attached sheets for outdoor and indoor terminations are the forms for filling technical data.

All blanks shall be filled in with the required information and figures.

2b Drawing with main dimensions and exact installation instruction of termination and drawing of mounting bracket shall be submitted with the bid.

2c List of special tools with itemized prices, if any.

2d **Packing details**

Principal dimensions of each package in cm .

Gross weight of each package in kg .

Number of packages in each case .

Principal dimensions of each case in cm .

Gross weight of each case in kg .

Volume of each case in m^3.

Number of cases .

Table 1

Physical Dimensions of 22 kV Single-core XLPE Underground Power Cable

Nominal cross-sectional area of conductor	mm^2	35	50	95	120	185	240	400	500
Diameter of conductor ± 1%	mm	6.95	8.33	11.45	12.95	15.98	18.47	23.39	26.67
Diameter over insulation, approx.	mm	19.0	20.5	23.5	25.0	28.0	30.5	35.5	39.0
Total cross-sectional area of copper wire screen, minimum	mm^2	10	10	10	10	25	25	25	25
Overall diameter, approx.	mm	28	30	32	34	38	42	48	52

Table 2

Physical Dimensions of 33 kV Single-core XLPE Underground Power Cable

Nominal cross-sectional area of conductor	mm^2	50	95	120	185	240	400	500
Diameter of conductor ± 1%	mm	8.33	11.45	12.95	15.98	18.47	23.39	26.67
Diameter over insulation, approx.	mm	25.5	28.5	30.0	33.0	35.5	40.5	44.0
Total cross-sectional area of copper wire screen, minimum	mm^2	10	10	10	25	25	25	25
Overall diameter, approx.	mm	35	38	40	44	47	55	58

Table 3

Physical Dimensions of Aluminium Stranded conductor

Nominal cross-sectional area (mm^2)	Outer diameter ± 1% (mm)
35	7.56
50	9.06
95	12.60
120	14.25
185	17.64
240	20.25
400	25.65

Invitation to Bid No. :

Specification No. : RCBL-033/2548

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
1	02150000	set(s)	Outdoor cable termination kit, housing of Silicone rubber or EPDM rubber, for 22 kV underground cable, copper conductor size 35 mm^2; and cable lug for bare aluminium conductor size 120 mm^2 .
2	02150001	set(s)	Ditto as Item 1, but for copper conductor size 50 mm^2.
3	02150003	set(s)	Ditto as Item 1, but for copper conductor size 95 mm^2 .
4	02150004	set(s)	Ditto as Item 1, but for copper conductor size 120 mm^2 .
5	02150006	set(s)	Ditto as Item 1, but for copper conductor size 185 mm^2; and cable lug for bare aluminium conductor size 185 mm^2 .
6	02150007	set(s)	Ditto as Item 1, but for copper conductor size 240 mm^2; and cable lug for bare aluminium conductor size 185 mm^2 .
7	02150009	set(s)	Ditto as Item 1, but for copper conductor size 400 mm^2; and cable lug for bare aluminium conductor size 185 mm^2 .
8	02150008	set(s)	Ditto as Item 1, but for copper conductor size 500 mm^2 . The cable lug for bare aluminium conductor is not required .
	II		

Invitation to Bid No. :

Specification No. : RCBL-033/2548

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
9	02150101	set(s)	Outdoor cable termination kit, housing of Silicone rubber or EPDM rubber, for 33 kV underground cable, copper conductor size 50 mm^2; and cable lug for bare aluminium conductor size 120 mm^2.
10	02150103	set(s)	Ditto as Item 9, but for copper conductor size 95 mm^2 .
11	02150104	set(s)	Ditto as Item 9, but for copper conductor size 120 mm^2 .
12	02150106	set(s)	Ditto as Item 9, but for copper conductor size 185 mm^2 .
13	02150107	set(s)	Ditto as Item 9, but for copper conductor size 240 mm^2; and cable lug for bare aluminium conductor size 185 mm^2 .
14	02150108	set(s)	Ditto as Item 9, but for copper conductor size 400 mm^2; and cable lug for bare aluminium conductor size 185 mm^2 .
15	02150109	set(s)	Ditto as Item 9, but for copper conductor size 500 mm^2. The cable lug for bare aluminium conductor is not required .

Invitation to Bid No. :

Specification No. : RCBL-033/2548

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
16	02160000	set(s)	Indoor cable termination kit, for 22 kV underground cable, copper conductor size 35 mm^2 .
17	02160001	set(s)	Ditto as Item 16, but for copper conductor size 50 mm^2 .
18	02160003	set(s)	Ditto as Item 16, but for copper conductor size 95 mm^2 .
19	02160004	set(s)	Ditto as Item 16, but for copper conductor size 120 mm^2 .
20	02160006	set(s)	Ditto as Item 16, but for copper conductor size 185 mm^2 .
21	02160007	set(s)	Ditto as Item 16, but for copper conductor size 240 mm^2 .
22	02160009	set(s)	Ditto as Item 16, but for copper conductor size 400 mm^2 .
23	02160008	set(s)	Ditto as Item 16, but for copper conductor size 500 mm^2 .

Invitation to Bid No. :

Specification No. : RCBL-033/2548

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
24	02160101	set(s)	Indoor cable termination kit, for 33 kV underground cable, copper conductor size 50 mm^2 .
25	02160103	set(s)	Ditto as Item 24, but for copper conductor size 95 mm^2 .
26	02160104	set(s)	Ditto as Item 24, but for copper conductor size 120 mm^2 .
27	02160106	set(s)	Ditto as Item 24, but for copper conductor size 185 mm^2 .
28	02160107	set(s)	Ditto as Item 24, but for copper conductor size 240 mm^2 .
29	02160108	set(s)	Ditto as Item 24, but for copper conductor size 400 mm^2 .
30	02160109	set(s)	Ditto as Item 24, but for copper conductor size 500 mm^2 .

2.4.4 Splicing Kit

for 22 kV

Invitation to Bid No. :
Specification No. : R-775/2539

C Material, equipment, and specifications for SPLICING KITS FOR 22 kV AND 33 kV XLPE CABLES

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed :

1a Scope

These specifications cover splicing kits to be used with underground cable 22 kV & 33 kV, single-core, copper conductor, cross-linked polyethylene insulated, copper wires screen and polyethylene sheath.

1b Standard

The splicing kits shall be manufactured and tested in accordance with the latest revision of IEEE standard 404, DIN 57 278/VDE 0278, or equivalent; unless otherwise specified in these specifications.

1c Principal requirement

1c.1 General

The splicing kits shall be suitable for use in tropical climatic area and highly contaminated atmosphere and shall be capable of operating at its full ratings in the following condition mentioned.

1c.2 Site and service conditions

The splicing kits shall be designed and constructed for direct burial installation and operation under the following conditions :

Ultitude	:	up to 1,500 m above sea level
Ambient air temperature	:	40^{o} C, maximum
Maximum soil temperature	:	35^{o} C, average on one (1) day
System voltage	:	3-phase, 22 kV & 33 kV solidly grounded neutral
Rated frequency	:	50 Hz

1c.3 Constructions

The splicing kit shall be premolded slip-on type, cold shrinkable type, or heat shrinkable type; but in case of the type specified in C3 Schedule of detailed requirement, the bidder shall quote such, otherwise the offer shall not be considered. Splicing method with tape wrapping shall not be accepted.

Stress control for the cable shield terminus may be molded stress cone or voltage gradient tube. Stress control by tape wrapping shall not be accepted.

Outer covering of splicing kit shall be semiconductive having grounding eye to provide a dead front ground shield for the insulation body.

Ground screen connection device shall be provided; and the connector for ground screen connection, if necessary, shall also be provided.

The splicing kits shall be suitable for cable having diameter over insulation and overall diameter as specified in Table 1 and Table 2.

The provided connector shall be suitable for copper conductor having diameter as specified in Table 1 and Table 2.

Outer sheath of shrinkable tube for protecting from mechanical and humidity, and sealing for preventing water entering into the cable when earthing the joint shall be provided.

Each splicing kit shall be supplied with parts ready for earthing in order to reduce the induced voltage at the joint.

1c.4 Tests and Test reports

The proposed splicing kit shall have successfully passed all the type tests or design tests in accordance with the reference standards.

The test reports shall be submitted either prior to receipt of bids or fifteen (15) days counted from the bid closing date.

The above type tests may be omitted if a record of tests made on identical ones can be supplied.

Standard factory tests shall be made in accordance with routine tests stated in reference standards.

There (3) sets of routine test reports shall be submitted at the time of delivery.

1d Packing

Each splicing kit shall be packed individually with installation instructions and list of materials to be supplied for each kit.

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 fork lift trucks.

Plastic foam shall not be accepted.

C2 Material and packing data to be given by bidder

2a Technical proposals

The attached sheets for splicing kits are the form for filling technical data. All blanks shall be filled in with the required information and figures.

(1) Catalog .
(2) Outline drawing .
(3) Installation instruction .
(4) Applied standard .

2b Drawing with main dimensions and exact installation instruction of splicing kits shall be submitted.

2c List of special tools with itemized price, if any.

2d Packing details

Principal dimensions of each package in cm .
Gross weight of each package in kg .
Number of packages in each case .
Principal dimensions of each case in cm .
Gross weight of each case in kg .
Volume of each case in m^3.
Number of cases .

Table 1

Physical Dimensions of 22 kV Single-core XLPE Underground Power Cable

Nominal cross-sectional area of conductor	mm^2	35	50	185	240	400	500
Diameter of conductor ± 1%	mm	6.95	8.33	15.98	18.47	23.39	26.67
Diameter over insulation, approx.	mm	19.0	20.5	28.0	30.5	35.5	39.0
Total cross-sectional area of copper wire screen, minimum	mm^2	10	10	25	25	25	25
Overall diameter, approx.	mm	28	30	38	42	48	52

Table 2

Physical Dimensions of 33 kV Single-core XLPE Underground Power Cable

Nominal cross-sectional area of conductor	mm^2	50	120	185	240	400	500
Diameter of conductor ± 1%	mm	8.33	12.95	15.98	18.47	23.39	26.67
Diameter over insulation, approx.	mm	25.5	30.0	33.0	35.5	40.5	44.0
Total cross-sectional area of copper wire screen, minimum	mm^2	10	10	25	25	25	25
Overall diameter, approx.	mm	35	40	44	47	55	58

Invitation to Bid No. :

Specification No. :

Proposed Technical Data for Splicing Kit

Material Number		
Manufacturer		
Country		
Catalog number (to be attached)		
Outline drawing number (to be attached)		
Installation instruction number (to be attached)		
Applied standard, publication number and year		
Confirm to attach list of standard factory tests including descriptive details (yes or no)		
Voltage rating kV		
Lightning impulse withstand voltage, dry kV crest		
Power frequency withstand voltage For 1 minute, dry kV		
For 6 hours, dry kV		
DC withstand voltage for 15 minutes, dry kV		
Partial discharge extinction voltage at .....pC kV		

Invitation to Bid No. :

Specification No. :

Proposed Technical Data for Splicing Kit

Material Number		
Hight voltage time test For 5 h kV		
For 1 h kV		
Stress control Method (stress cone, voltage gradient material, etc.		
Type (slip on, heat shrink, tape wrapping etc.)		
Material		
Splicing housing Type (slip on, heat shrink, tape wrapping etc.)		
Material		
Single piece or two piece design		
Range of diameter over insulation to be accommodated with mm		
Range of overall diameter to be accommodated with mm		
Compression connector Manufacturer		

Invitation to Bid No. :

Specification No. :

Proposed Technical Data for Splicing Kit,

Material Number		
Applied standard, publication number and year		
Catalog number (to be attached)		
Material		
Conductor type and size to be accommodated with mm^2		
Range of diameter of conductor to be accommodated with mm		
Ground screen connection Connection device (wire or mesh tube)		
Material		
Confirm to be provided with connector for wire connection (yes or no)		

Invitation to Bid No. :

Specification No. :

Proposed Technical Data for Splicing Kit

Material Number		
Earthing device Catalog number (to be attached kV		
Specify type of cable screen to be used with (wire screen or tape screen)		
Material of housing		
Outer sheath Type (slip on, heat shrink, tape wrapping etc.		
Material		
Guaranteed period after shipment years		
Storage condition for the guaranteed period (to be specified)		
Expected service life after installation years		
Packing Confirm to be packed individually for each kit (yes or no)		
Confirm to be included with installtion instruction for each kit (yes or no)		
Net weight kg		
Packing detailed drawing number (to be attached)		

Invitation to Bid No. :

Specification No. : R-775/2539

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
1	02170006		Splicing kit, premolded slip-on type or shrinkable type, for 22 kV system voltage, single-core, cross-linked polyethylene insulated copper cable, conductor size 185 mm^2 . Each kit complete with : 1) Stress control, splicing housing , connector, ground screen connection, outer sheath, and earthing device. 2) Necessary installation materials, installation instructions, and accessories.
2	02170007		Ditto as Item 1, but conductor size 240 mm^2 .
3	02170009		Ditto as Item 1, but conductor size 400 mm^2 .
4	02170008		Ditto as Item 1, but conductor size 500 mm^2 .

Invitation to Bid No. :

Specification No. : R-775/2539

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
5	02170106		Splicing kit, premolded slip-on type or shrinkable type, for 33 kV system voltage, single-core, cross-linked polyethylene insulated copper cable, conductor size 185 mm^2 . Each kit complete with : 1) Stress control, splicing housing , connector, ground screen connection, outer sheath, and earthing device. 2) Necessary installation materials, installation instructions, and accessories.
6	02170107		Ditto as Item 5, but conductor size 240 mm^2 .
7	02170108		Ditto as Item 5, but conductor size 400 mm^2 .
8	02170109		Ditto as Item 5, but conductor size 500 mm^2 .

Specification No. : R-775/2539

Proposed Technical Data for Splicing Kit

PEA Material No._____

Manufacturer	-	
Country of origin	-	
Catalog No. (to be attached)	-	
Outline drawing No. (to be attached)	-	
Installation instruction No. (to be attached)	-	
Applied standard, publication No. and year	-	
Confirm to attach list of standard factory tests including descriptive details	(Yes/No)	
Rated voltage	kV	
Lightning impulse withstand voltage	kV crest	
Power frequency withstand voltage		
For 1 minute, dry	kV	
For 6 hours, dry	kV	
DC withstand voltage, for 15 minutes, dry	kV	
Partial discharge extinction voltage at .....pC	kV	
Hight voltage time test		
For 5 hours	kV	
For 1 hour	kV	
Stress control		
Method (stress cone, voltage gradient material, etc.)	-	
Type (slip on, heat shrink, tape wrapping, etc.)	-	
Material	-	
Splicing housing		
Type (slip on, heat shrink, tape wrapping, etc.)	-	
Material	-	
Single-piece or two-piece design	-	
Range of diameter over insulation to be accommodated with	mm	
Range of overall diameter to be accommodated with	mm	

Specification No. : R-775/2539

Proposed Technical Data for Splicing Kit

PEA Material No._____

<u>Compression connector</u> Manufacturer	-	
Applied standard, publication No. and year	-	
Catalog No. (to be attached)	-	
Material	-	
Conductor type and size to be accommodated with	mm^2	
Range of diameter of conductor to be accommodated with	mm	
<u>Ground screen connection</u> Connection device (wire or mesh tube)	-	
Material	-	
Confirm to be provided with connector for wire connection	(Yes/No)	
<u>Earthing device</u> Catalog No. (to be attached)		
Specify type of cable screen to be used with (wire screen or tape screen)	-	
Material of housing	-	
<u>Outer sheath</u> Type (slip on, heat shrink, tape wrapping, etc).	-	
Material	-	
Guaranteed period after shipment/delivery	Years	
Storage condition for the guaranteed period (to be specified)	-	
Expected service life after installation	Years	
<u>Packing</u> Confirm to be packed individually for each kit	(Yes/No)	
Confirm to be included with installtion instruction for each kit	(Yes/No)	
Net weight	kg	
Packing detailed drawing No. (to be attached)	-	

2.4.5 Lightning Arrester for 22 kV

Invitation to Bid No.:

C Material, equipment, and specifications for HIGH VOLTAGE SURGE ARRESTERS

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed:

1a Scope

These specifications cover HV surge arresters of non-linear metal-oxide resistor type without spark gaps, for a.c. power systems and outdoor installation.

1b Standards

The HV surge arresters shall be manufactured and tested in accordance with the following standard:

Thai Industrial Standards (TIS):

TIS 2366-2551 [IEC 60099-4 Edition 2.1 (2006-07)] Metal-oxide surge arresters without gaps for a.c. systems

And all other relevant standards, unless otherwise specified in these specification.

PEA will also accept the HV surge arresters tested in accordance with the later edition of the above standard.

1c Principal requirement

1c.1 General

The housing of the HV surge arresters shall be polymeric material.

Each HV surge arrester shall be hermetically sealed and suitable for outdoor installation and using in tropical climatic area and highly contaminated atmosphere or heavy pollution level.

1c.2 Service conditions and installation

The HV surge arresters shall be suitable for connecting directly to the line and operation under the following conditions:

Altitude	:	up to 1,000 m above sea level
Maximum ambient temperature	:	up to 40 ^{O}C
Mean annual relative humidity	:	79%
Mean maximum annual relative humidity	:	94%
Climatic	:	tropical climate

1c.3 Ratings and characteristics

The HV surge arresters shall have ratings and characteristics equal to or better than those specified in **Tables 1 Ratings and characteristics of HV surge arresters**.

1c.4 Disconnecting device

Each 5 kA HV surge arrester and 10 kA HV surge arrester with line discharge class 2 shall be fitted with disconnecting device.

The disconnecting device is not required for 10 kA HV surge arrester with line discharge class 3.

1c.5 Line terminal and connector

Line terminal of the HV surge arrester shall be the threaded stud type.

Connector (Terminal lug) suitable for connecting aluminium conductor to the line terminal shall be provided. The connector shall be compression type and shall be made of aluminium. Each connector shall be furnished with one (1) nut, two (2) flat washers and one (1) spring lock washer. The nuts, washers and spring lock washers shall be made of stainless steel, or better. Sizes of the alulminium conductors are specified in **C3 Schedule of detailed requirement**.

1c.6 Ground terminal and connectors

Ground terminal of the HV surge arresters shall be the threaded stud type.

Connector (Terminal lug) suitable for connecting flexible copper insulated ground lead to the ground terminal shall be provided. The connector shall be compression type and shall be completed with one (1) nut, one (1) flat washer and one (1) spring lock washer. The nuts, washers and spring lock washers shall be made of stainless steel, or better.

Connector, M 8 U-bolt clamp type, suitable for connecting the flexible copper insulated ground lead to galvanized steel stranded conductor shall be provided.

Sizes of the flexible copper insulated ground leads and galvanized steel stranded conductors are specified in **C3 Schedule of detailed requirement**.

1c.7 Marking

PEA's trademark, as the figure below, shall be made an integral part of each HV surge arrester or on the nameplate.

1c.8 Insulated mounting base

Each 5 kA HV surge arrester and 10 kA HV surge arrester with line discharge class 2 shall be assembled with an additional insulating mounting base for connecting to a wide variety of mounting brackets.

1c.9 Mounting bracket

Mounting brackets for the 5 kA HV surge arrester and 10 kA HV surge arrester with line discharge class 2, if required (**see C3 Schedule of detailed requirement),** shall be similar to EEI-NEMA mounting bracket and shall be suitable for mounting on cross-arm, section of 100 mm x 100 mm to 120 mm x 120 mm, with carriage bolts of not less than 150 mm long.

10 kA HV surge arrester with line discharge class 3 shall be self-supporting and mounted on solid hot-dip galvanized steel supporting structures suitable for mounting on cross-arm as specified above.

1c.10 Bird guard cap

Each line terminal of the HV surge arresters shall have a bird guard cap made of ultra-violet resistant and tracking resistant material, e.g. polypropylene, neoprene, etc; which is suitable for exposure to sunlight.

1c.11 Samples

Samples shall be supplied on request. In case the samples are requested by PEA, the bidder have to supply samples of each type of HV surge arresters in quantity requested within fifteen (15) calendar days.

The bidders who cannot supply the requested samples shall be rejected.

PEA reserves the right to test the samples according to PEA's testing procedure. In case of the failing test results, the bidders shall be rejected.

The samples shall not be returned.

1d Tests and test reports

The HV surge arresters shall be passed type tests (design tests) in accordance with TIS 2366-2551 [IEC 60099-4 Edition 2.1 (2006-07)] by the following test items[1)]:

1) Insulation withstand tests on the arrester housing
2) Residual voltage tests
3) Long-duration current impulse withstand tests
4) Operating duty tests
5) Short-circuit tests[2)]
6) Tests of arrester disconnectors (when fitted)
7) Internal partial discharge tests
8) Bending moment tests

9) Environment tests

10) Weather ageing tests[3)]

Note:

1) PEA will also accept the HV surge arresters passed the type tests in accordance with the later edition of the above standard which may have a different test items or test procedure comparing with TIS 2366-2551 [IEC 60099-4 Edition 2.1 (2006-07)].

2) The test current shall not be less than 10 kA r.m.s. for 5 kA surge arresters and shall not be less than 20 kA r.m.s. for 10 kA surge arresters.

