



กรมไฟฟ้าภูมิภาค  
PROVINCIAL ELECTRICITY AUTHORITY

# PROVINCIAL ELECTRICITY AUTHORITY

## TECHNICAL SPECIFICATION DIVISION

### THREE-PHASE TRANSFORMERS FOR 22 kV AND 33 kV 50 Hz DISTRIBUTION SYSTEMS WITH ABILITY TO WITHSTAND SHORT CIRCUIT

Specification No. RTRN-035/2561

Approved date : 04 NOV 2020

Rev. No. : 6

Form No. 02-3S

Page 1 of 3

#### APPENDIX 1

#### Comparison Method

In case the ability to withstand the dynamic short circuit is demonstrated by comparison between the reference transformer and similar transformer. In this case the bidders have to submit the short circuit test report of the reference transformer, calculation report of short circuit force which using Finite Element Method (FEM) software, all necessary information according to **Table 3** Design data of the reference transformers and the proposed transformers as well as the necessary information in order to show that the short-circuit withstand test report can prove the performance of the proposed transformers with the bid.

The short circuit test procedure of the reference transformer shall be according to **1e.2.2 Test procedure of Type test and Short-circuit withstand test.**

For the ability to withstand the dynamic effects of short circuit test, the total number of tests shall be three made in a different position of the tap-changer according to IEC 60076-5. The duration of each test shall be 0.5 s

The transformer is considered similar or representative to another transformer (proposed transformers) taken as a reference if it has the following characteristics in common with the latter:

- (1) Same type of operation, for example generator step-up unit, distribution, interconnection transformer and same rated voltage according to **Table 1**;
- (2) Same conceptual design, for example dry-type, oil-immersed type, core type with concentric windings, sandwich type, shell type, circular coils, non-circular coils;
- (3) Same arrangement and geometrical sequence of the main windings;
- (4) Same type of winding conductors, for example, aluminium, aluminium alloy, annealed or hardened copper, metal foil, wire, flat conductor, continuously transposed conductors and epoxy bonding, if used;
- (5) Same type of main windings for example, helical-, disc-, layer-type, pancake coils;
- (6) Absorbed power at short circuit (rated power/per unit short-circuit impedance) between 30% and 130% of that relating to the reference unit, see **Table 2**;
- (7) Axial forces, radial forces, axial winding stresses and radial winding stresses occurring at short circuit not exceeding 120% of those in the reference unit. (Force shall be calculated by Finite element program such as FLD12 etc., Hand calculation shall be rejected)
- (8) Same manufacturing processes;
- (9) Same clamping and winding support arrangement.

In case the comparison method, the short-circuit withstand test report of the reference transformer and a calculation report as a result of the comparison between the reference transformer and proposed transformer shall be submitted with the bid. The calculation report shall give evidence the force and stress according to item (7) and all necessary information according to item (1) to (9).

**EME**  
PEA



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Table 1

Type of operation and rated voltage of the proposed transformers similar to the reference transformers

Type and Rated voltage	The reference transformer	The proposed transformers
Type	3 Phase only	3 Phase
Rated primary voltage	22 kV	22 kV
Rated primary voltage	33 kV	33 kV
Rated secondary voltage (3 phase)	416/240 V	416/240 V

Table 2

Rated power of the proposed transformers similar to the reference transformers

	Rated power (kVA) of the reference transformers	Rated power (kVA) of the proposed transformers												
		315	400	500 <sup>(1)</sup>	630	800	1,000	1,250	1,500	2,000				
1	250	315		500 <sup>(1)</sup>										
2	315	315	400	500 <sup>(1)</sup>										
3	400	315	400	500 <sup>(1)</sup>	630									
4	500 <sup>(1)</sup>	315	400	500 <sup>(1)</sup>										
5	630	315	400	500 <sup>(1)</sup>	630	800								
6	800	315	400	500 <sup>(1)</sup>	630	800	1,000							
7	1,000	315	400	500 <sup>(1)</sup>	630	800	1,000	1,250						
8	1,250	315	400	500 <sup>(1)</sup>	630	800	1,000	1,250	1,500					
9	1,500	315	400	500 <sup>(1)</sup>	630	800	1,000	1,250	1,500					
10	2,000		400		630	800	1,000	1,250	1,500	2,000				

Note :

<sup>(1)</sup> Based on 6.5% short-circuit impedance. In case the impedance of 500 kVA transformer more than 6.5%, the bidders shall recalculate this table for PEA approval.