3) The duration of the tests shall not be less than 1,000 hours (Test series A).

The type tests shall be conducted by the acknowledged independent testing laboratories.

The following independent testing laboratories and institutes are accepted by PEA:

- KEMA : KEMA Laboratories (THE NETHERLANDS)
- V'Fall : Statens Vattenfallsverk, The Swedish State Power Board (SWEDEN)
- CRIEPI : Central Research Institute of Electric Power Industry (JAPAN)
- EdF : Electrical de France (FRANCE)
- CESI : Centro Elettrotecnico Sperimentale Italiano (ITALY)
- PLI : Powertech High Power Laboratory (CANADA)
- STRI : Swedish Transmission Research Institute (SWEDEN)
- ……. : Testing and Certification (AUSTRALIA)
- ……. : Ontario Hydro Technologies (CANADA)
- SATS : Scandinavian Association for Testing Electric Power Equipment (NORWAY)
- ASTA : ASTA certification services (UK)
- EGAT : The Electricity Generating Authority of Thailand (THAILAND)
- ……. : Testing Laboratory, Electrical Engineering Department, Faculty of Engineering, Chulalongkorn University (THAILAND)
- TISI : Thai Industrial Standards Institute (THAILAND)

The bidder are at liberty to quote the HV surge arresters which are tested by the other independent testing laboratories not mentioned above, but have to be subjected to approval of PEA before the tests are proceeded and before the bid closing date.

The type test certificate(s) or test report(s) of the HV surge arresters having same type as the proposed HV surge arresters shall be submitted with the bid or within fifteen (15) calendar days after the bid closing date. The Item offered without submitting the type test reports shall be rejected.

The HV surge arresters shall be passed the routine tests in accordance with TIS 2366-2551 [IEC 60099-4 Edition 2.1 (2006-07)] at least the following tests items:

1) Measurements of reference voltage (U_{ref}) at the reference current (I_{ref})
2) Residual voltage tests on complete arresters, assembled arrester units or on a sample comprising one or several resistor elements
3) Internal partial discharge tests

The HV surge arresters shall be passed the acceptance tests in accordance with TIS 2366-2551 [IEC 60099-4 Edition 2.1 (2006-07)] at least the following tests items:

1) Measurements of power-frequency voltage on the complete arresters at the reference current (I_{ref})
2) Lightning impulse residual voltage tests on complete arresters or arrester units
3) Internal partial discharge tests

Note:
PEA will also accept the HV surge arresters passed the routine tests and the acceptance tests in accordance with the later edition of the above standard which may have a different test items or test procedure comparing with TIS 2366- 2551 [IEC 60099-4 Edition 2.1 (2006-07)].

Each lot of the HV surge arresters supplied, PEA reserves the right to have the acceptance test made by the supplier's factory or by acknowledged independent testing laboratories on the random samples, which are chosen by PEA's acceptance committee, as follows:

1) Three (3) samples, for the supply of no more than 5,000 units
2) Five (5) samples, for the supply of more than 5,000 units

The costs of all tests and reports shall be borne by the Contractor.

1e Packing

Each set of the HV surge arresters including all accessories shall be packed in a suitable package. Plastic foam shall not be accepted.

The packages of the same item shall be packed in seaworthy wooden case(s) to avoid damage during transportation; or the packages of the same item shall be packed in suitable package(s) for delivery by container.

Each wooden case(s) shall be strong enough for stacking over with at least another one.

If the wooden case(s) is made of rubber wood (Yang-para or Hevea brasiliensis), the wooden parts shall be treated with wood preservative.

The details of wood treatment shall be described.

C2 Material and packing data to be given by bidder

For each item offered, the following details shall be submitted:

2a Details of the HV surge arresters

Manufacturer's name/country of origin

Catalogue number

Description of materials used for the component parts

Surface finishing of the component parts

Details about working of metal-oxide

Details of sealing and testing

2b Design data and guarantee of the proposed HV surge arresters:

Proposed Item……

Characteristics	Unit	Proposed data
Applied standard	-	
Rated voltage (U_r)	kV r.m.s.	
Continuous operating voltage (U_c)	kV r.m.s.	
Rated frequency	Hz	
Nominal discharge current (I_n)	kA peak	
Maximum residual voltage (U_{res}) at nominal discharge current	kV peak	
Rated short-circuit current (I_s) Total duration of test current	kA r.m.s. s	
High-current impulse withstand	kA peak	
Line discharge class Minimum long-duration current impulse withstand Virtual duration of peak	- A peak μs	
Material of arrester housing	-	
Minimum creepage distance from live part to ground	mm	
Weight of one surge arrester including accessories	kg	

2c Drawings of surge arresters including all accessories with main dimensions in mm

2d Drawings of connectors, clamps, earth leads, and mounting brackets with dimensions in mm; and specifications of materials used for the component parts

2e **Drawing of disconnecting devices showing the internal construction, and time-current characteristic curves of disconnecting devices**

2f **Manufacturer's name and technical data of arrester housings**

2g **List of routine tests**

2h **Packing details**

Packing method (shown by drawing(s), and describe packing materials)
Number of sets in each package (one)
Dimensions of each package in cm
Gross weight of each package in kg
Net weight of each package in kg
Number of packages

If several packages are contained in one big case, further details are required:
Dimensions of each case in cm
Volume of each case in m^3
Gross weight of each case in kg
Number of packages in each case
Number of cases
Type of storage facility required (indoor/outdoor)

Note: **Conditions for documentation and consideration**

1. The Contractor has to supply reports of routine tests, in English and/or Thai, before shipment/delivery, to the following address:

Power System Standard Division
Provincial Electricity Authority
200 Ngam Wong Wan Road, Chatuchak
Bangkok Metropolis 10900
Thailand

2. The bidders have to submit the sufficient references describing the previous experience of the suppliers (e.g. list of supply of equipment and/or materials having the same or similar design as proposed, field experience, the registration of TISI, the copies of license, and/or the inspection to supplier's factory by PEA's inspectors, etc.) to the satisfaction of PEA.
3. Delivery time is one of the important factors to be considered.

Table 1

Ratings and characteristics of HV surge arresters

Characteristics	Unit	Requirements									
Rated voltage (U_r)	kV r.m.s.	3	21			24			30		
Rated frequency	Hz	50	50			50			50		
Nominal discharge current (I_n)	kA peak	5	5	10	10	5	10	10	5	10	10
Maximum residual voltage (U_{res}) at nominal discharge current	kV peak	24	70	60	60	80	68.5	68.5	100	85.5	85.5
Rated short-circuit current (I_s)	kA r.m.s.	10	10	20	20	10	20	20	10	20	20
High-current impulse withstand	kA peak	65	65	100	100	65	100	100	65	100	100
Line discharge class	-	-	-	2	3	-	2	3	-	2	3
Minimum long-duration current impulse withstand	A peak	75	75	-	-	75	-	-	75	-	-
Virtual duration of peak	μs	1,000	1,000	2,000	2,400	1,000	2,000	2,400	1,000	2,000	2,400
Minimum creepage distance from live part to ground	mm	-	600	600	600	600	600	600	900	900	900

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
1	1040009903	sets	HV surge arrester, suitable for 5 kV supply system, with: Rated voltage (U_r) : 3 kV r.m.s. Nominal discharge current (I_n) : 5 kA peak Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.
2	1040000000	sets	HV surge arrester, suitable for 22 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 21 kV r.m.s. Nominal discharge current (I_n) : 5 kA peak Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
3	1040000002	sets	HV surge arrester, suitable for 22 kV distribution system with neutral grounding resistor (NGR), with: Rated voltage (U_r) : 24 kV r.m.s. Nominal discharge current (I_n) : 5 kA peak Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.
4	1040000100	sets	HV surge arrester, suitable for 33 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 30 kV r.m.s. Nominal discharge current (I_n) : 5 kA peak Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
5	1040000001	sets	HV surge arrester, suitable for 22 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 21 kV r.m.s. Nominal discharge current (I_n) : 10 kA peak Line discharge class : 2 Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.
6	1040000009	sets	HV surge arrester, suitable for 22 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 21 kV r.m.s. Nominal discharge current (I_n) : 10 kA peak Line discharge class : 3 Complete with line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
7	1040000003	sets	HV surge arrester, suitable for 22 kV distribution system with neutral grounding resistor (NGR), with: Rated voltage (U_r) : 24 kV r.m.s. Nominal discharge current (I_n) : 10 kA peak Line discharge class : 2 Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.
8	1040000010	sets	HV surge arrester, suitable for 22 kV distribution system with neutral grounding resistor (NGR), with: Rated voltage (U_r) : 24 kV r.m.s. Nominal discharge current (I_n) : 10 kA peak Line discharge class : 3 Complete with line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
9	1040000101	sets	HV surge arrester, suitable for 33 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 30 kV r.m.s. Nominal discharge current (I_n) : 10 kA peak Line discharge class : 2 Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.
10	1040000105	sets	HV surge arrester, suitable for 33 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 30 kV r.m.s. Nominal discharge current (I_n) : 10 kA peak Line discharge class : 3 Complete with line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, mounting bracket for mounting the arrester in vertical (90^O) position on a cross-arm, and bird guard cap.

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
11	1040000007	sets	HV surge arrester, suitable for 22 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 21 kV r.m.s. Nominal discharge current (I_n) : 5 kA peak Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with one (1) bolt M 12x50 mm (of at least 40 mm thread length), one (1) nut, two (2) flat washers and one (1) spring lock washer of stainless steel or better (without mounting bracket) for mounting the arrester in vertical (90^O) position on a transformer tank, and bird guard cap.
12	1040000008	sets	HV surge arrester, suitable for 22 kV distribution system with neutral grounding resistor (NGR), with: Rated voltage (U_r) : 24 kV r.m.s. Nominal discharge current (I_n) : 5 kA peak Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with one (1) bolt M 12x50 mm (of at least 40 mm thread length), one (1) nut, two (2) flat washers and one (1) spring lock washer of stainless steel or better (without mounting bracket) for mounting the arrester in vertical (90^O) position on a transformer tank, and bird guard cap.

II

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
13	1040000106 II	sets	HV surge arrester, suitable for 33 kV distribution system with solidly-grounded system, with: Rated voltage (U_r) : 30 kV r.m.s. Nominal discharge current (I_n) : 5 kA peak Complete with disconnecting device, line terminal and connector (terminal lug) suitable for aluminium conductor diameter of 7.5 - 9.0 mm (sizes 35 – 50 mm^2), ground terminal and connector (terminal lug) with flexible copper insulated ground lead size 16 mm^2 and length of no less than 430 mm and M 8 U-bolt clamp type connector for connecting the ground lead to galvanized steel stranded conductor diameter of 9.0 mm, insulated mounting base with one (1) bolt M 12x50 mm (of at least 40 mm thread length), one (1) nut, two (2) flat washers and one (1) spring lock washer of stainless steel or better (without mounting bracket) for mounting the arrester in vertical (90^O) position on a transformer tank, and bird guard cap.

2.4.6 Disconnecting Switch for 22 kV

Invitation to Bid No. :

Specification No. : R-902/2542

C Material, equipment, and specifications for SINGLE-POLE HIGH-VOLTAGE DISCONNECTING SWITCHES FOR INSTALLATION ON DISTRIBUTION CIRCUITS

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed :

1a Scope

These specifications cover single-pole high-voltage disconnecting switches (disconnectors, isolators) suitable for outdoor installation on 22 kV and 33 kV 50 Hz distribution circuits.

1b Standard

The single-pole high-voltage disconnecting switches shall be manufactured and tested in accordance with the latest IEC Publication 129, ANSI C 37, NEMA Standard SG 6, or equivalent; unless otherwise specified in these specifications.

1c Principal requirement

1c.1 General

The high-voltage disconnecting switches shall be single-pole, single-throw, designed and constructed for outdoor installation and operation under the following condition :

Altitude	: up to 1,000 m above sea level
Ambient air temperature	: up to 40^{o}C
Relative humidity	: up to 100 %

Each set of the disconnecting switches shall comprise :

a) Steel channel, or aluminium channel base, with mounting strap(s) and mounting hardware.
b) Two (2) supporting insulators.
c) Two-copper-bus-bar blade.
d) Operating eye, inner diameter of not less than 26 mm, to permit hookstick operation.
e) Positive latch, to prevent accidental opening.
f) 90^{o} open position blade stop.

g) Contacts, stationary and moving, of silver to copper or silver to silver.

h) Mechanism to maintain good contact pressure.

i) Two (2) loadbuster hooks.

j) Terminal pads, of high conductivity materials (preferably bronze with tin plated) which are drilled in accordance with NEMA Standards, two-hole (9/16" holes on 1 3/4" centers), and designed for connecting to aluminium terminal connectors (lugs) .

Complete with pad mounting hardware (bolts of 50 mm (2") long, nuts, washers, and lockwashers) of stainless steel.

k) Nameplate with inscriptions.

l) Others according to manufacturer's design.

1c.2 Supporting insulators

The supporting insulators shall be in accordance with the latest ANSI/NEMA Standards, i.e. TR 208 for 22 kV switch and TR 210 for 33 kV switch; except their cantilever strengths shall not be less than 450 kg (1,000 lbs) . Brown glazed insulators are preferable.

1c.3 Mounting

The disconnecting switches shall be suitable for mounting and operating in both vertical mounting position and horizontal underhung position. The channel bases, mounting straps, and mounting hardwares (bolts, nuts, washers, and lockwashers) shall be suitable for mounting the switches on double cross-arm, as shown in the enclosed drawing.

1c.4 Galvanizing

All ferrous materials, other than stainless steel, shall be hot-dip galvanized according to ASTM Specifications or equivalent.

1c.5 Electrical characteristics

The disconnecting switches shall have electrical characteristics equal to or better than those specified in Table 1 or 2 .

1c.6 Sample

Samples shall be supplied on request.

1d Packing

Three (3) disconnecting switch sets, including their accessories shall be seaworthy packed in a wodden case or crate to avoid damage during transportation.

If the wooden case or crate is made of rubber wood (Yang-para or Hevea brasiliensis), the wooden parts shall be treated with wood preservative.

The details of wood treatment shall be described.

Plastic foam shall not be accepted.

1e Tests and test reports

The disconnecting switches shall pass the manufacturer's standard routine tests.

The following type/design tests in accordance with the latest IEC Publication 129, or ANSI C 37 and NEMA Standard SG 6, or equivalent, shall be made :

a) Insulation level tests, or Dielectric tests.
b) Temperature-rise tests.
c) Short-circuit current tests, or Short-time current tests.
d) Mechanical endurance tests, or Mechanical operation tests.

The supporting insulators shall pass manufacturer's standard routine tests.

The design tests shall be made in accordance with ANSI/NEMA Standard C 29 or equivalent.

The above type/design tests shall be conducted at the internationally acknowledged reputable test laboratories and may be omitted if a record of the tests made on identical units can be supplied.

Bidders, who have never submitted the test reports, have to submit the test reports either prior to receipt of bids or within fifteen (15) calendar days of the bid closing date, for saving bid consideration time.

The costs of all tests and reports shall be borne by the Contractor.

C2 Material and packing data to be given by bidder

2a Guarantee performance data of the single-pole disconnecting switches (vide Pages 5 of 9 and to 6 of 9) .

2b Details, drawings and/or catalogues, with dimensions in mm, of :

(1) Complete set of the disconnecting switch.

(2) Channel base, with mounting strap(s) and mounting hardware.

(3) Supporting insulator.

(4) Terminal pad.

(5) Nameplate with inscriptions.

(6) Etc .

2c Description of materials used for the component parts for :

(1) Channel base, with mounting strap(s) and mounting hardware.

(2) Supporting insulator.

(3) Blade.

(4) Contact.

(5) Loadbuster hook.

(6) Terminal pad.

(7) Etc .

2d List of routine tests .

2e Packing details

Packing method (shown by drawing(s) and describe packing materials) .

Number of disconnecting switch sets in each case or crate (three (3) sets) .

Dimensions (L x W x H) of each case or crate in cm .

Volume of each case or crate in m^3 .

Gross weight of each case or crate in kg .

Number of cases or crates.

Invitation to Bid No. :

Specification No. : R-902/2542

2a.1 GUARANTEE PERFORMANCE DATA OF SINGLE-POLE DISCONNECTING SWITCH

Item.....

Manufacturer's name			
Country of origin			
Type / Model / Catalogue No.			
Applied standards			
RATING :			
Rated voltage	kV		
Rated maximum voltage	kV		
Rated frequency	Hz	50/60	
Rated insulation level :		To earth and between poles	Across the isolating distance
rated impulse withstand voltage (BIL)	kV, peak		
rated 1-min power-frequency withstand voltage, dry	kV, rms		
rated 10-s power-frequency withstand voltage, wet	kV, rms		
Rated continuous current	A		
Rated short-time current; (For ANSI/NEMA)			
rated momentary current	kA, rms		
rated three-second current	kA, rms		

Invitation to Bid No. :

Specification No. : R-902/2542

Item.....

Rated short-time withstand current (For IEC)	kA, rms						
Rated duration of short-circuit (For IEC)	s						
Rated peak withstand current (For IEC)	kA						
CONTACTS :		Jaw end			Hinge end		
		Stationary		Moving	Stationary		Moving
Base material (e.g., copper)							
Surface treatment material / Thickness		/ µm		/ µm	/ µm		/ µm

TEMPERATURE RISE

At rated continuous current & rated frequency, over a range of ambient temperature of 10^{o}C to 40^{o}C, of :

Jaw end contacts	^{o} C			
Hinge end contacts	^{o} C			

MISCELLANEOUS :

Make and type of insulators	-		Colour	
Weight of each set	kg			

2a.2 If the detail documents of Item 1 on Page 7 of 9 shall be sent to PEA before shipment/delivery :

(Yes / No) .....

Note : Conditions for documentation and consideration

1. The Contractor has to send reports of routine test, in **English and/or Thai**, before shipment/delivery, to the following address :

   Electrical and Mechanical Engineering Division

   Provincial Electricity Authority

   200 Ngam Wong Wan Road, Chatuchak

   Bangkok Metropolis 10900

   Thailand

2. The Bidder has to submit reports of type/design tests and sufficient references describing the previous experience of the manufacturer (e.g. list of supply of equipment having the same or similar design as proposed, field experience, the registration of TISI, the copies of license, and/or the inspection to manufacturer by PEA's inspectors, etc.) to the satisfaction of PEA .

Table 1

Electrical Characteristics of Single-Pole Disconnecting Switches According to IEC Publication 129, Series I

For distribution circuit/system voltage / Characteristics	kV	22	33
Rated voltage	kV	24	36
Rated insulation level, to earth and between poles :			
rated impulse withstand voltage	kV, peak	125	170
rated 1-min power-frequency voltage, dry	kV, rms	50	70
Rated frequency	Hz	50	50
Rated normal (continuous) current	A, rms	630	630
Rated short-time withstand current	kA, rms	16	16
Rated duration of short-circuit	s	1	1
Rated peak withstand current	kA	40	40

Table 2

Electrical Characteristics of Single-Pole Disconnecting Switches According to ANSI C 37

For distribution circuit/system voltage / Characteristics	kV	22	33
Rated voltage	kV	-	-
Rated maximum voltage	kV	25.8	38.0
Rated frequency	Hz	50/60	50/60
Rated continuous current	A, rms	600	600
Rated short-time current :			
rated momentary current (asymmetrical)	kA, rms	40	40
rated three-second current	kA, rms	25	25
Rated withstand voltage, to earth and between poles :			
rated impulse withstand voltage, BIL	kV, crest	150	200
rated 1-min power-frequency withstand voltage, dry	kV, rms	70	95
rated 10-s power-frequency withstand voltage, wet	kV, rms	60	80

.

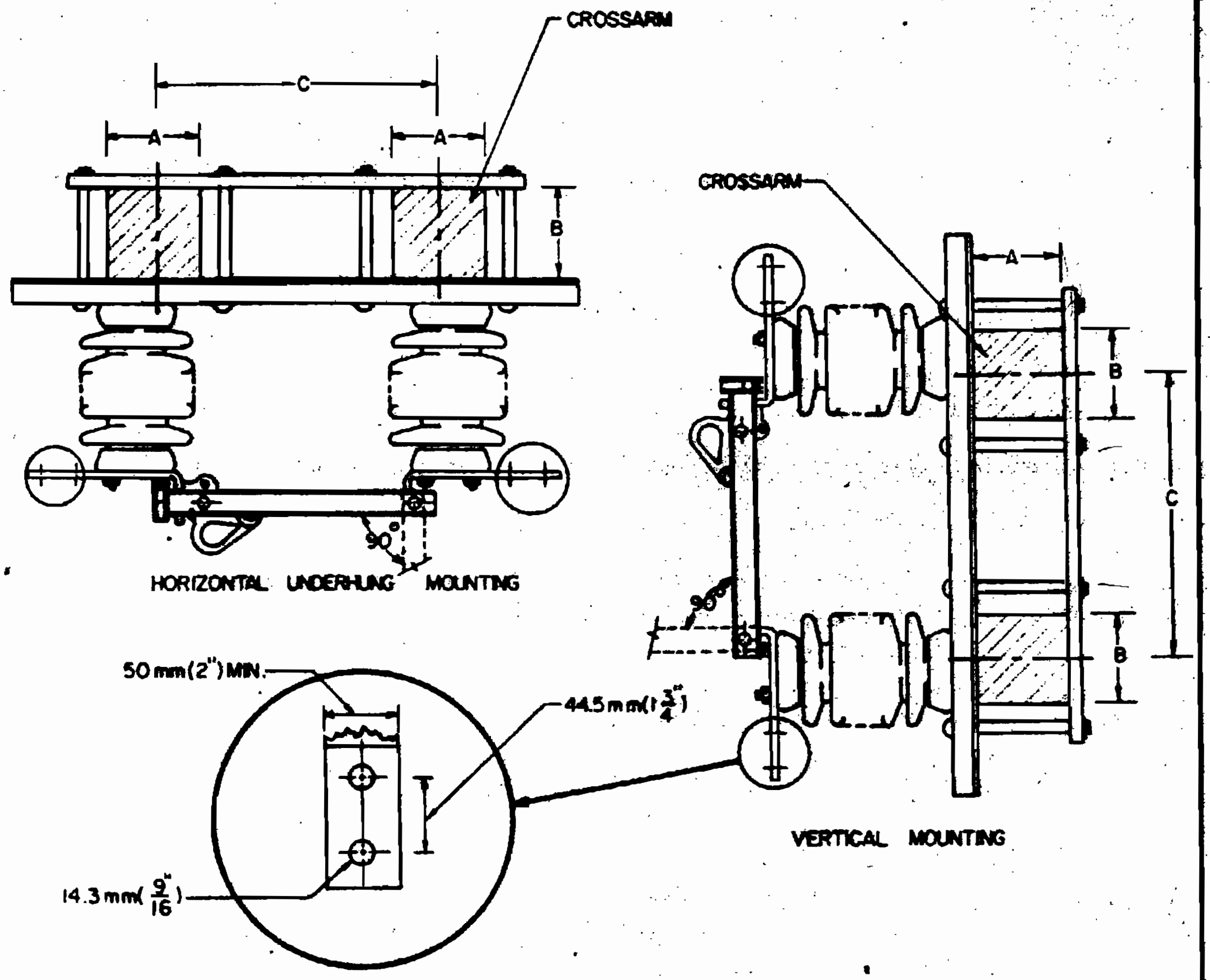
Invitation to Bid No. :

Specification No. : R-902/2542

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
1	04050000		Single-pole disconnecting switch, hookstick operated, outdoor type, for system voltage 22 kV 50 Hz : Standard : IEC, or ANSI & NEMA Rated continuous current : 630 A or 600 A Complete with terminal pads of 2-hole (terminal connectors are not included), installation instruction and mounting accessories.
2	04050100		Ditto as Item 1, but system voltage 33 kV 50 Hz . **Note :** Enclosed Drawing No. SA2-015/26004 .

การประกอบเลขที่
ASSEMBLY NO.



DOUBLE CROSSARM A X B	C
FROM 100 X 100	FROM 250
TO 120 X 120	TO 300

PRELIMINARY

ALL DIMENSIONS ARE IN MILLIMETERS

DO NOT SCALE

กองวิศวกรรมไฟฟ้าและเครื่องกล ฝ่ายวิศวกรรม	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ........
ผู้เขียน ผู้ลอก ผู้ตรวจ หัวหน้าแผนก ผู้อำนวยการกอง ผู้อำนวยการฝ่าย	ผู้อนุมัติ..........	ถูกแทนโดยแบบ........ เขียนเสร็จวันที่ 23 ก.พ. 2526 แก้แบบครั้งที่........ มิติเป็น........ มิลลิเมตร มาตราส่วน........
รองผู้ว่าการฝ่ายเทคนิค	SINGLE POLE DISCONNECTING SWITCHES FOR 22 kV & 33 kV DISTRIBUTION CIRCUITS	แบบเลขที่ SA2-015/26004 แผ่นที่ 1 ของจำนวน 1 แผ่น

2.4.7 Fuse cutout and Fuse link for 22 kV

Invitation to Bid No:

C Material, equipment, and specifications for HIGH-VOLTAGE DISTRIBUTION FUSE CUTOUTS AND FUSE LINKS

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed:

1a Scope

These specifications cover high-voltage distribution fuse cutouts (fuse cutouts) and fuse links; suitable for installation in 22 kV and 33 kV 50 Hz distribution systems with solidly grounded neutral at substations.

1b Standards

The fuse cutouts and fuse links shall be manufactured and tested in accordance with following standard:

Institute of Electrical and Electronics Engineers (IEEE)

IEEE C37.42-2009 : IEEE Standard specifications for high-voltage (>1000 V) expulsion-type distribution-class fuses, fuse and disconnecting cutouts, fuse disconnecting switches, and fuse links, and accessories used with these devices

And all other relevant standard, unless otherwise specified in these specification

PEA will also accept the fuse cutouts and fuse links tested in accordance with the later version of the above standard.

1c Principal requirement

1c.1 Service conditions and installation

The fuse cutouts and fuse links shall be suitable for operation under the following conditions:

Altitude	: up to 1,000 m above sea level
Ambient air temperature	: up to 40^{o}C
Relative humidity	: up to 94 %
Climatic condition	: tropical climate

1c.2 Fuse cutouts

The fuse cutout shall be single-pole, single throw, drop-open, outdoor single venting type, and shall have fuse holder. The construction of the fuse cutout is shown in **figure 1** in drawing No.**SA4-015/56004** attached.

Each fuse cutout shall be comprised and equipped with:

1) Contacts, stationary and moving, of silver to silver
2) Fuse holder, suitable for removable buttonhead type fuse link. Thread dimension of solid cap of the fuse holder shall be M 22 x 2 mm . Fuse holder fittings shall be made of high conductivity copper-alloy casting. Fuse tube shall be made of fiberglass reinforced. Inner diameters of pulling eye and lifting eye shall be not less than 26 mm. Dimensions of the 22 kV and 33 kV fuse holders shall be according to **figure 2** and **figure 3** shown in drawing No.**SA4-015/56004** respectively.
3) Spring loaded flipper. The spring loaded shall be designed for receiving pressure at the fuse holder of not less than 6 kg.
4) Spring latch to prevent opening under vibration
5) Upper and lower terminal connectors (pads) and cable lugs, 2-hole NEMA pad. The bolts, nuts, lockwashers and spring lockwashers (if any), furnished on the terminal pads and cable lugs, shall be made of stainless steel or better.
6) Upper and lower shield mounting parts, made of galvanized steel grade HR1, or better
7) Upper contact shield, made of galvanized steel grade HR1, or stainless steel grade 304, or brass with Cu $\geq$80% (i.e. UNS C93600, JIS CAC 406 (BC 6))
8) Loadbuster hooks
9) Insulator, porcelain, alternate shed, single piece and bird-proofed, preferably brown glazed. Complete with insulator mounting support made of galvanized steel grade HR1, or better
10) Lower contact shield (Hinge support), made of stainless steel grade 304 or brass with Cu $\geq$80% (i.e. UNS C93600, JIS CAC 406 (BC 6))
11) Mounting bracket, type B according to IEEE C37.42, suitable for cross-arm section range of 100 mm x 100 mm to 120 mm x 120 mm, with carriage bolts of not less than 150 mm long, see **figure 4** and **figure 5** shown in drawing No.**SA4-015/56004**
12) Others according to manufacturer's design.

When mounting the fuse cutout on the mounting bracket, the center line through the top and bottom of the insulator shall be at an angle of 15° to 30° from the vertical.

The fuse cutouts shall have characteristics as follows:

Characteristics \ Nominal system voltage	kV	22	33
	Unit	**Requirement**	
Rated frequency	Hz	50	50
Rated maximum (design) voltage	kV r.m.s.	27	38
Rated continuous current	A r.m.s.	Stated in **"C3 Schedule of detailed requirement"**	
Rated interrupting current	kA r.m.s.		
Basic impulse insulation level (BIL), with standard wave	kV peak	not less than 125	not less than 150
Minimum power frequency dry withstand test voltage, terminal to ground	kV r.m.s.	42	70
Minimum creepage distance of porcelain insulator from live part to ground	mm	320	650
Minimum creepage factor of insulator (Creepage distance/Arcing distance)	-	2.0	2.3

1c.3 Fuse links

The fuse links shall be removable button head type. Thread dimension of button head and arc shortening rod shall be 1/4"-28UNF. The fuse element shall be soldered each both end. Dimension of the fuse link shall be according to **figure 6** shown in drawing No.**SA4-015/56004**.

The electrical properties of the fuse link must be guaranteed and shall be designed to prevent the fuse holder damage from arc interruption when the fuse blows.

1c.4 Samples

Samples shall be supplied on request. In case of samples are requested by PEA, The bidder have to supply samples of each item of the fuse cutouts or the fuse links within fifteen (15) calendar days. The bidders who cannot supply the requested samples shall be rejected.

PEA reserves the right to test the samples according to PEA's testing procedure. In case of the failing test results, the bidders shall be rejected.

The samples shall not be returned.

1c.5 Markings

The markings shall be marked legibly and durably as follows:

1) PEA's trademark (as figure below), manufacturer's name and/or trademark, month and year of manufacture, and contract number shall be marked on the fuse cutout body (insulator or metal part).

2) Manufacturer's name and/or trademark, month and year of manufacture, contract number, and ratings (rated maximum voltage, rated continuous current and rated interrupting current) shall be marked on the fuse holder (metal part only).
3) The marking on the fuse cutout body and fuse holder using plastic sticker shall not be accepted.
4) Amperage shall be marked on each buttonhead of the fuse links.
5) Other according to manufacturer's design

1d Packing

The fuse cutouts shall be separately seaworthy packed in suitable carton boxes.

Each fuse link shall be separately packed in suitable packages.

The carton boxes/packages shall be packed in pallet base crate or pallet base wooden case to avoid damage during transportation, see **Table 1** for packing detail.

If the pallet base crate or pallet base wooden case is made of rubber wood (Yang-para), the wooden parts shall be treated with wood preservative. The details of wood treatment shall be described.

Table 1

Packing details of fuse cutouts

System voltage (kV)	Quantity per carton box (set)	Quantity per pallet base crate /pallet base wooden case (carton boxes)
22	1	50
33	1	40

1e Test inspection and test reports

The fuse cutouts and fuse links shall be passed the manufacturer's standard routine tests, and also passed the routine tests in accordance with the relevant IEEE standard.

The routine test items shall be submitted with the bid.

The fuse cutouts and fuse links shall be passed all items of the type/design tests in accordance with the relevant IEEE standard and shall be passed additional type/design test items as follows:

Nominal system voltage / Test items/Description	kV	22	33
- Minimum basic impulse insulation level (BIL) (Procedure B according to IEEE 4 "Fifteen impulse of the specified shape and polarity at the withstand voltage level are applied to the test object. The requirements of the test are satisfied if not more than two disruptive discharges occur in the self-restoring part of the insulation.")	kV peak	125	150
- Minimum critical impulse flashover voltage (CFO)	kV peak	140	165
- Minimum power-frequency wet test voltage, terminal to ground, at 60 s	kV r.m.s.	36	60

All items of the type/design tests and additional type/design tests shall be conducted by the acknowledged independent testing laboratory.

The following independent testing laboratories accepted by PEA:

- KEMA : KEMA Laboratories (THE NETHERLANDS)
- V' Fall : Statens Vattenfallsverk, The Swedish State Power Board (SWEDEN)
- CRIEPI : Central Research Institute of Electric Power Industry (JAPAN)
- EdF : Electricite de France (FRANCE)
- CESI : Centro Elettrotecnico Sperimentale Italiano (ITALY)
- PLI : Powertech High Power Laboratory (CANADA)
- STRI : Swedish Transmission Research Institute (SWEDEN)
- TCA : Testing and Certification (AUSTRALIA)
- OHT : Ontario Hydro Technologies (CANADA)
- EGAT : The Electricity Generating Authority of Thailand (THAILAND)
- …….. : Testing Laboratory, Electrical Engineering Department, Faculty of Engineering, Chulalongkorn University (THAILAND)
- SATS : Scandinavian Association for Testing Electric Power Equipment (NORWAY)
- ASTA : ASTA Certification Services (UK)

The bidder are at liberty to quote the fuse cutouts and fuse links which are tested at the other independent testing laboratories not mentioned above, but have to be subjected to approval of PEA before the tests are proceeded and before the bid closing date.

PEA will also accept type/design test reports accordance with the relevant IEEE standards conducted by the manufacturer or other independent testing laboratories not mentioned above. In this case the bidder shall submit evidence of the manufacturing experience of at least twenty (20) years of fuse cutouts and fuse links.

PEA will also accept the fuse cutouts and fuse links have been supplied to PEA and get the order from PEA's Procurement Department (from PEA's Head office), without test reports by laboratories mentioned above.

The type/design test certificates or test reports of the fuse cutouts and fuse links having same type/design as the proposed fuse cutouts and fuse links shall be submitted with the bid or within fifteen (15) calendar days after the bid closing date. The Item offered without submitting the type test reports shall be rejected.

The costs of all tests and reports shall be borne by the Contractor.

PEA reserves the right to send the representatives at PEA's expense to inspect and witness test 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.

The acceptance inspection by PEA shall be as follows:

- **Dimension and pressure tests for the fuse holders**

  Ten (10) samples of the fuse holders shall be selected at random from each lot and tested in accordance with following items:

  (1) Dimensional test

  The dimensions of all samples shall be measured by PEA's standard gauge as shown in drawing **No.SA4-015/56005**.

  (2) Pressure test

  The pressure test of all samples shall be tested by PEA's standard measuring device as shown in drawing No.**SA4-015/56005**.

  In case of the test failed more than one (1) sample for either dimensional test or pressure test, another ten (10) samples of the fuse holders shall be selected and tested for dimension and pressure testing, all samples shall be passed the tests.

- **Mechanical strength (operation) test for the fuse cutouts**

  Three (3) samples of the fuse cutouts shall be selected at random from each lot. The samples shall be mounted on the testing machine as shown in drawing No.**SA4-015/56006** for mechanical strength (operation) test at 200 operations under load of 475 ± 25 N. After the test all samples shall be no crack or loose on any part components.

C2 Material and packing data to be given by bidder

2a For each item offered, the following details shall be submitted:

Fuse cutouts

Catalogue number

Manufacturer's name and technical data of insulators

Description of materials and surface finishing of the component parts of fuse cutouts, as follows:

- Contacts
- Fuse holders; fuse tubes, and fuse holder fittings
- Spring loaded flippers
- Spring latches
- Upper and lower terminal connectors
- Upper and lower shield mounting parts
- Upper contact shield
- Loadbuster hooks
- Insulator
- Lower contact shield (Hinge support)
- Mounting brackets
- etc.

Rated frequency in Hz

Rated maximum (design) voltage in kV r.m.s.

Rated continuous current in A r.m.s.

Rated interrupting current in kA r.m.s.

Basic impulse insulation level (BIL), with standard wave in kV peak

Minimum power frequency dry withstand test voltage, terminal to ground in kV r.m.s.

Creepage distance of porcelain insulator from live part to ground in mm

Creepage factor of insulator

Range of fuse links which can be used with the same fuse cutout

Contact resistance in Ω

Weight in kg/set

Fuse links

Catalogue number

Description of materials used for the component parts

Surface finishing of the contacts

Rated current in A

Chart of melting time (current in A depending on melting time in second)

Chart of clearing time (current in A depending on clearing time in second)

Weight in kg/100 pieces

2b Details and drawings, with main dimensions in mm, of:

- Fuse cutouts
- Insulators
- Terminal connectors
- Hinge supports
- Fuse holders
- Fuse holder caps
- Mounting brackets
- Fuse links

2c Packing details

Fuse cutout

Packing method (shown by drawing(s) and describe packing materials)

Number of fuse cutout(s) in each carton box

Dimensions of each carton box in cm

Volume of each carton box in m^3

Gross weight of each carton box in kg

Net weight of each carton box in kg

Number of carton boxes

If several carton boxes are contained in pallet base crate or pallet base wooden case, further details are required:

Number of carton boxes in each pallet base crate or pallet base wooden case

Dimensions of each pallet base crate or pallet base wooden case in cm

Volume of each pallet base crate or pallet base wooden case in m^3

Gross weight of each pallet base crate or pallet base wooden case in kg

Number of pallet base crates or pallet base wooden cases

Fuse link

Packing method

Dimensions of each package in cm

Volume of each package in m^3

Gross weight of each package in kg

Net weight of each package in kg

Number of packages

If several packages are contained in one big case, further details are required:

Number of packages in each case

Dimensions of each case in cm

Volume of each case in m^3

Gross weight of each case in kg

Number of cases

Note: Conditions for documentation and consideration

1. The **Contractor** has to supply documents as follows:
   (1) One (1) set of instruction book for installation, operation and maintenance of the fuse cutouts shall be packed together with each package **in English or Thai**.
   (2) Reports of type/design tests and routine tests of the proposed fuse cutouts and fuse links shall be sent to the Authority, thirty (30) calendar days before the first shipment, at the following address:

   Power System Standard Division
   Provincial Electricity Authority
   200 Ngam Wong Wan Road, Chatuchak
   Bangkok Metropolis 10900 Thailand
2. Delivery time is one of the important factors to be considered.

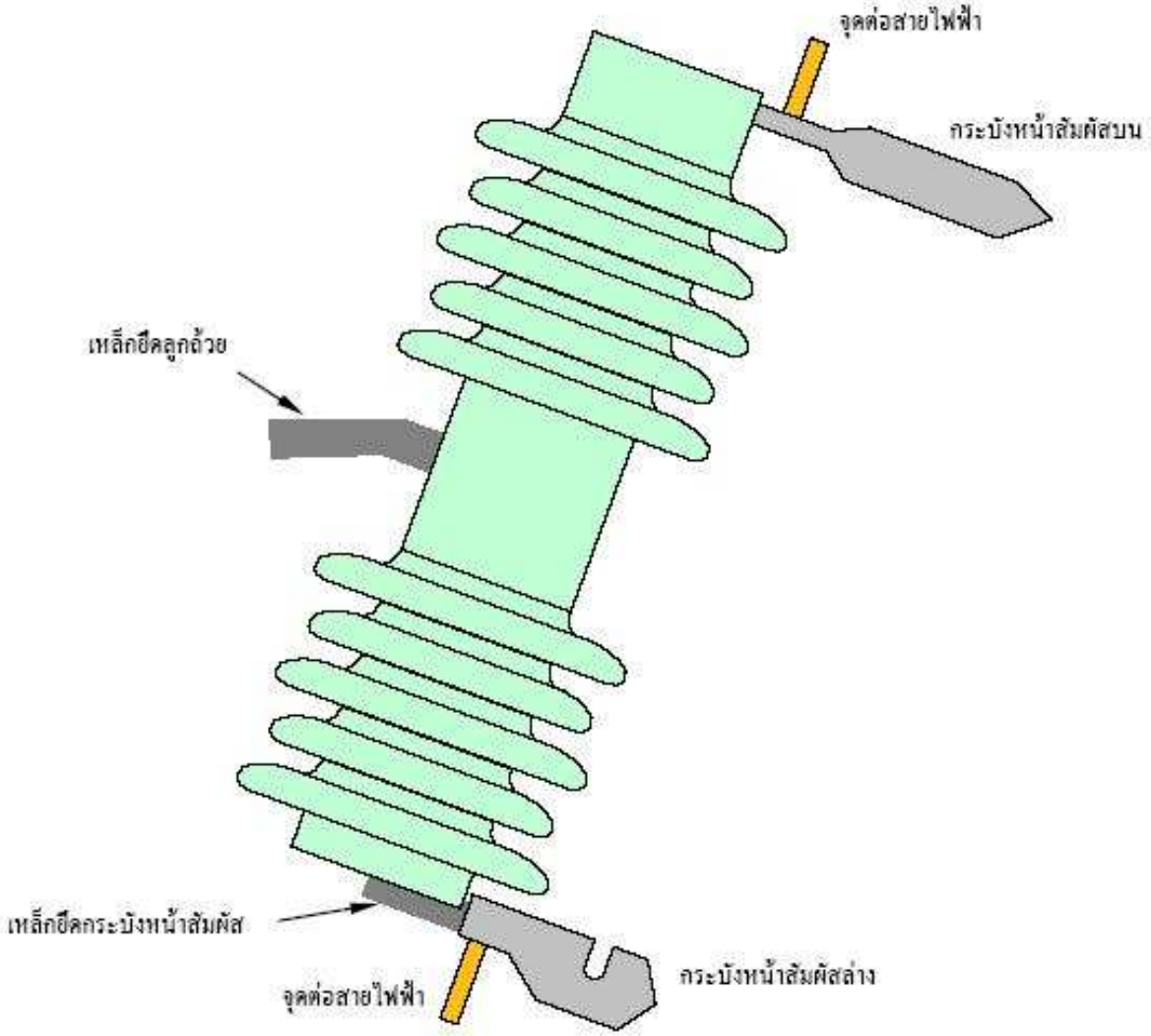


Figure 1.1 Construction of fuse cutout

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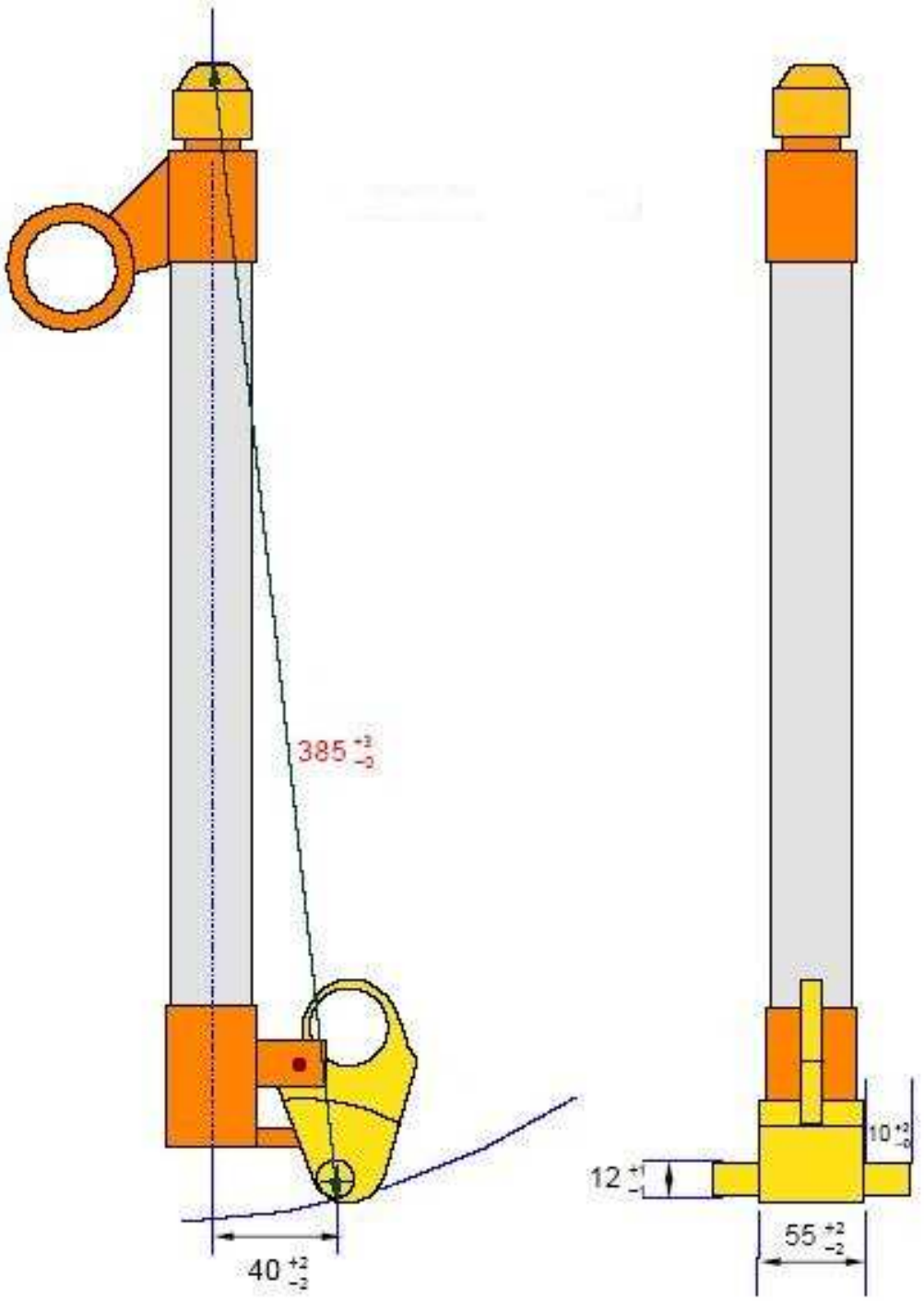

Figure 1.2 Fuse holder for 22 kV

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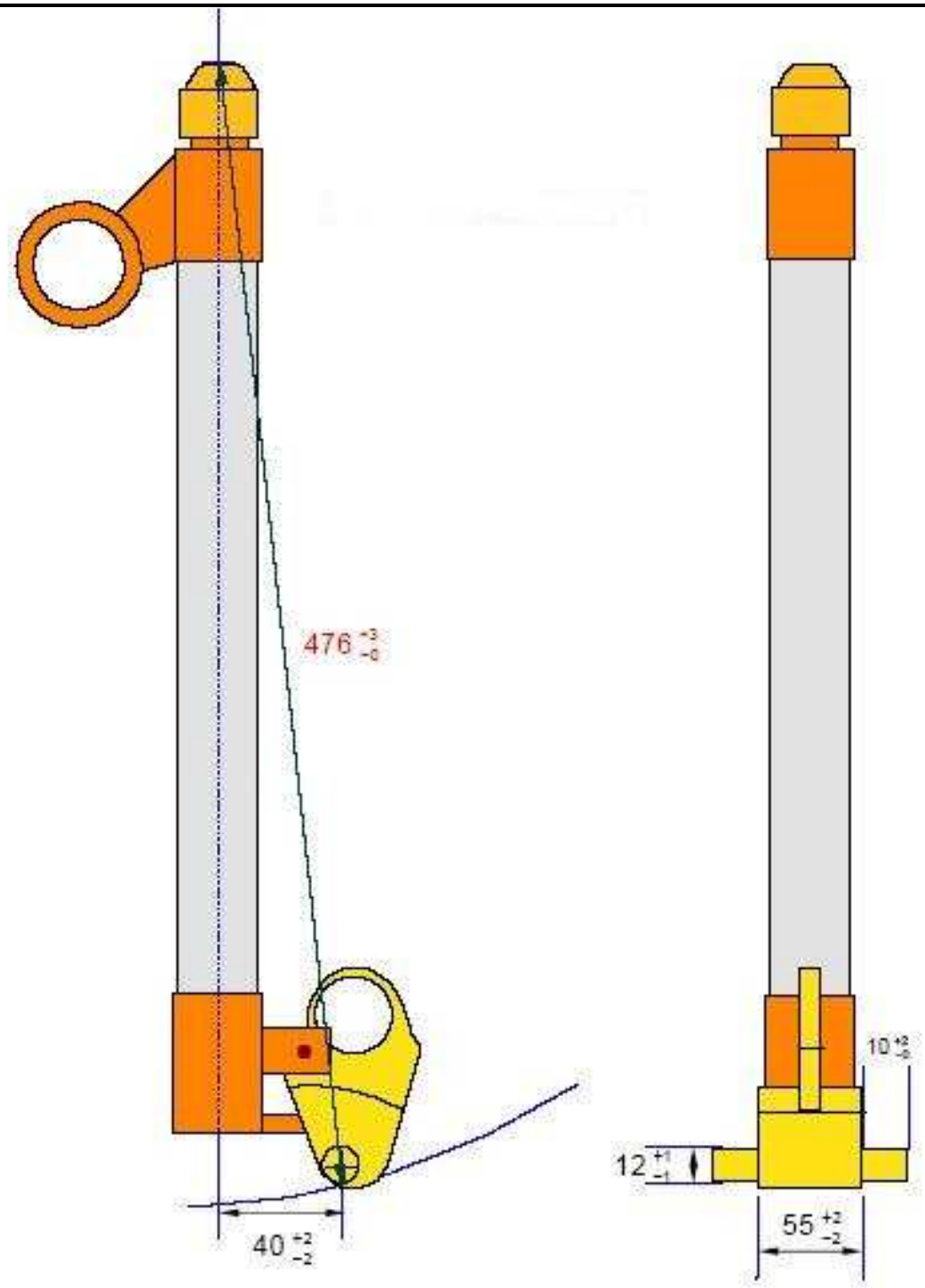

Figure 1.3 Fuse holder for 33 kV

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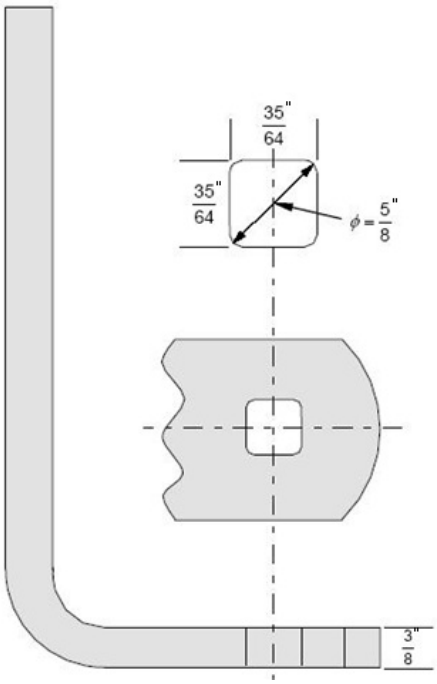

Figure 1.4 Type B mounting bracket according to IEEE C37.42

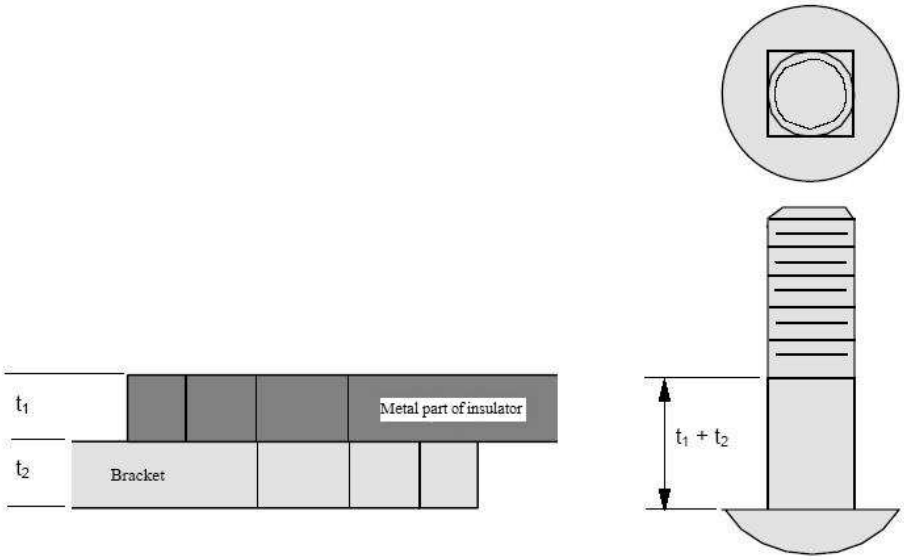

Figure 1.5 Bolt for connect bracket to metal part of insulator

Note :

- All dimension in inch.
- Tolerance of all dimensions shall be according to IEEE C37.42.

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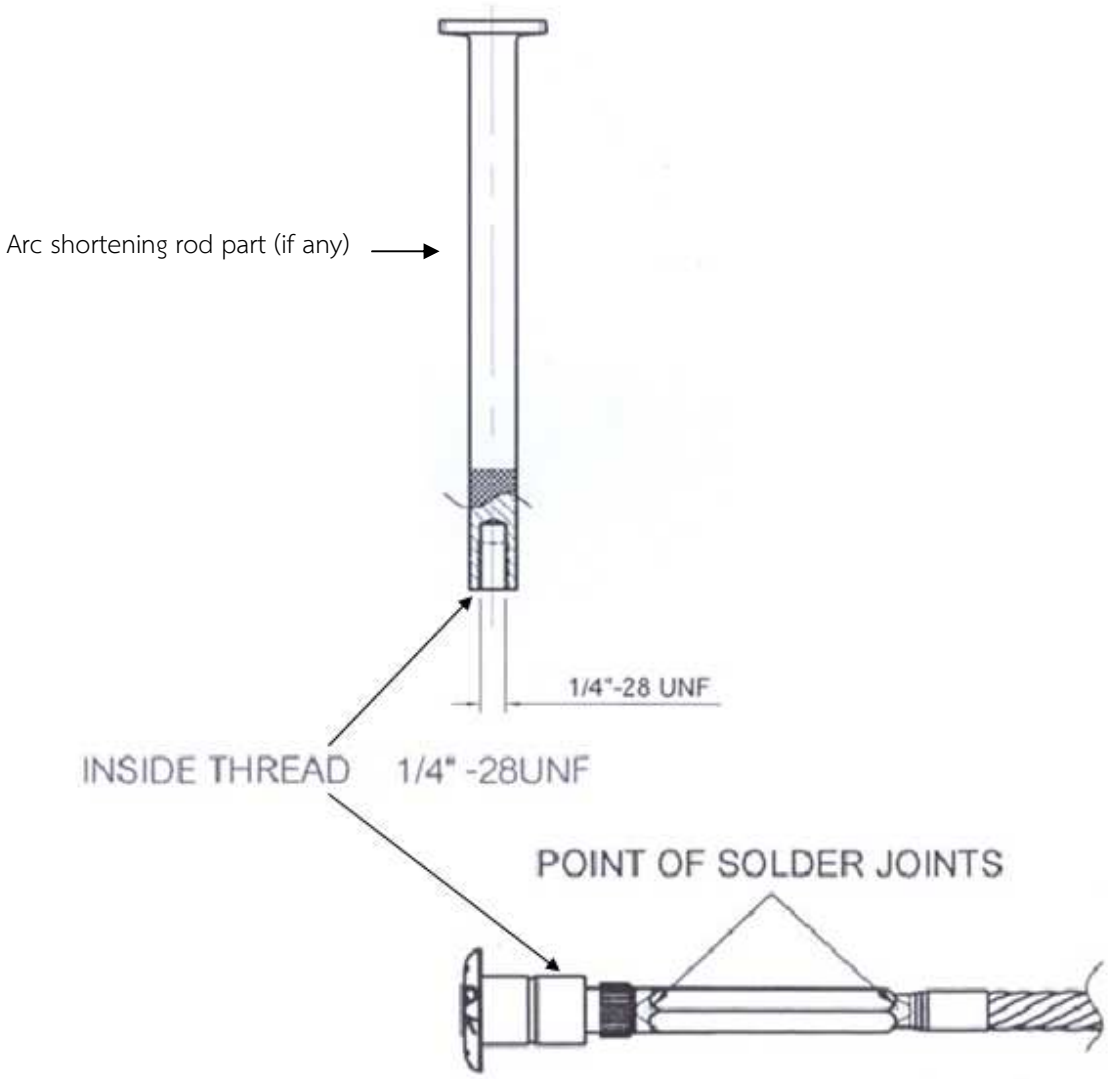

Figure 1.6 Thread dimension of button head and arc shortening rod

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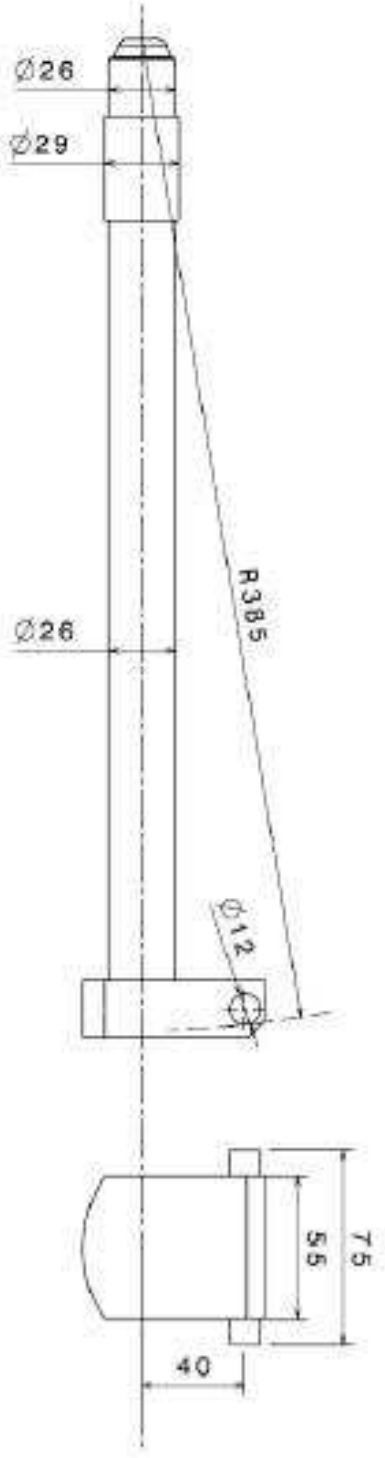

Figure 1.2 Fuse holder for 22 kV

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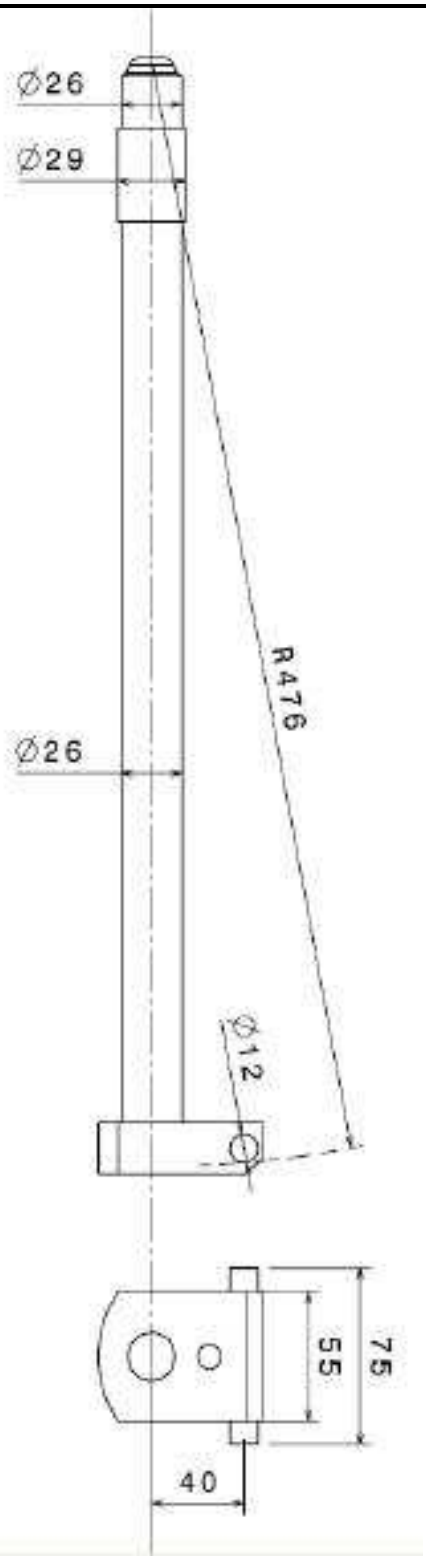

Figure 1.3 Fuse holder for 33 kV

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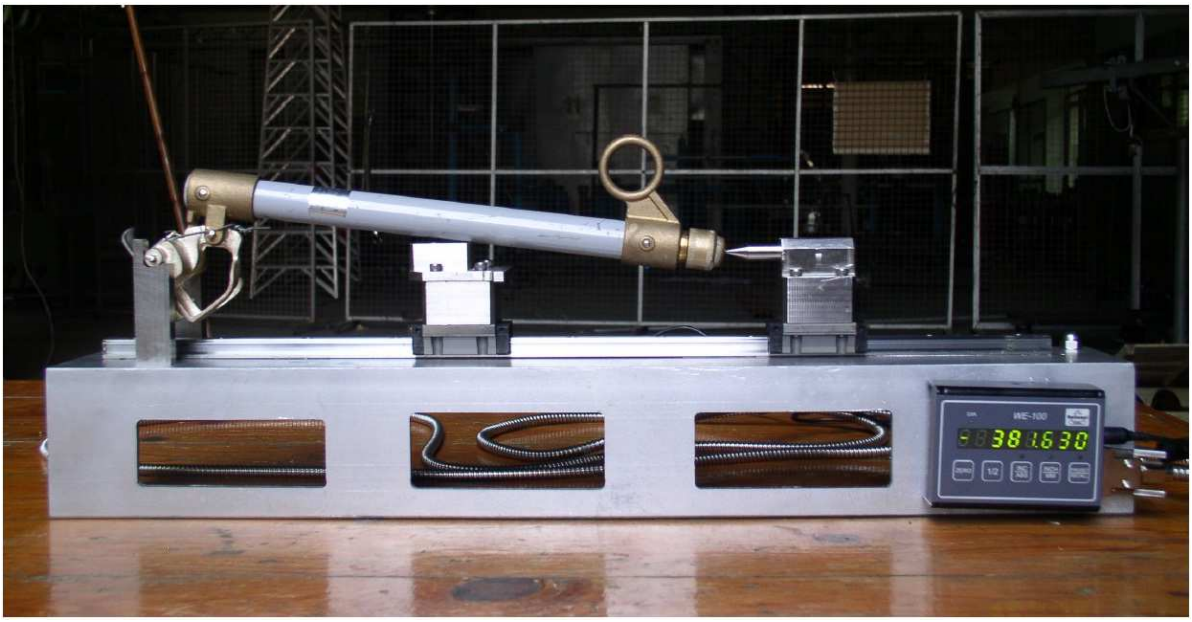

Fuse holder length measuring device

Fuse holder pressure measuring device

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ..... เขียนเสร็จวันที่..... แก้แบบวันที่..... มิติเป็น.....-..... มาตราส่วน.....
ผู้เขียน....จุมพล แก้วยิ้ม..... ผู้สำรวจ..... วิศวกร....จุมพล แก้วยิ้ม..... หัวหน้าแผนก.....	Dimension and pressure tests for the fuse holders	
ผู้อำนวยการกอง..... ผู้อำนวยการฝ่าย.....	Appendix II	แบบเลขที่ SA4-015/56005 แผ่นที่.....3.....ของจำนวน.....3.....แผ่น

Fuse cutout closing machine

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ..... เขียนเสร็จวันที่..... แก้แบบวันที่..... มิติเป็น.....-..... มาตราส่วน.....
ผู้เขียน....จุมพล แก้วยิ้ม..... ผู้สำรวจ..... วิศวกร....จุมพล แก้วยิ้ม..... หัวหน้าแผนก.....	Mechanical strength (operation) test for the fuse cutouts	
ผู้อำนวยการกอง..... ผู้อำนวยการฝ่าย.....	Appendix III	แบบเลขที่ SA4-015/56006 แผ่นที่.....1.....ของจำนวน.....1.....แผ่น

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
1	1040010002	1 lot	1.1____sets. Fuse cutout, with fuse holder having a solid cap, for 22 kV distribution system, with : Rated continuous current : 100 A Rated interrupting current at : not less than 8 kA, r.m.s. symmetrical, or X/R ratio of 12 not less than 12 kA, r.m.s. asymmetrical Complete with mounting bracket, and accessories.
	1040010006		1.2____pcs. Spare fuse holder, for the fuse cutout in 1.1 .
2	1040010100	1 lot	2.1____sets. Fuse cutout, with fuse holder having a solid cap, for 33 kV distribution system, with :. Rated continuous current : 100 A Rated interrupting current at : not less than 5 kA, r.m.s. symmetrical, or X/R ratio of 15 not less than 8 kA, r.m.s. asymmetrical Complete with mounting bracket, and accessories.
	1040010102		2.2____pcs. Spare fuse holder, for the fuse cutout in 2.1 .

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
3	1040030000		Fuse link, removable buttonhead, type K or H, length not less than 650 mm, system voltage 22 kV, rated current 1 A .
4	1040030001		Ditto as Item 3, but rated current 2 A .
5	1040030002		Ditto as Item 3, but rated current 3 A .
6	1040030003		Ditto as Item 3, but rated current 5-6 A .
7	1040030004		Fuse link, removable buttonhead, type K, length not less than 650 mm, system voltage 22, kV rated current 8 A .
8	1040030005		Ditto as Item 7, but rated current 10 A .
9	1040030006		Ditto as Item 7, but rated current 15 A .
10	1040030007		Ditto as Item 7, but rated current 20 A .
11	1040030008		Ditto as Item 7, but rated current 25 A .
12	1040030009		Ditto as Item 7, but rated current 30 A .
13	1040030010		Ditto as Item 7, but rated current 40 A .
14	1040030011		Ditto as Item 7, but rated current 50 A .
15	1040030012		Ditto as Item 7, but rated current 65 A .

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
16	1040030013		Ditto as Item 7, but rated current 100 A .
17	1040030101		Fuse link, removable buttonhead, type K or H, length not less than 760 mm, system voltage 33 kV, rated current 2 A .
18	1040030102		Ditto as Item 19, but rated current 3 A .
19	1040030103		Ditto as Item 19, but rated current 5-6 A .
20	1040030104		Fuse link, removable buttonhead, type K, length not less than 760 mm, system voltage 33 kV, rated current 8 A .
21	1040030105		Ditto as Item 22, but rated current 10 A .
22	1040030106		Ditto as Item 22, but rated current 15 A .
23	1040030107		Ditto as Item 22, but rated current 20 A .
24	1040030108		Ditto as Item 22, but rated current 25 A .
25	1040030109		Ditto as Item 22, but rated current 30 A .
26	1040030110		Ditto as Item 22, but rated current 40 A .
27	1040030111		Ditto as Item 22, but rated current 50 A .

2.4.8 Fault indicator for OH Line, RMU and Compact Unit Substation

PROVINCIAL ELECTRICITY AUTHORITY

POWER SYSTEMS STANDARD DIVISION

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
1	1020440300		1.1 ..... set(s) Fault indicator, shall be able to indicate on both phase to phase fault and earth fault, shall be designed for hot line installation and disconnection with grip-all clampstick or universal head stick, firmly attached to the overhead line, water resistant and operating properly in direct sunlight, all metal parts shall be non-corrosive material, shall be designed to work with upstream reclosing circuit breaker, recloser and fuse in order to have the choice to indicate on either temporary or permanent fault, shall have an inrush restraint feature, and shall be designed to avoid any false operation or proximity tripping from any adjacent unshielded conductors, with : Standard : the latest ANSI/IEEE 495 (guide for testing faulted circuit indicators) For system voltage : 22 kV to 33 kV Phase : single-phase Minimum conductor spacing for properly operation of fault indication and inrush restraint : not more than 240 mm Setting method : current threshold - Setting range for current threshold : 250 to 1,000 A, or better (selectable) Operating time : not more than 100 ms De-energization detecting method : loss of current Maximum available fault current : 25 kA (sym.) Reset method : timer and manual, or better Resetting time : 2 hours Clamping range : up to 35 mm, or better Indication : LED flashlight

C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
			Visibility : up to 100 m. distance in bright day-light Flashing frequency : not less than 10 times/minute Operating temperature : up to 70 ^{o}C Power supply : lithium battery of not less than 10 years shelf life 1.2 1 lot. Adapter for installation and disconnection of fault indicator by a clampstick or universal head stick, if necessary (number requires approximately 5% of the fault indicator, but not less than 5 sets). 1.3 1 lot. Any reset and test equipment, if necessary (number required approximately 5% of the fault indicator, but not less than 3 sets). Note. : 1. The proposed fault indicator shall have successfully passed all the type tests or design tests in accordance with the applicable standards. 2. 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. 3. The bidder has to quote the Unit Costs; and portion of Item shall not be considered. 4. The bidder has to quote optional accessories with a list of quantities and their itemized prices, if any; PEA reserves the right to purchase the optional accessories by some or all items, to adjust their quantities, or to cancel them. 5. The bidder has to supply one(1) complete set as sample, within fifteen(15) days, counted from the Committee's request. The sample will be returned after consideration.

2.4.9 Compact Ring Main Unit for 22 kV

C Material, equipment, and specifications for COMPACT RING MAIN UNIT FOR 22 kV and 33 kV 50 Hz UNDERGROUND DISTRIBUTION SYSTEM

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed:

1a Scope

These specifications cover compact ring main unit for installation on 22 kV and 33 kV 50 Hz underground distribution systems.

1b Standard

The compact ring main unit shall be manufactured and tested in accordance with following standard:

International Electrotechnical Commission (IEC):

IEC 62271-202: 2006 High-voltage switchgear and controlgear - Part 202: High-voltage/low voltage prefabricated substation

And all other relevant standard, unless otherwise specified in these specification.

PEA will also accept the compact ring main unit tested in accordance with the later edition of the above standard.

1c Principal requirement

1c.1 Service condition and installation

The compact ring main unit shall be designed and constructed for outdoor installation and operation under the following conditions:

Altitude	: up to 1,000 m above sea level
Maximum ambient air temperature	: 40 ^{o}C
Mean annual ambient temperature	: 30 ^{o}C
Mean annual relative humidity	: 79 %
Mean maximum annual relative humidity	: 94 %
Climatic condition	: tropical climate
Maximum seismic factor	: 0.1 g
Lightning stroke expectancy	: 100 thunder storm days/year
Specific corrosive elements at site	: salt; soot

The compact ring main unit housing shall have protection class of IP34 or better.

The compact ring main unit shall be suitable for installation in the public area such as crowded side-walk. Public safety and attractive design are also the main points in bid consideration. The compact ring main unit shall be designed, constructed and tested to meet at least the following requirements:

1. The compact ring main unit enclosure shall pass the internal arc test according to IEC 62271-202: 2006 or later edition, accessibility type B.

   The bidder shall provide type test certificate of an independent institute to prove that the offered compact ring main unit shall meet the above requirements. These type test certificates shall be submitted with the bid.

2. The compact ring main unit housing shall be strong enough to retain the protective function of the housing against access of the live-parts in case of external impact.

PEA will accept the deviation of the proposed compact ring main unit comparing to the type test reports carried out according to clause **1e.2** in the following conditions:

- The proposed compact ring main unit housing could have bigger dimensions than the dimensions stated in type test reports but not bigger than the dimension limits specified in this specification.
- The ring main units could be different manufacturer or type from the ones installed in compact ring main unit at the time of type testing carried out.

1c.2 Compact ring main unit construction

The compact ring main unit shall be assembled on a common base frame as one piece, easily transported without any special tool. Therefore the compact ring main unit shall be provided with suitable lifting facilities.

The housing shall be designed and manufactured of standardized parts. All housing parts are made of galvanized and powder coated steel sheets with a steel thickness of not less than 2.0 mm, a zinc thickness of not less than 0.225 kg/m^2 and an electrostatic plastic powder coat thickness of not less than 75 μm. Inner walls are either made of galvanized or stainless steel.

The Reinforced concrete or stainless steel housing shall be accepted. The thickness of stainless steel sheet shall be of not less than 1.5 mm.

The design and construction of the compact ring main unit shall be weatherproof, fully tropicalized suitable for outdoor use in a humid tropical climate and it shall be unaffected by moisture, dust, condensation or any other ambient condition.

The housing shall be able to prevent detrimental dust from entering into the station, 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 housing. The housing shall be vermin-proof.

Accesses doors shall be provided with handle and be able to be latched in the open position. All mounting hardware (i.e. locking devices, hinges, pins, bolts, nuts) shall be stainless steel. All locks shall be provided with master keys and duplicate keys.

The base of compact ring main unit shall be suitable for mounting on concrete pad or foundation. The concrete pad/foundation shall be constructed by PEA and shall be limited to those portions which required to be cast in site only.

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

The compact ring main unit shall require minimum or no maintenance. No high-voltage live-parts shall be accessible.

Except otherwise specified all metal surface shall be treated to protect them against corrosion and finished with final coat of top quality paint in grey or factory standard colour. The bidder shall state the final colours available which PEA shall select before signing the contract.

The painting process shall be described in the bid. (Especially for installation located close to the sea within 1 km). The manufacturer shall be able to prove that the select process can protect the surface against corrosion when exposed to humid and polluted atmosphere. It shall also possess excellent surface adhesion and reasonable immune to abrasion and external impact.

The minimum of one earthing points shall be provided for each station. The earthing points shall be made of non-corrosive material throughout such as stainless steel. All metal parts are galvanic connected.

All parts and any necessary installation materials (such as cable clamps, cable terminals, cable heads, fixing hardware etc.) shall be completely furnished so that the compact ring main unit can be put into operation when arrived at site and primary and secondary cables are connected.

The housing of compact ring main unit shall be designed and erected to install not less than four (4) functional units of RMU.

1c.3 Compact ring main unit equipment

The compact ring main unit shall consist of the following main equipment (the equipment):

(1) SF_6 insulated ring main unit

(2) Housing

The compact ring main units have various types as specified in **Table 1**.

Table 1

Types of compact ring main units

Item	TYPE	Rated Voltage	RMU construction		Installation
			No. of cable feeder switch	No. of transformer feeder switch	
1	24-21-O	24 kV	2	1	On ground
2	24-22-O	24 kV	2	2	On ground
3	24-30-O	24 kV	3	0	On ground
4	24-31-O	24 kV	3	1	On ground
5	24-40-O	24 kV	4	0	On ground
6	24-21-S	24 kV	2	1	Semi-buried
7	24-22-S	24 kV	2	2	Semi-buried
8	24-30-S	24 kV	3	0	Semi-buried
9	24-31-S	24 kV	3	1	Semi-buried
10	24-40-S	24 kV	4	0	Semi-buried
11	36-21-O	36 kV	2	1	On ground
12	36-22-O	36 kV	2	2	On ground
13	36-30-O	36 kV	3	0	On ground
14	36-31-O	36 kV	3	1	On ground
15	36-40-O	36 kV	4	0	On ground
16	24-50-O	24 kV	5	0	On ground

1c.4 SF_6 - insulated ring main unit

1c.4.1. Manufacturer qualification

1c.4.1.1 Manufacturer qualification for 22 kV

The manufacturer shall have reference list of supplies to customers outside the country of origin not less than five (5) years and not less than 500 units of ring main unit, except for manufacturers who used to supply to Provincial Electricity Authority (PEA) or Metropolitan Electricity Authority (MEA) the same type of ring main unit.

1c.4.1.2 Manufacturer qualification for 33 kV

The manufacturer shall have reference list of supplies to customers outside the country of origin not less than three (3) years and not less than 300 units of ring main unit, except for manufacturers who used to supply to Provincial Electricity Authority (PEA) the same type of ring main unit.

The definition of “same type” is the ring main unit (RMU) having same characteristic as follow:

- Type of mechanism
- Type of interrupter
- Rated voltage, or higher
- Rated normal current, or higher
- Rated short-time current, or higher

1c.4.2 Ratings

The ring main unit shall have ratings as specified in **Table 2**.

Table 2

Rating of the ring main unit

Description	22 kV system	33 kV system
Rated voltage	24 kV	36 kV
Rated lightning impulse withstand voltage	125 kV peak	170 kV peak
Rated one-minute power frequency withstand voltage	50 kV r.m.s.	70 kV r.m.s.
Rated frequency	50 Hz	50 Hz
Rated normal current		
- cable feeder	600 A	400 A
- transformer feeder	200 A	200 A

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Description	22 kV system	33 kV system
Rated short-time current (1 sec), at rated voltage	16 kA	16 kA
Rated short-circuit making current, at rated voltage	40 kA peak	40 kA peak

1c.4.3 Construction

The ring main unit shall be of self-supported, metal-enclosed, hermetically sealed in SF_6 - filled container and completely independent from atmospheric influence three-pole type. All high- voltage live parts except fuse compartment shall be enclosed to meet IP 65 protection class. The earthing bar shall be in cover for personal safety.

The switch container (tank) shall be made of stainless steel or nickel-chromium steel. Tank - painting can be neglected. Outside surface shall be painted.

1c.4.4 Cable feeder switch

The switch for cable feeder shall be on-load type. The mechanism shall be able to upgrade for replacing by motor-drive for remote on - off operation in the future. The mechanical switch position indicator shall be provided.

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

Each load break switch and earthing switch shall have padlock provision to enable locking in either "open" or "closed" position.

1c.4.5 Transformer feeder switch

The switch for transformer feeder shall be on-load type with fuses. The on-load switch with fuse shall have trip-free mechanism.

The fuse chamber shall be enclosed to meet at least IP 54 protection class. Fuse shall be HRC fuse in accordance with DIN standard equipped with striker pin for three phase tripping and shall have auxiliary contacts for remote status monitoring. The dimensions of fuse shall comply with DIN 43625.

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.

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

The earthing switch shall be designed to earth both side of the fuse. The earthing switch designed to earth only cable side of fuse by using three (3) position switches shall be accepted.

Each load break switch and earthing switch shall have padlock provision to enable locking in either "open" or "closed" position.

1c.4.6 Cable connection

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

(1) Having cable compartment for personal safety and being free from vermin. 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.

(2) Be disconnected and then reconnected without damaging any part of the connection systems.

(3) Being suitable for cable feeders of single-core cross-link polyethylene insulation, copper wire screen, polyethylene sheath, H.V. power cable copper conductor size 240 mm^2.

(4) Being suitable for transformer feeders of single-core cross-link polyethylene insulation, copper wire screen, polyethylene sheath, H.V. power cable copper conductor size 50 mm^2.

1c.4.7 Accessories

The ring main unit shall be furnished and equipped with the following accessories.

(1) Short-circuit indicator(s) with automatic/manual mode indication resetting on each phase of incoming feeders. The indicator(s) shall be equipped with auxiliary contact. The light indication of the indicator(s) shall be at the front of the unit. The equipment requirement shall contain at least the following data:

a) Allow the fast identification of the faulty section, by providing a light indication when they are located upstream from the fault. An auxiliary output contact shall be available to provide the same information as the light indication.

b) Can be setting mode to manual or automatic mode

In case of manual mode, fault indication can be reset:

- By pressing a local push button on the local control panel: global (fault indications on all channels) reset;
- By remote control from the control center: global reset;

In case of automatic mode, fault indication can be reset:

- Automatically after a time delay configurable channel per channel, between 0.3 sec. to 120 min;

(2) Voltage indicators for each phase of cable feeder(s) and transformer feeder(s)

(3) Gas pressure indicator

(4) Facilities to test the cable feeders

(5) Pressure relief vent (explosion vent) with metal bursting plate

(6) Earthing terminal, with solderless clamp type connector suitable for copper conductor diameter of 12.6 mm (size 95 mm^2); complete with lock washer of stainless steel or better

(7) Lifting facilities

(8) Three (3) pieces of fuse per transformer, for use as spare, having the same size and rating as those use in the transformer feeder, kept inside the housing preferable in the box/bracket fixed on the door

(9) Other necessary accessories according to manufacturer's design

1c.5 Cable connector

1c.5.1 General

Cable connectors for 22 kV and 33 kV XLPE copper cable shall be manufactured and tested in accordance with the ANSI/IEEE 386; or VDE and DIN Standards, particular DIN 47636 Part 1 to Part 7, EN-50181, IEC 60137, or equivalent, unless otherwise specified in these specifications.

The cable connectors shall be designed and constructed to connect the XLPE cable to the bushing of the equipment (ring main unit).

1c.5.2 Ratings

The cable connectors shall have ratings as specified in **Table 3**.

Table 3

Ratings of cable connectors

Rated voltage	kV	22	33
Rated current, continuous			
- for cable feeder	A	600	400
- for transformer feeder	A	200	200
Rated short-time current (1 sec), at rated voltage			
- for cable feeder	kA	16	16
- for transformer feeder	kA	10	10
Rated short-circuit making current, at rated voltage	kA	40	40

1c.5.3 Construction

The cable connector shall be suitable for single-core cross link polyethylene insulation, copper wire screen, polyethylene sheath, H.V. power cable copper conductor. The insulator body of the termination shall be of pre-molded type made from silicone rubber or EPDM with integrated stress control electrodes and an earthed conductive outside shield. The cable connectors shall be neutral to environmental influences, maintenance-free and suitable to be even flooded.

For cable feeder

The cable connectors for cable feeder of ring-main unit shall be of bolted-on touchable T-shaped type and shall be suitable for cone-shaped protruding bushing according to DIN 47636 Part 5 and Part 6, EN-50181, IEC 60137 or equivalent with screwed contact.

The T-shaped plug-in termination shall be able to connect a test bushing for cable testing in place of the sealing piece of the backside. The cone for the test bushing shall have the same dimensions as the bushing of the ring-main unit.

For transformer feeder

The cable connectors for transformer feeder of ring-main unit shall be touchable elbow shaped type and shall be suitable for cone-shaped protruding bushing according to DIN 47636 Part 1 to Part 4, EN-50181, IEC 60137 or equivalent with plugged contact.

1c.5.4 Marking

The cable connectors shall have indication mark (e.g. ink stamp, brand, or molded in) with the following information:

- Manufacturer's name or Trade mark
- Continuous current rating
- Maximum voltage rating
- Cable insulation diameter range

1c.6 Mechanical control

The compact ring main unit shall be furnished with mechanical control for switch operation. As minimum, the mechanical control shall include the following:

- Manual operating mechanisms for closing and opening of switches
- Manual operating mechanisms for earthing switches
- Switch position indicators
- Others according to manufacturer’s designs

1c.7 Rating plates and nameplates

Each compact ring main unit and equipment shall be provided with rating plates and nameplates.

(1) Nameplates

The nameplate for each electrical equipment installed in room, and for each power circuit shall be made of laminated plastic material, black on the surface with a white internal layer. Lettering shall be machine-engraved into the nameplate to form white letters against the black background. The nameplate lists shall be provided by PEA.

(2) Rating plates

Each compact ring main unit shall have a rating plate with the following details:

- Manufacturer's name
- Type and serial number
- Year of construction
- Rated voltage
- Rated frequency
- Rated operating current of busbar
- Rated operating current of feeder
- Rated lightning impulse withstand voltage
- Rated peak withstand current
- Degree of protection
- Rated service pressure of SF_6 gas, if any
- Applied standard

This rating plate shall be fixed inside the housing preferable in the rear side of the door.

Each ring main unit shall have its own rating plate. The following details shall be given :

- Manufacturer's name
- Type and serial number
- Year of construction
- Rated voltage
- Rated frequency
- Rated normal current
- Rated lightning impulse withstand voltage
- Rated one-minute power frequency withstand voltage
- Rated short time current (1 sec)
- Rated short-circuit making current
- Rated service pressure of SF_6 gas
- Applied standard

1c.8 Corrosion protection, painting, and finishing

All steel surfaces which are not galvanized or not stainless steel shall receive a standard protection against corrosion. As a minimum painting standard the following shall be applied:

- Cleaning to the bare material by mechanical and/or chemical means.
- Phosphatizing or priming with at least one coat of zinc or lead based primer.
- Finishing coat shall be gray with high scratch resistance. RAL-code will be agreed upon with the successful bidder. The coat thickness shall be at least 50 μm.

1c.9 Special tools

Special tools and accessories required for the installation, commissioning/testing/proper operation, and maintenance of the compact ring main unit shall be quoted separately with itemized prices.

1c.10 Spare parts

Spare parts, if required or recommended by the bidder for two-year operation, shall be quoted separately.

PEA reserves the right to purchase spare parts by some or all items, or to adjust the quantities.

1c.11 Training

1c.11.1 Operation Training

The three (3) days operation training course shall be provided at the Authority's head office. The objective of this course is to train the Authority personnel in how to use the Compact ring main unit. The Authority intends that the personnel receiving this training will become operators. The training materials shall include the Compact ring main unit user's manual. The Authority shall be permitted to reproduce any of the training materials and to tape training sessions for internal use.

The Bidders have to quote recommended training course with their lists of quantities and itemized prices.

The operation training course will be attended by twelve (12) people.

1c.11.2 Maintenance Training

Training is required to prepare the Authority's personnel to assume full responsibility for future Authority maintenance of the Compact ring main unit, including their repair. All training shall be conducted in English and/or Thai, at Authority head office or at manufacturer. All training material and facilities including maintenance tools and another special tools shall be provided by the Contractor. The Authority shall be permitted to reproduce any of the training materials and to tape training sessions for internal use.

The Bidders have to quote recommended training course with their lists of quantities and itemized prices.

The maintenance training will be attended by four (4) people.

1d Packing

The compact ring main unit, accessories, special tools, and spare parts, shall be seaworthy packed separately in suitable boxes / crates / cases / bundles / drums / or pieces of loose material which will not be returned.

Each individual package (e.g. box, crate, case, bundle, drum, or piece of loose material) of each shipment/delivery shall be clearly tagged or marked to show the contents and the gross weight corresponding to the Invoice and Packing list for easy identification.

Each package shall contain a copy of the packing list in a waterproof envelope.

In case of supplying more than one compact ring main unit, parts belonging to different switchgear shall not be packed in the same package. The packages shall be lettered and numbered by the Contractor to designate station, package number and total number of packages of each station being shipped/delivery; for example when two stations are supplied,

A-1/5, A-2/5, ... A-5/5 for the station A.

B-1/7, B-2/7, ... B-7/7 for the station B.

the letters designate the station , the first digit designates the package number, and the second digit designates the total number of packages.

Special tools and spare parts if ordered, shall be separately packed in other packages on which the words “SPECIAL TOOLS” or “SPARE PARTS” and package number/total number of packages being shipped/delivered shall be marked.

1e Tests and test report

1e.1 Routine Tests

The compact ring main unit and equipment shall pass the manufacturer's standard routine tests and also pass the routine tests in accordance with the relevant reference standards. The test report of the equipment shall state the following items:

Ring main unit

(1) Power frequency voltage tests on the main circuit
(2) Dielectric tests on control and auxiliary circuits
(3) Measurement of resistance of main circuit
(4) Mechanical operation tests
(5) Test of interlocking system
(6) Verification of correct wiring and labeling

1e.2 Type tests

Compact ring main unit

The compact ring main unit shall have passed the type tests in accordance with IEC 62271-202: 2006 or later edition at least the following items:

(1) Dielectric test

(2) Temperature-rise tests

(3) Functional tests

(4) Verification of the degree of protection

(5) Mechanical tests

a) Wind pressure

b) Roof loads

c) Mechanical impacts

(6) Internal fault test

The type test certificates or test reports of the Compact ring main unit shall be submitted with the bid or within fifteen (15) calendar days after the bid closing date.

PEA will also accept the type test certificates or test reports after signing the contract. In this case the Bidder have to submit test plan including information i.e. test procedure, laboratory and test date to PEA for consideration instead and the complete type test certificates and/or test reports shall be submitted for approval before shipment.

Ring main unit

The ring main unit shall have passed the type tests in accordance with IEC 62271-200: 2003 or later edition, IAC type A for both busbar and cable compartment. The bidder shall provide type test certificate of an independent institute to prove that the offered ring main unit shall meet the above requirements. These type test certificates shall be enclosed with the bid.

1e.3 Costs of tests

The costs of all tests and test reports shall be borne by the Contractor.

C2 Material and packing data

The bidder has to submit with the bid following data and details of compact ring main unit and equipment:

2a Design data and guarantee of:

- Compact ring main unit for 22 & 33 kV 50 Hz underground distribution systems (see **Annex C2-1.1** and **Annex C2-1.2**)
- SF_6 - insulated ring main unit (see **Annex C2-2**)

2b Drawings of each type of compact ring main unit housing with dimensions in mm, showing particulars of normal construction details

2c Drawings of compact ring main unit layout with dimensions in mm of the whole station

2d Drawings of the compact ring main unit erection including a general concrete pad/foundation plan

2e Bill of Material for each compartment

2f Details, catalogues and drawings, with main dimensions in mm, of:

(1) Ring main unit
(2) Operating mechanism of the ring main unit
(3) Cable connector, for ring main unit
(4) Interlocking system
(5) Lock and locking facilities
(6) Rating plate
(7) Corrosion protection, painting, and finishing
(8) Accessories according to manufacturer's design

2g List of routine tests and type tests

2h List of special tools with itemized prices

2i List of spare parts with itemized prices

2j Recommended maintenance periods of ring main unit based on time in normal service or number of operation in normal service, as follows:

- rated breaking current
- rated making current
- mechanical ON/OFF

2k Operation and maintenance manual

2l Packing details:

Packing method (shown by drawings and describe packing material)

Type of storage facility required (indoor, outdoor)

Number of packages

Dimensions (L x W x H) of each package in mm

Volume of each package in m^3

Gross weight of each package in kg

Number of packages

Note: Conditions for documentation and consideration

The Contractor has to supply the following documents, before shipment/delivery, for each ordered station, to the following address:

Technical Specification Division

Engineering Department

Provincial Electricity Authority

200 Ngam Wong Wan Road, Chatuchak

Bangkok Metropolis 10900

Thailand

All drawing shall be in accordance with the IEC 60113 and sized as follows:

A1 594 mm x 841 mm

A2 420 mm x 594 mm

A3 297 mm x 420 mm

A4 210 mm x 297 mm

1. Drawings and data for approval

The Contractor shall supply six copies each of at least the drawings and data listed below, for approval by The Authority, within fifteen calendar days after the date of effectiveness of the Contract.

(1) Complete compact ring main unit arrangement drawings showing the details of equipment layout.

(2) Foundation frame plans with fastening details. Earthing arrangement and access points to earthing bus.

(3) Detail drawings and specifications for all equipment to be supplied including the characteristic curves of current transformers.

(4) Complete internal connection and elementary diagrams (AC and DC schematic), of control for operating mechanism and auxiliary equipment.

(5) Complete interlocking scheme of the whole compact ring main unit.

(6) All other drawings considered necessary for the installation, operation and maintenance of the compact ring main unit equipment.

Generally, if no more details are required, one approved copy of each drawing/document will be returned to the Contractor within fifteen calendar days after receipt by The Authority. If The Authority requires additional information, the Contractor cannot regard the lost time as a reason for extending the delivery time without penalty.

When the drawings have been returned for correction, the Contractor shall make the necessary revisions on them and shall submit the corrected drawings and data for approval within thirty (30) calendar days.

Any manufacturing done before approval of the drawings and data will be at the Contractor's risk. The Authority shall have the right to require the Contractor to make any changes in the design which may be necessary in the opinion of The Authority, to make the equipment conform to the requirements and intent of this Contract Documents without additional cost to The Authority. Approval of the Contractor's drawings shall not be held to relieve the Contractor of any part of his obligation to meet all of the requirements of this Contract Documents or of the responsibility for the correctness of his drawings.

2. Final approved drawings

The Contractor shall furnish six copies each and one transparent reproducible copy each of the final approved drawings.

3. Three sets of instruction book in English and Thai for installation, operation and maintenance of compact ring main unit and equipment.

4. Three sets of instruction book in English and Thai for installation, operation, and maintenance of all instruments, meters, switches, indicators, alarms, and relays, if any

5. Reports of type tests and routine tests of the equipment.

Invitation to Bid No. : **ANNEX C2-1.1**

2a. GUARANTEE PERFORMANCE DATA OF RING MAIN UNIT HOUSING, ON GROUND TYPE

Description	Unit	Required Data		Proposed Data	
		22 kV	33 kV	22 kV	33 kV
Manufacturer	-	-	-		
Country of origin	-	-	-		
Type designation	-	-	-		
Indoor or outdoor installation	-	Outdoor	Outdoor		
Applied standard, publication number and year	-	-	-		
Rated power	kVA	-	-		
Number of phases	-	3	3		
Rated frequency	Hz	50 Hz	50 Hz		
Arc-fault test	Yes/No	Yes	Yes		
Degree of protection of housing	-	IP34 or better	IP34 or better		
Housing materials	-	Galvanized and powder coated steel sheets or Reinforced concrete or Stainless steel			
Overall dimensions :					
- Length, maximum	mm	2,000 (3,000*)	2,000		
- Width, maximum	mm	2,000	2,000		
- Height, maximum (above ground level)	mm	2,500	2,500		
- Depth, maximum (under ground)	mm	-	-		

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* For five (5) functions Compact Ring Main Unit.

Invitation to Bid No. : **ANNEX C2-1.1**

2a. GUARANTEE PERFORMANCE DATA OF RING MAIN UNIT HOUSING, ON GROUND TYPE

Description	Unit	Required Data		Proposed Data	
Net weight	kg	-	-		
Confirm to provide lifting facilities	Yes/No	YES	YES		
Fault indicators :					
- Manufacturer	-	-	-		
- Catalog number (to be attached)	-	-	-		
- Range of suitable overall diameter of cable	mm	-	-		
Net weight	kg	-	-		
Catalog number (to be attached)	-	-	-		
Dimensional drawing number (to be attached)	-	-	-		
Packing detailed drawing number (to be attached)	-	-	-		

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Invitation to Bid No. : **ANNEX C2-1.2**

2a. GUARANTEE PERFORMANCE DATA OF RING MAIN UNIT HOUSING, SEMI-BURIED TYPE

Description	Unit	Required Data	Proposed Data
		22 kV	22 kV
Manufacturer	-	-	
Country of origin	-	-	
Type designation	-	-	
Indoor or outdoor installation	-	Outdoor	
Applied standard, publication number and year	-	-	
Rated power	kVA	-	
Number of phases	-	3	
Rated frequency	Hz	50 Hz	
Arc-fault test	Yes/No	Yes	
Housing materials	-	Galvanized and powder coated steel sheets or Reinforced concrete or Stainless steel	
Degree of protection of housing	-	IP34 or better	
Overall dimensions :			
- Length, maximum	mm	2,000	
- Width, maximum	mm	2,000	
- Height, maximum (above ground level)	mm	1,600	

Invitation to Bid No. : **ANNEX C2-1.2**

2a. GUARANTEE PERFORMANCE DATA OF RING MAIN UNIT HOUSING, SEMI-BURIED TYPE

Description	Unit	Required Data	Proposed Data
- Depth, maximum (under ground)	mm	-	
Net weight	kg	-	
Confirm to provide lifting facilities	Yes/No	YES	
Fault indicators :			
- Manufacturer	-	-	
- Catalog number (to be attached)	-	-	
- Range of suitable overall diameter of cable	mm	-	
Net weight	kg	-	
Catalog number (to be attached)	-	-	
Dimensional drawing number (to be attached)	-	-	
Packing detailed drawing number (to be attached)	-	-	

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Invitation to Bid No. : **ANNEX C2-2**

2a. GUARANTEE PERFORMANCE DATA of SF_6 – INSULATED RING MAIN UNIT OF 22 kV AND 33 kV

Description	Unit	Required Data		Proposed Data	
Ring Main Unit		22 kV	33 kV	22 kV	33 kV
Manufacturer	-	-	-		
Country of origin	-	-	-		
Type designation	-	-	-		
Indoor or outdoor installation	-	Indoor	Indoor		
Applied standard, publication number and year	-	IEC 62271-200: 2003			
Catalogue number (to be attached)	-	-	-		
Dimensional drawing number (to be attached)	-	-	-		
Single-line diagram number (to be attached)	-	-	-		
Degree of protection of enclosure					
- High voltage live parts except fuse compartment	-	IP 65			
- Fuse chamber	-	IP 54			
Material of switch container/tank	-	Stainless steel or Nickel chromium steel			
Colour of outside-painting	-	-	-		
Material of drive-mechanism	-	-	-		

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Invitation to Bid No. : **ANNEX C2-2**

2a. GUARANTEE PERFORMANCE DATA of SF_6 – INSULATED RING MAIN UNIT OF 22 kV AND 33 kV

Description	Unit	Required Data		Proposed Data	
Principle of drive-sealing	-	-	-		
Principle of drive-moving (turn/push)	-	-	-		
Insulating medium	-	SF_6			
Arc quenching medium	-	SF_6			
Principle of arc quenching	-	-	-		
Rated SF_6 gas pressure	PSI	-	-		
Rated voltage	kV	24	36		
Rated lightning impulse withstand voltage					
- To earth and between pole	kV, peak	125	170		
- Across the isolating distance	kV, peak	-	-		
Rated power frequency withstand voltage, at rated SF_6 gas pressure					
- To earth and between pole	kV, r.m.s.	-	-		
- Across the isolating distance	kV, r.m.s.	-	-		

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Invitation to Bid No. : **ANNEX C2-2**

2a. GUARANTEE PERFORMANCE DATA of SF_6 – INSULATED RING MAIN UNIT OF 22 kV AND 33 kV

Description	Unit	Required Data		Proposed Data	
Rated power frequency withstand voltage, at atmospheric pressure					
- To earth and between pole	kV, r.m.s.	50	70		
- Across the isolating distance	kV, r.m.s.	-	-		
Number of phase	-	3	3		
Rated frequency	Hz	50	50		
Rated normal current					
- Cable feeder	A	600	400		
- Transformer feeder	A	200	200		
Rated short-time current (1 sec), at rated voltage	kA	16	16		
Rated short-circuit making current	kA, peak	40	40		
Contact					
- Type	-	-	-		
- Material	-	-	-		
- Surface treatment	-	-	-		
- Maximum temperature rise at ..... A	K	-	-		
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Invitation to Bid No. : **ANNEX C2-2**

2a. GUARANTEE PERFORMANCE DATA of SF_6 – INSULATED RING MAIN UNIT OF 22 kV AND 33 kV

Description	Unit	Required Data		Proposed Data	
High voltage fuses					
- Manufacturer	-	-	-		
- Country of origin	-	-	-		
- Applied standard, publication number and year	-	**DIN**			
- Catalogue number (to be attached)	-	-	-		
- Outline drawing number (to be attached)	-	-	-		
- Rated voltage of HRC fuses	kV	-	-		
- Interrupting capacity	kA	-	-		
- Length	mm	-	-		
Cable connector at cable feeder of RMU					
- Manufacturer	-	-	-		
- Country of origin	-	-	-		
- Type	-	bolt-on touchable T-shaped type			
- Applied standard, publication number and year	-	ANSI/IEEE 386 or VDE/DIN particular DIN 47636 Parts 5 & 6 or EN-50181, IEC 60137			
- Catalogue number (to be attached)	-	-	-		
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Invitation to Bid No. : **ANNEX C2-2**

2a. GUARANTEE PERFORMANCE DATA of SF_6 – INSULATED RING MAIN UNIT OF 22 kV AND 33 kV

Description	Unit	Required Data		Proposed Data	
- Outline drawing number (to be attached)		-	-		
- Range of conductor diameter to be accommodated with	mm	-	-		
- Range of diameter over insulation of cable to be used with	mm	-	-		
- Range of overall diameter of cable to be used with	mm	-	-		
- Phase spacing	mm	-	-		
Cable connector at transformer feeder		-	-		
- Manufacturer	-	-	-		
- Country of origin	-	-	-		
- Type	-	plug-in termination of touchable elbow shaped type			
- Applied standard, publication number and year	-	ANSI/IEEE 386 or VDE/DIN particular DIN 47636 Parts 1 to 4 or EN-50181, IEC 60137			
- Catalogue number (to be attached)	-	-	-		
- Outline drawing number (to be attached)	-	-	-		
- Range of conductor diameter to be accommodated with	mm	-	-		
- Range of diameter over insulation of cable to be used with	mm	-	-		

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Invitation to Bid No. : **ANNEX C2-2**

2a. GUARANTEE PERFORMANCE DATA of SF_6 – INSULATED RING MAIN UNIT OF 22 kV AND 33 kV

Description	Unit	Required Data		Proposed Data	
- Range of overall diameter of cable to be used with	mm	-	-		
- Phase spacing	mm	-	-		
Confirm to provide :					
- Fault indicator(s)	(Yes/No)	Yes			
- Voltage indicator(s)	(Yes/No)	Yes			
- Gas pressure indicator	(Yes/No)	Yes			
- Facilities to test the cable feeder	(Yes/No)	Yes			
- Pressure relief vent with metal bursting plate	(Yes/No)	Yes			
- Lifting facilities	(Yes/No)	Yes			
- Earthing terminals	(Yes/No)	Yes			
Quality system certificate of the manufacturer	(Yes/No)	in accordance with ISO 9001/TIS 9001 or ISO 9002/TIS 9002			

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C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
1	1040130024	set(s)	Compact ring main unit, TYPE 24-21-O, for 22 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 1.1 1 set 24 kV SF_6 - insulated ring main unit consisting of : 1.1.1 2 units Cable feeder 1.1.2 1 unit Transformer feeder 1.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 1 of 5.
2	1040130025	set(s)	Compact ring main unit, TYPE 24-22-O, for 22 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 2.1 1 set 24 kV SF_6 - insulated ring main unit consisting of : 2.1.1 2 units Cable feeder 2.1.2 2 units Transformer feeder 2.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 2 of 5.

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
3	1040130026	set(s)	Compact ring main unit, TYPE 24-30-O, for 22 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 3.1 1 set 24 kV SF_6 - insulated ring main unit consisting of 3 units of cable feeder 3.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 3 of 5.
4	1040130027	set(s)	Compact ring main unit, TYPE 24-31-O, for 22 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 4.1 1 set 24 kV SF_6 - insulated ring main unit consisting of : 4.1.1 3 units Cable feeder 4.1.2 1 unit Transformer feeder 4.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 4 of 5.

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
5	1040130028	set(s)	Compact ring main unit, TYPE 24-40-O, for 22 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 5.1 1 set 24 kV SF_6 - insulated ring main unit consisting of 4 units of cable feeder 5.2 1 unit Housing Complete with manual local control panel and fault indicator. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 5 of 5.
6	1040130029	set(s)	Compact ring main unit, TYPE 24-21-S, for 22 kV 50 Hz underground distribution system, semi-buried, outdoor installation, consisting of : 6.1 1 set 24 kV SF_6 - insulated ring main unit consisting of : 6.1.1 2 units Cable feeder 6.1.2 1 unit Transformer feeder 6.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 1 of 5.

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
7	1040130030	set(s)	Compact ring main unit, TYPE 24-22-S, for 22 kV 50 Hz underground distribution system, semi-buried, outdoor installation, consisting of : 7.1 1 set 24 kV SF_6 - insulated ring main unit consisting of : 7.1.1 2 units Cable feeder 7.1.2 2 units Transformer feeder 7.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 2 of 5.
8	1040130031	set(s)	Compact ring main unit, TYPE 24-30-S, for 22 kV 50 Hz underground distribution system, semi-buried, outdoor installation, consisting of : 8.1 1 set 24 kV SF_6 - insulated ring main unit consisting of 3 units of cable feeder 8.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 3 of 5.

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
9	1040130032	set(s)	Compact ring main unit, TYPE 24-31-S, for 22 kV 50 Hz underground distribution system, semi-buried, outdoor installation, consisting of : 9.1 1 set 24 kV SF_6 - insulated ring main unit consisting of : 9.1.1 3 units Cable feeder 9.1.2 1 unit Transformer feeder 9.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 4 of 5.
10	1040130033	set(s)	Compact ring main unit, TYPE 24-40-S, for 22 kV 50 Hz underground distribution system, semi-buried, outdoor installation, consisting of : 10.1 1 set 24 kV SF_6 - insulated ring main unit consisting of 4 units of cable feeder 10.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48003** page 5 of 5.

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
11	1040130112	set(s)	Compact ring main unit, TYPE 36-21-O, for 33 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 11.1 1 set 36 kV SF_6 - insulated ring main unit consisting of : 11.1.1 2 units Cable feeder 11.1.2 1 unit Transformer feeder 11.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48004** page 1 of 5.
12	1040130113	set(s)	Compact ring main unit, TYPE 36-22-O, for 33 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 12.1 1 set 36 kV SF_6 - insulated ring main unit consisting of : 12.1.1 2 units Cable feeder 12.1.2 2 units Transformer feeder 12.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48004** page 2 of 5.

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
13	1040130114	set(s)	Compact ring main unit, TYPE 36-30-O, for 33 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 13.1 1 set 36 kV SF_6 - insulated ring main unit consisting of 3 units of cable feeder 13.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48004** page 3 of 5.
14	1040130115	set(s)	Compact ring main unit, TYPE 36-31-O, for 33 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 14.1 1 set 36 kV SF_6 - insulated ring main unit consisting of : 14.1.1 3 units Cable feeder 14.1.2 1 unit Transformer feeder 14.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48004** page 4 of 5.

C3 Schedule of detailed requirement

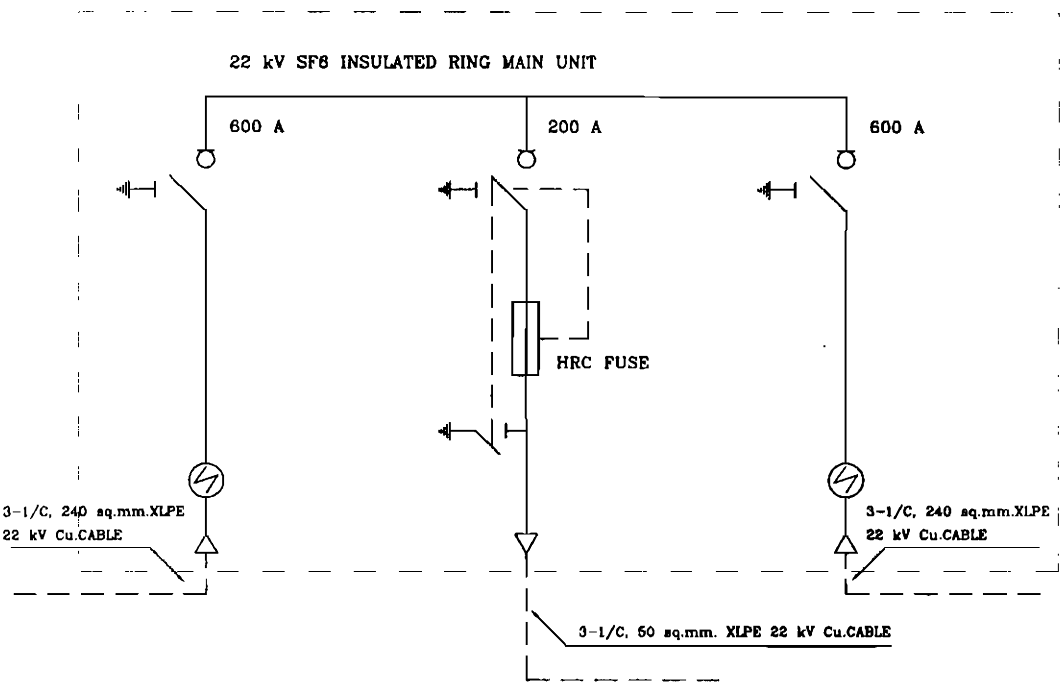
Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
15	1040130116	set(s)	Compact ring main unit, TYPE 36-40-O, for 33 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 15.1 1 set 36 kV SF_6 - insulated ring main unit consisting of 4 units of cable feeder 15.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/48004** page 5 of 5.
16	1040130034	set(s)	Compact ring main unit, TYPE 24-50-O, for 22 kV 50 Hz underground distribution system, on ground, outdoor installation, consisting of : 16.1 1 set 24 kV SF_6 - insulated ring main unit consisting of 5 units of cable feeder 16.2 1 unit Housing Complete with manual local control panel and fault indicators. Arrangement of the Compact ring main unit equipment shall be as shown on the Dwg. No. **SA5-015/50002** page 1 of 1.
17	-	lot(s)	Special tools for 24 kV Compact ring main unit (Give details).
18	-	lot(s)	Spare parts for 24 kV Compact ring main unit, for two-years operation (Give details).
19	-	lot(s)	Operation training course including on-site training for 24 kV compact ring main unit.
20	-	lot(s)	Maintenance training course for 24 kV compact ring main unit.

C3 Schedule of detailed requirement

Invitation to Bid No.:

Item	PEA Material No.	Quantity	Description
21	-	lot(s)	Supervisor(s) for 24 kV compact ring main unit.
22	-	lot(s)	Special tools for 36 kV Compact ring main unit (Give details).
23	-	lot(s)	Spare parts for 36 kV Compact ring main unit, for two-years operation (Give details).
24	-	lot(s)	Operation training course including on-site training for 36 kV compact ring main unit.
25	-	lot(s)	Maintenance training course for 36 kV compact ring main unit.
26	-	lot(s)	Supervisor(s) for 36 kV compact ring main unit.
			Note : 1. Enclosed Drawings No. **SA5-015/48003**, **SA5-015/48004**, **SA5-015/50002** 2. For each item offered, the bidder has to quote the unit cost. 3. Bidders have to offer recommended spare parts, special tools, training courses and supervisor(s) with a list of quantities and their itemized prices, if any; the Authority reserves the right to purchase them by some or all of items, to adjust their quantities, or to cancel them. Evaluation and comparison of bid price shall be of main Item only (Compact Ring Main Unit) 4. Supervisor(s) shall be provided for installation the compact ring main units until ready for operation at PEA's site(s). PEA shall provide and arrange civil work, workmen, and general tools for installation.
III			

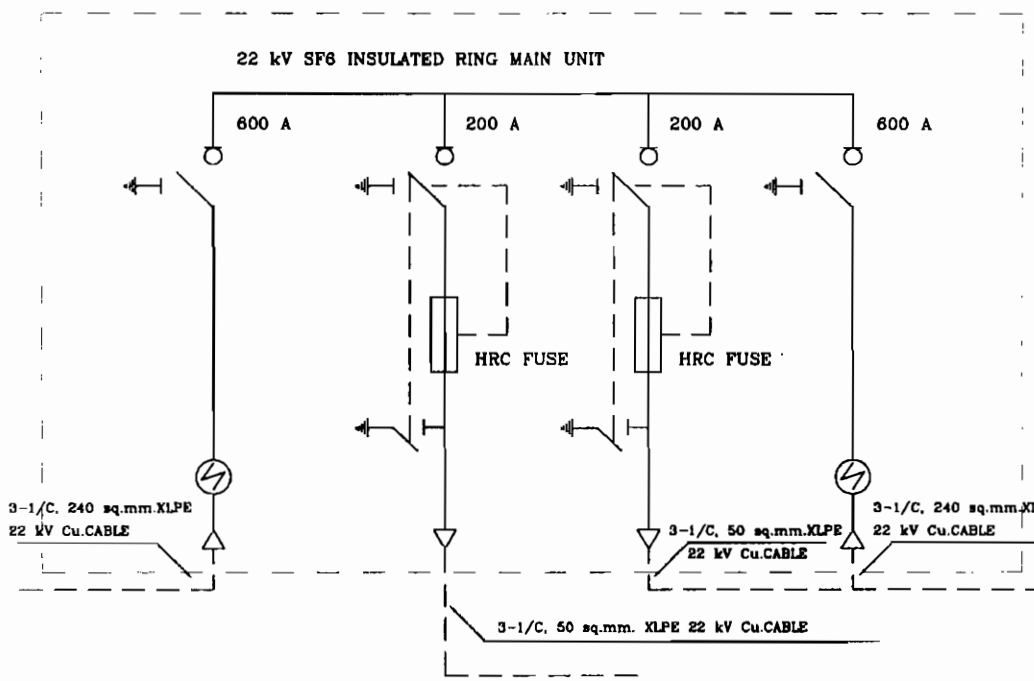


REMARK : FUSE RATING SHALL BE SELECTED TO APPROPRIATE WITH THE RELEVANT DRAWINGS

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ... ถูกแทนโดยแบบ...
ผู้เขียน...ประทีป มีบุญ... ผู้สำรวจ... วิศวกร... หัวหน้าแผนก... ผู้อำนวยการกอง... ผู้อำนวยการฝ่าย...	ผู้ว่าการ... (แทน)...	เขียนเสร็จวันที่...ก.ค. 2548 แก้แบบวันที่...-... มิติเป็น...-... มาตราส่วน...-...
รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า ...	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 22 kV TYPE 24-21-O AND TYPE 24-21-S	แบบเลขที่.SA5-015/48003 แผ่นที่.1.ของจำนวน.5.แผ่น

PSD

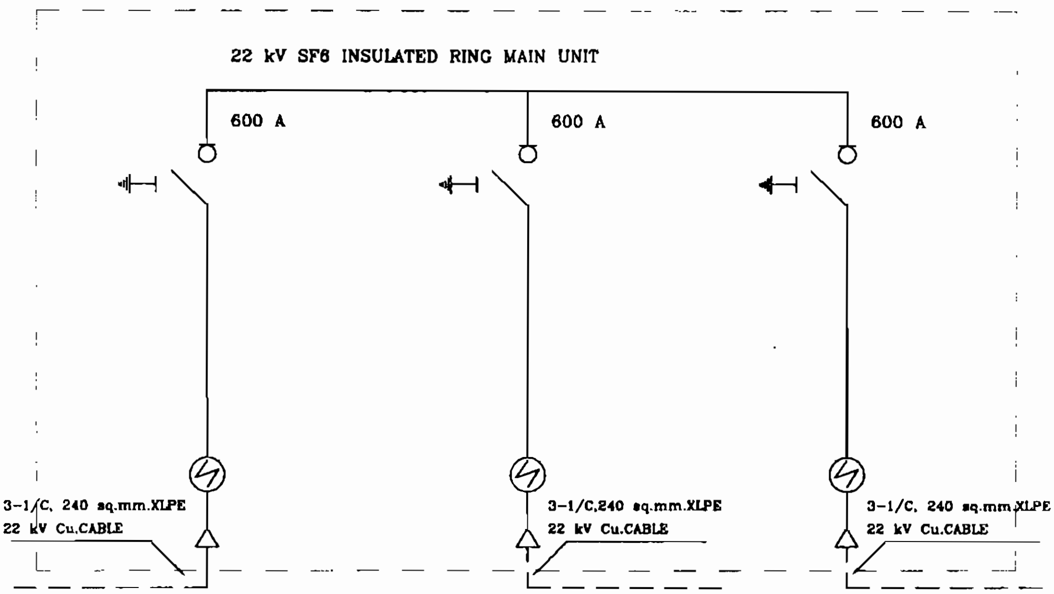


REMARK : FUSE RATING SHALL BE SELECTED TO APPROPRIATE WITH THE RELEVANT DRAWINGS.

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
ผู้เขียน...ประทีป มีบุญ..... ผู้สำรวจ..... วิศวกร..... หัวหน้าแผนก..... ผู้อำนวยการกอง..... ผู้อำนวยการฝ่าย.....	ผู้ว่าการ.....(.....)	เขียนเสร็จวันที่...ก.ค. 2548 แก้แบบวันที่.....-..... มิติเป็น.....-..... มาตราส่วน.....-.....
รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 22 kV TYPE 24-22-O AND TYPE 24-22-S	แบบเลขที่.SA5-015/48003 แผ่นที่.2.ของจำนวน.5.แผ่น

PSD



PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ.................. ถูกแทนโดยแบบ..............
ผู้เขียน...ประทีป มีบุญ..... ผู้สำรวจ...................... วิศวกร......................... หัวหน้าแผนก.................. ผู้อำนวยการกอง............... ผู้อำนวยการฝ่าย..............	ผู้ว่าการ...........................(แทน)	เขียนเสร็จวันที่....ก.ค. 2548 แก้แบบวันที่......-.......... มิติเป็น.......-............ มาตราส่วน.......-........
รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 22 kV TYPE 24-30-0 AND TYPE 24-30-S	แบบเลขที่.SA5-015/48003 แผ่นที่..3..ของจำนวน..5..แผ่น

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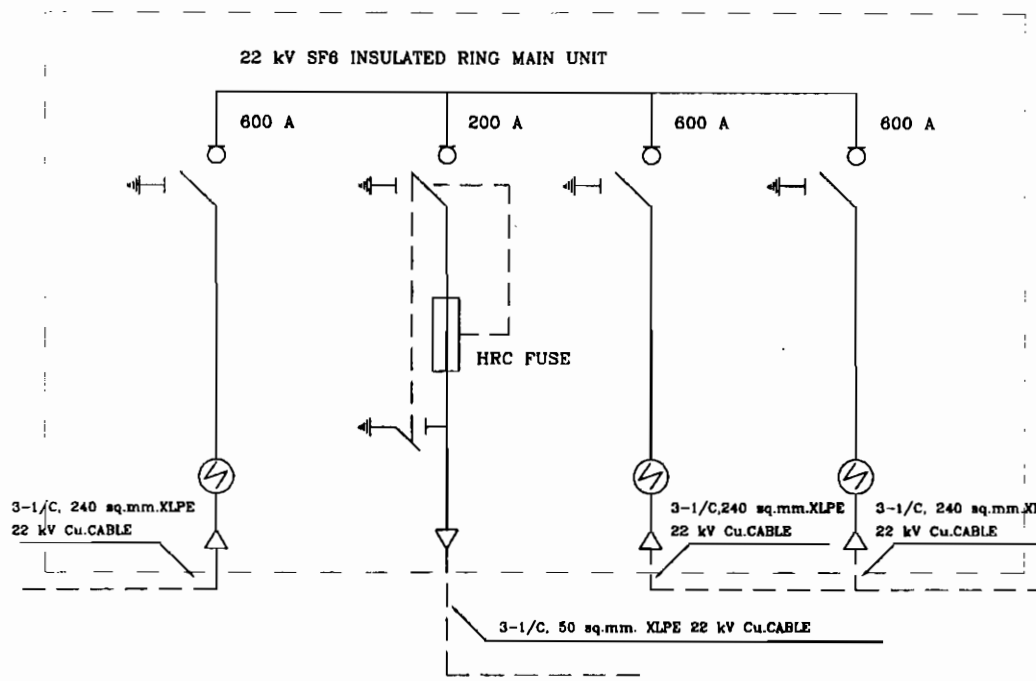

REMARK : FUSE RATING SHALL BE SELECTED TO APPROPRIATE WITH THE RELEVANT DRAWINGS.

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
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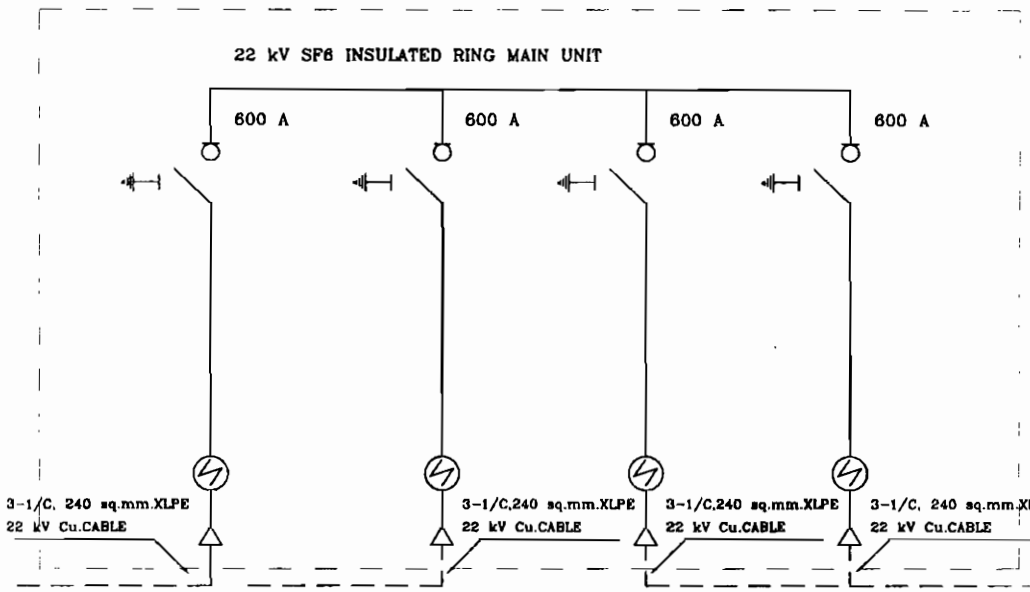

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
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รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า		แบบเลขที่ SA5-015/48003 แผ่นที่ 5 ของจำนวน 5 แผ่น

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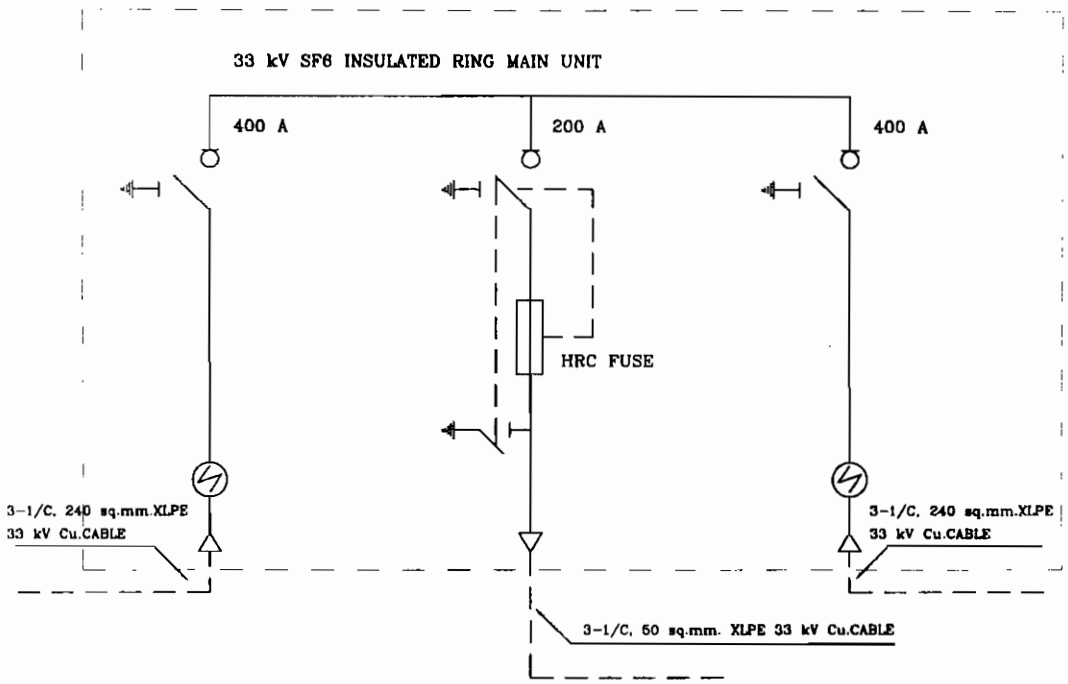

REMARK : FUSE RATING SHALL BE SELECTED TO APPROPRIATE WITH THE RELEVANT DRAWINGS.

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
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รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 33 kV TYPE 36-21-0	แบบเลขที่ SA5-015/48004 แผ่นที่ 1 ของจำนวน 5 แผ่น

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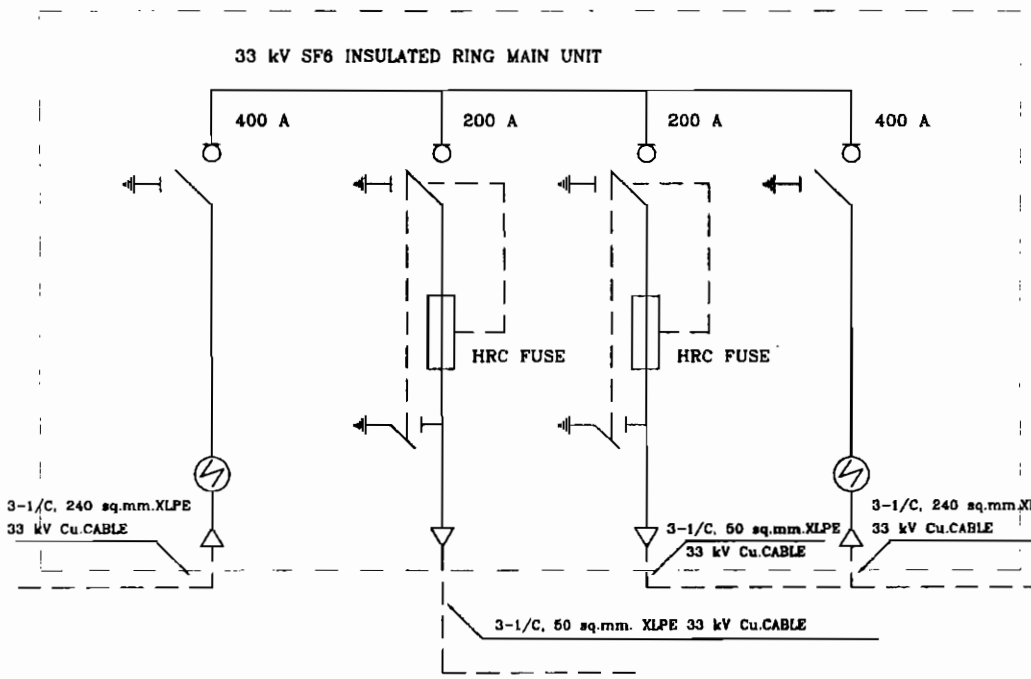

REMARK : FUSE RATING SHALL BE SELECTED TO APPROPRIATE WITH THE RELEVANT DRAWINGS.

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
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รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 33 kV TYPE 36-22-0	แบบเลขที่ SA5-015/48004 แผ่นที่ 2 ของจำนวน 5 แผ่น

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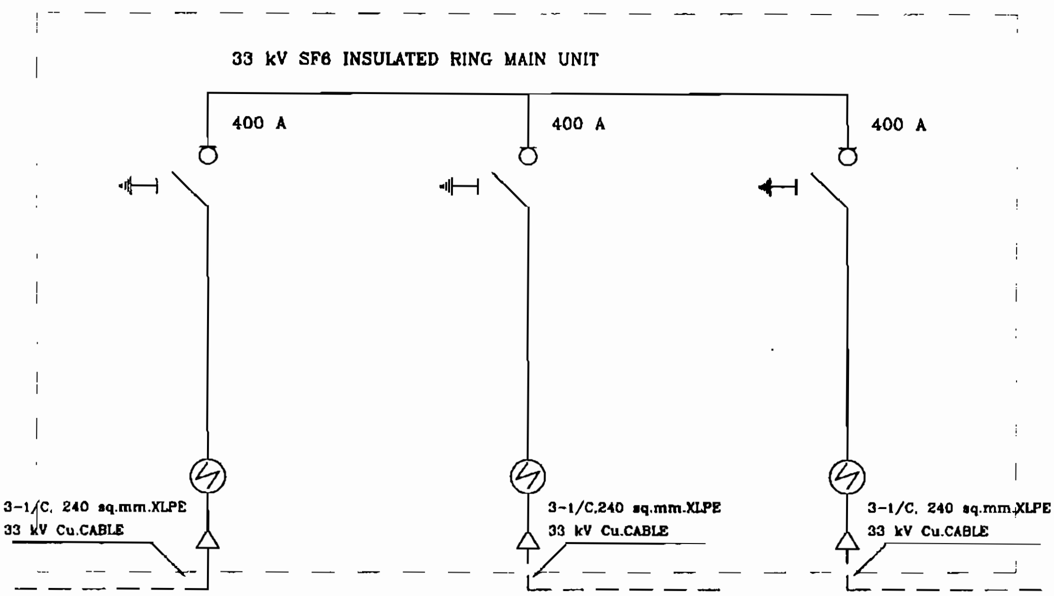

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ.................. ถูกแทนโดยแบบ..............
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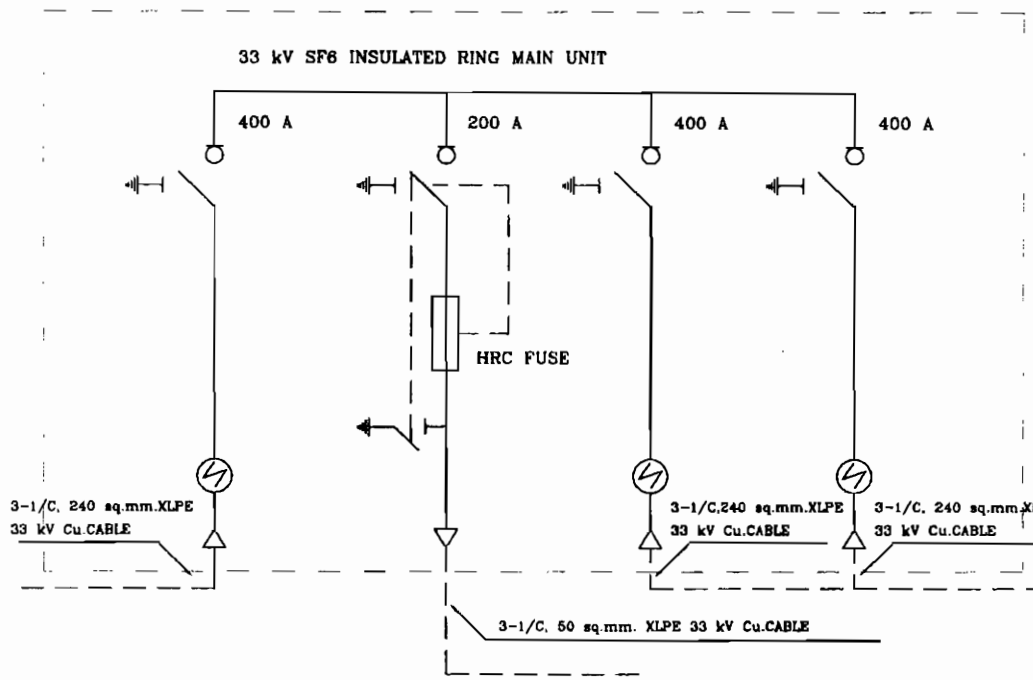
รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 33 kV TYPE 36-30-0	แบบเลขที่.SA5-015/48004 แผ่นที่.3.ของจำนวน.5.แผ่น

PSD



REMARK : FUSE RATING SHALL BE SELECTED TO APPROPRIATE WITH THE RELEVANT DRAWINGS.

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
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รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 33 kV TYPE 36-31-0	แบบเลขที่ SA5-015/48004 แผ่นที่ 4 ของจำนวน 5 แผ่น

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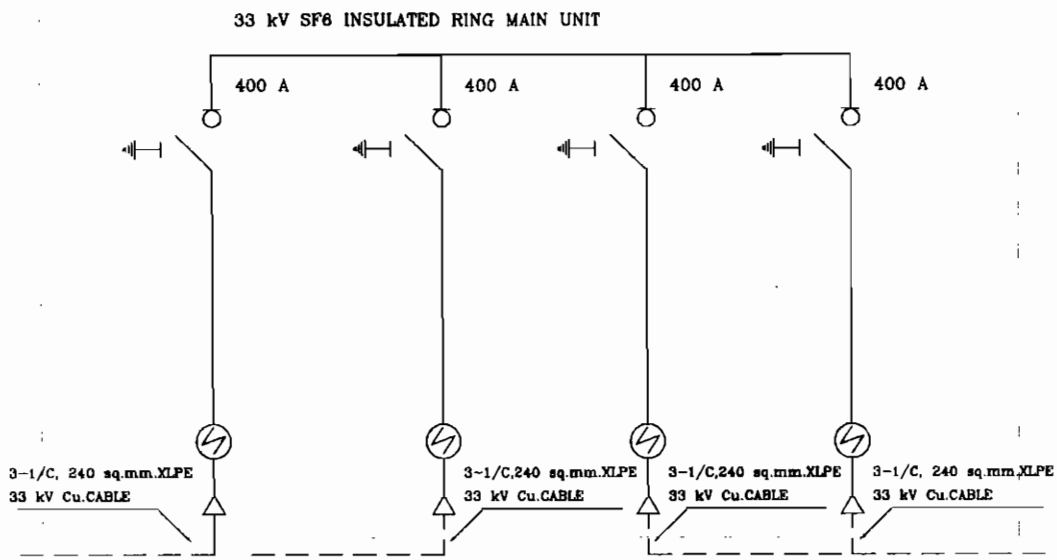

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
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รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 33 kV TYPE 36-40-0	แบบเลขที่ SA5-015/48004 แผ่นที่ 5 ของจำนวน 5 แผ่น

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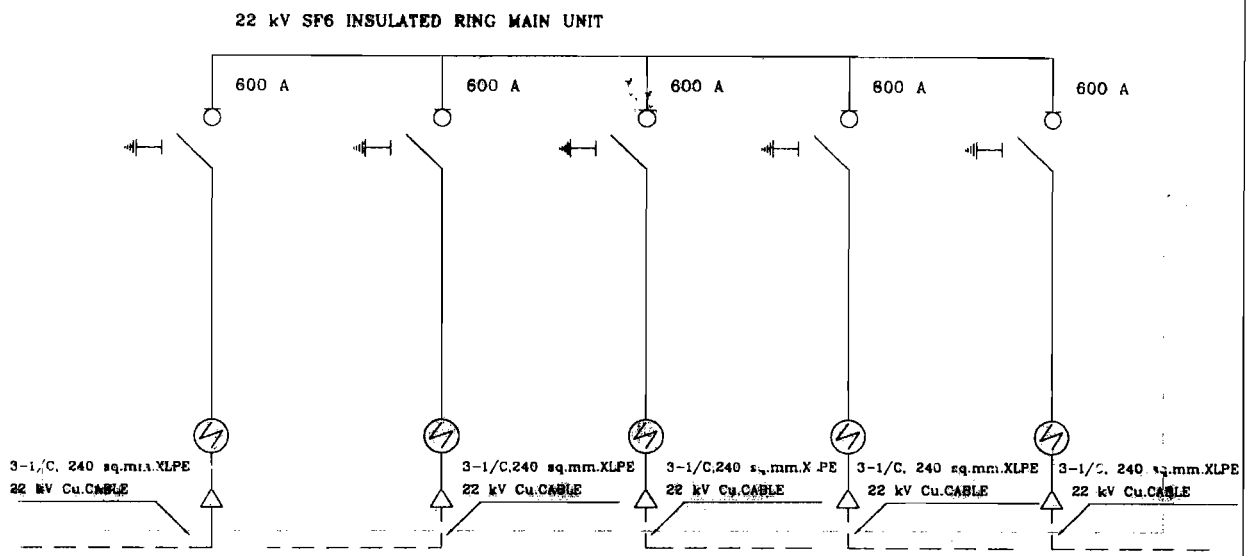

PRELIMINARY

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
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รองผู้ว่าการวางแผนและพัฒนาระบบไฟฟ้า	SINGLE LINE DIAGRAM COMPACT RING MAIN UNIT 22 kV TYPE 24-50-0	แบบเลขที่ SA5-015/50002 แผ่นที่ 1 ของจำนวน 1 แผ่น

2.4.10 Compact Unit Substation for 22 kV

C Material, equipment, and specifications for COMPACT UNIT SUBSTATION FOR 22 kV and 33 kV 50 Hz UNDERGROUND DISTRIBUTION SYSTEM

C1 General material and packing instructions

Additional to the general instructions, the following shall be observed:

1a Scope

These specifications cover compact unit substation for installation on 22 kV and 33 kV 50 Hz underground distribution systems.

1b Standard

The compact unit substation shall be manufactured and tested in accordance with following standard:

International Electrotechnical Commission (IEC):

IEC 62271-202: 2006 High-voltage switchgear and controlgear - Part 202: High-voltage/low voltage prefabricated substation

And all other relevant standard, unless otherwise specified in these specification.

PEA will also accept (the compact unit substation) the type tests report in accordance with the later edition of the above standard.

1c Principal requirement

1c.1 Service condition and installation

The compact unit substation shall be designed and constructed for outdoor installation and operation under the following conditions:

Altitude	:	up to 1,000 m above sea level
Maximum ambient air temperature	:	40 ^{o}C
Mean annual ambient temperature	:	30 ^{o}C
Mean annual relative humidity	:	79 %
Mean maximum annual relative humidity	:	94 %
Climatic condition	:	tropical climate
Maximum seismic factor	:	0.1 g
Lightning stroke expectancy	:	100 thunder storm days/year
Specific corrosive elements at site	:	salt; soot

The compact unit substation shall be suitable for installation in the public area such as crowded side walk. Public safety and attractive design are also the main points in bid consideration. The compact unit substation shall be designed, constructed and tested to meet at least the following requirements:

(1) The compact unit substation enclosure shall pass the internal arc test according to IEC 62271-202: 2006 or later edition, accessibility type B.

The bidder shall provide type test certificate of an independent institute to prove that the offered compact unit substation shall meet the above requirements. These type test certificates shall be submitted with the bid.

(2) The compact unit 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.

PEA will accept the deviation of the proposed compact unit substation comparing to the type test reports carried out according to clause **1e.2** in the following conditions:

- The proposed compact unit substation enclosure could have bigger dimensions than the dimensions stated in type test reports but not bigger than the dimension limits specified in this specification.
- The ring main units could be different manufacturer or type from the ones installed in compact unit substation at the time of type testing carried out.

1c.2 Compact unit substation construction

The housing of compact unit substation shall be of class of enclosure 20, or better.

The housing of compact unit substation shall be divided into three main sections as follows:

(1) High-voltage room in protection class IP 34 or better, equipped with a SF_6 - insulated ring main unit.

(2) Transformer room in protection class IP 34 or better, to accept an oil-filled type transformer up to 1,000 kVA. Rated output of transformer shall be as specified in "**C3 Schedule of detailed requirement**". The room shall be ONAN cooled and vermin proof sealed.

(3) Low-voltage room in protection class IP 34 or better, equipped with a low-voltage switchgear, local control panel and distribution management system (DMS) interfacing equipment (if any) and accessories. To prevent water condensation, the heater(s) with hygrostat shall be provided for whole room or separately for each equipment cubicle.

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 compact unit substation which is factory assembled on a common base frame as one piece, easily transported without any special tool. Therefore the compact unit substation shall be provided with suitable lifting facilities.

The housing shall be designed and manufactured of standardized parts. All housing parts are made of galvanized and powder coated steel sheets with a steel thickness of not less than 2.0 mm, a zinc thickness of not less than 0.225 kg/m^2 and an electrostatic plastic powder coat thickness of not less than 75 μm. Inner walls are either made of galvanized or stainless steel.

The Reinforced concrete or stainless steel housing shall be accepted. The thickness of stainless steel sheet shall be of not less than 1.5 mm.

The design and construction of the compact unit substation shall be weatherproof, fully tropicalized suitable for outdoor use in a humid 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 station, 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. Access doors shall be provided for each compartment. The doors to different compartment shall be equipped separate handles and be able to be latched in the open position. All mounting hardware (i.e. locking devices, hinges, pins, bolts, nuts) shall be stainless steel. All locks shall be provided with master keys and duplicate keys.

The service lighting shall be provided for all rooms. H.V. room and L.V. room shall be illuminated by a door controlled switch.

For safe protection of environment even under transformer leakage conditions the housing shall have a base pan made of oil-tight welded steel sheets (not less than 4 mm thick) with hot dip galvanized (zinc thickness of not less than 0.500 kg/m^2), powder coated and bituminized or oil-tight welded stainless steel (not less than 3 mm thick) or reinforced concrete. This base shall be suitable for mounting on concrete pad or foundation. The concrete pad/foundation shall be constructed by PEA and shall be limited to those portions which required to be cast in site only.

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.

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

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 grey or factory standard colour. The bidder shall state the final colours available which PEA shall select before signing the contract.

The painting process shall be described in the bid. The manufacturer shall be able to prove that the select process can protect the surface against corrosion when exposed to humid and polluted atmosphere (especially for installation located close to the sea within 1 km). It shall also possess excellent surface adhesion and reasonable immune to abrasion and external impact.

The minimum of three earthing points shall be provided for each station. One each in high-voltage compartment, low-voltage compartment and in transformer compartment. The earthing points shall be made of non-corrosive material throughout such as stainless steel. All metal parts are galvanic connected.

All parts and any necessary installation materials such as cable clamps, cable terminals, cable heads, fixing hardware etc. shall be completely furnished so that the compact unit substation can be put into operation when arrived at site and primary and secondary cables are connected.

1c.3 Compact unit substation equipment

The compact unit substation shall consist of the following main equipment (the equipment):

(1) SF_6 insulated ring main unit

(2) Transformer

(3) L.V. switchgear

The compact unit substations have various types defined the rating, construction, capacity and DMS interfacing as specified in **Table 1**.

Table 1

Types of the compact unit substations

Item	Type	Rated Voltage (kV)	RMU construction		Transformer capacity (kVA)	DMS interfacing
			No. of cable feeder switch	No. of transformer feeder switch		
1	**A24-1-630**	24	2	1	630	No
2	**A24-1-1000**	24	2	1	1,000	No
3	**A24-2-630**	24	2	2	630	No
4	**A24-2-1000**	24	2	2	1,000	No
5	**A24-3-630**	24	3	1	630	No
6	**A24-3-1000**	24	3	1	1,000	No
7	**A36-1-630**	36	2	1	630	No
8	**A36-1-1000**	36	2	1	1,000	No
9	**A36-2-630**	36	2	2	630	No
10	**A36-2-1000**	36	2	2	1,000	No
11	**A36-3-630**	36	3	1	630	No
12	**A36-3-1000**	36	3	1	1,000	No
13	**B24-1-630**	24	2	1	630	Yes
14	**B24-1-1000**	24	2	1	1,000	Yes
15	**B24-2-630**	24	2	2	630	Yes
16	**B24-2-1000**	24	2	2	1,000	Yes
17	**B24-3-630**	24	3	1	630	Yes
18	**B24-3-1000**	24	3	1	1,000	Yes
19	**B36-1-630**	36	2	1	630	Yes
20	**B36-1-1000**	36	2	1	1,000	Yes
21	**B36-2-630**	36	2	2	630	Yes
22	**B36-2-1000**	36	2	2	1,000	Yes
23	**B36-3-630**	36	3	1	630	Yes
24	**B36-3-1000**	36	3	1	1,000	Yes

1c.4 SF_6 - insulated ring main unit

1c.4.1.1 Manufacturer qualification for 22 kV

The manufacturer shall have reference list of supplies to customers outside the country of origin not less than five (5) years and not less than 500 units of ring main unit, except for manufacturers who used to supply to Provincial Electricity Authority (PEA) or Metropolitan Electricity Authority (MEA) the same type of ring main unit.

1c.4.1.2 Manufacturer qualification for 33 kV

The manufacturer shall have reference list of supplies to customers outside the country of origin not less than three (3) years and not less than 300 units of ring main unit, except for manufacturers who used to supply to Provincial Electricity Authority (PEA) the same type of ring main unit.

The definition of "same type" is the ring main unit (RMU) having same characteristic as follow:

- Type of mechanism
- Type of interrupter
- Rated voltage, or higher
- Rated normal current, or higher
- Rated short-time current, or higher

1c.4.2 Ratings

The ring main unit shall have ratings as specified in **Table 2**.

Table 2

Ratings of the ring main unit

Description	22 kV system	33 kV system
Rated voltage	24 kV	36 kV
Rated lightning impulse withstand voltage	125 kV peak	170 kV peak
Rated one-minute power frequency withstand voltage	50 kV r.m.s.	70 kV r.m.s.
Rated frequency	50 Hz	50 Hz
Rated normal current: - Cable feeder - Transformer feeder	 600 A 200 A	 400 A 200 A
Rated short-time current (1 sec), at rated voltage	16 kA	16 kA
Rated short-circuit making current, at rated voltage	40 kA peak	40 kA peak

1c.4.3 Construction

The ring main unit shall be of self-supported, metal-enclosed, hermetically sealed in SF_6 - filled container and completely independent from atmospheric influence three-pole type. All high- voltage live parts except fuse compartment shall be enclosed to meet IP 65 protection class. The earthing bar shall be in cover for personal safety.

The switch container (tank) shall be made of stainless steel or nickel-chromium steel. Tank - painting can be neglected. Outside surface shall be painted.

1c.4.4 Cable feeder switch

The switch for cable feeder shall be on-load type. The mechanism shall be motor-drive for remote on - off operation with manual operated in case of no power supply and mechanical switch position indicator.

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

Each load break switch and earthing switch shall have padlock provision to enable locking in either “open” or “closed” position.

The mechanism shall be supplied power via power supply specified in **1c.9.7** or DC rectifier depending on type of compact unit substation.

1c.4.5 Transformer feeder switch

The switch for transformer feeder shall be on-load type with fuses. The on-load switch with fuse shall have trip-free mechanism.

The fuse chamber shall be enclosed to meet at least IP 54 protection class. Fuse shall be HRC fuse in accordance with DIN standard equipped with striker pin for three phase tripping and shall have auxiliary contacts for remote status monitoring. The dimensions of fuse shall comply with DIN 43 625.

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.

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

The earthing switch shall be designed to earth both side of the fuse link. The earthing switch designed to earth only cable side of fuse link by using three (3) position switches shall be accepted.

Each load break switch and earthing switch shall have padlock provision to enable locking in either “open” or “closed” position.

1c.4.6 Cable connection

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

(1) Having cable compartment for personal safety and being free from vermin. 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.

(2) Be disconnected and then reconnected without damaging any part of the connection systems.

(3) Being suitable for cable feeders of single-core cross-link polyethylene insulation, copper wire screen, polyethylene sheath, H.V. power cable copper conductor size 240 mm^2 .

(4) Being suitable for transformer feeders of single-core cross-link polyethylene insulation, copper wire screen, polyethylene sheath, H.V. power cable copper conductor size 70 mm^2 .

1c.4.7 Accessories

The ring main unit shall be furnished and equipped with the following accessories.

(1) Short-circuit indicator(s) with Automatic/Manual mode indication resetting on each phase of incoming feeders. The indicator(s) shall be equipped with auxiliary contact. The light indication of the indicator(s) shall be at the front of the unit. The equipment requirement shall contain at least the following data:

a) Allow the fast identification of the faulty section, by providing a light indication when they are located upstream from the fault. An auxiliary output contact shall be available to provide the same information as the light indication.

b) Can be setting mode to manual or automatic mode

In case of Manual mode, fault Indication can be reset:

- By pressing a local push button on the local control panel: global (Fault indications on all channels) reset;
- By remote control from the control center: global reset;

In case of Automatic mode, fault Indication can be reset:

- Automatically after a time delay configurable channel per channel, between 0.3 Sec. to 120 min;

(2) Voltage indicators for each phase of cable feeder(s) and transformer feeder(s)

(3) Gas pressure indicator

(4) Facilities to test the cable feeders

(5) Pressure relief vent (explosion vent) with metal bursting plate

(6) Earthing terminal, with solderless clamp type connector suitable for copper conductor diameter of 12.6 mm (size 95 mm^2); complete with lock washer of stainless steel or better

(7) Lifting facilities