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Regional Electricity Authority

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Table 3

Design data of the reference transformers and the proposed transformers

Description	Design value of the reference transformers		Design value of the proposed transformers	
Rating (kVA)				
% Short circuit impedance				
Construction of Core				
HV Windings, made of				
LV Windings, made of				
Construction of HV Windings (Layer or disk)				
Construction of LV Windings (Layer or Foil)				
HV Current density (please enclosed the calculation sheet)				
LV Current density (please enclosed the calculation sheet)				
Axial force (please enclosed software calculation sheet)	<u>HV</u>	<u>LV</u>	<u>HV</u>	<u>LV</u>
Axial stress (please enclosed software calculation sheet)	<u>HV</u>	<u>LV</u>	<u>HV</u>	<u>LV</u>
Radial force (please enclosed software calculation sheet)	<u>HV</u>	<u>LV</u>	<u>HV</u>	<u>LV</u>
Radial stress (please enclosed software calculation sheet)	<u>HV</u>	<u>LV</u>	<u>HV</u>	<u>LV</u>
Same arrangement of main windings and geometrical sequence as the reference unit (Yes/No) (please enclosed the winding detail drawing)				
Same clamping and supporting arrangement. (Yes/No) (please enclosed the clamping detail drawing)				



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Specification No. RTRN-035/2561: THREE-PHASE TRANSFORMERS FOR 22 kV and 33 kV 50 Hz DISTRIBUTION SYSTEMS WITH ABILITY TO WITHSTAND SHORT CIRCUIT

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### C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
1	1050010066	set(s)	50 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
2	1050010067	set(s)	100 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
3	1050010068	set(s)	160 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
4	1050010069	set(s)	250 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
5	1050010070	set(s)	315 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
6	1050010071	set(s)	400 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
7	1050010072	set(s)	500 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
8	1050010073	set(s)	630 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
9	1050010074	set(s)	800 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
10	1050010075	set(s)	1,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.



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### C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
11	1050010076	set(s)	1,250 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
12	1050010077	set(s)	1,500 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
13	1050010078	set(s)	2,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.
14	1050010138	set(s)	50 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
15	1050010139	set(s)	100 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
16	1050010140	set(s)	160 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
17	1050010141	set(s)	250 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
18	1050010142	set(s)	315 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
19	1050010143	set(s)	400 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
20	1050010144	set(s)	500 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.



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### C3 Schedule of detailed requirement

Item	PEA Material No.	Quantity	Description
21	1050010145	set(s)	630 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
22	1050010146	set(s)	800 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
23	1050010147	set(s)	1,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
24	1050010148	set(s)	1,250 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
25	1050010149	set(s)	1,500 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.
26	1050010150	set(s)	2,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.

Note : Enclosed Drawings No. SA4-015/47002 and No. SA4-015/50008



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Specification No. RTRN-035/2561: THREE-PHASE TRANSFORMERS FOR 22 kV and 33 kV 50 Hz DISTRIBUTION SYSTEMS WITH ABILITY TO WITHSTAND SHORT CIRCUIT

C4 Price schedule		Manufacturer :			Unit Cost (See details & conditions attached)	Total Cost (See details & conditions attached)
Invitation to Bid No.:		Country of origin :				
Item	PEA Material No.	Catalogue No.	Description	Quantity		
1	1050010066		50 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)		
2	1050010067		100 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)		
3	1050010068		160 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)		
4	1050010069		250 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)		
5	1050010070		315 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)		



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Specification No. RTRN-035/2561: THREE-PHASE TRANSFORMERS FOR 22 kV and 33 kV 50 Hz DISTRIBUTION SYSTEMS WITH ABILITY TO WITHSTAND SHORT CIRCUIT

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C4 Price schedule		Manufacturer :			Total Cost (See details & conditions attached)
Invitation to Bid No.:		Country of origin :			
Item	PEA Material No.	Catalogue No.	Description	Quantity	Unit Cost (See details & conditions attached)
6	1050010071		400 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)	
7	1050010072		500 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)	
8	1050010073		630 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)	
9	1050010074		800 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)	
10	1050010075		1,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)	
11	1050010076	I	1,250 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)	





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Manufacturer :

Country of origin :

Trade-mark :

C4 Price schedule

Invitation to Bid No.:

Item	PEA Material No.	Catalogue No.	Description	Quantity	Unit Cost (See details & conditions attached)	Total Cost (See details & conditions attached)
12	1050010077		1,500 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)		
13	1050010078		2,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 22,000-416/240V, symbol Dyn11.	set(s)		
14	1050010138		50 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		
15	1050010139		100 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		
16	1050010140		160 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		



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C4 Price schedule		Manufacturer :			Total Cost (See details & conditions attached)
Invitation to Bid No.:		Country of origin :			
Item	PEA Material No.	Catalogue No.	Description	Quantity	Unit Cost (See details & conditions attached)
17	1050010141		2.50 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)	
18	1050010142		315 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)	
19	1050010143		400 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)	
20	1050010144		500 kVA, three-phase transformer, permanently sealed and completely oil filled system (without gas cushion) type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)	
21	1050010145		630 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)	



**PROVINCIAL ELECTRICITY AUTHORITY**  
**TECHNICAL SPECIFICATION DIVISION**

Specification No. RTRN-035/2561: **THREE-PHASE TRANSFORMERS FOR 22 kV and 33 kV 50 Hz DISTRIBUTION SYSTEMS WITH ABILITY TO WITHSTAND SHORT CIRCUIT**

**Manufacturer :**

**Country of origin :**

**Trade-mark :**

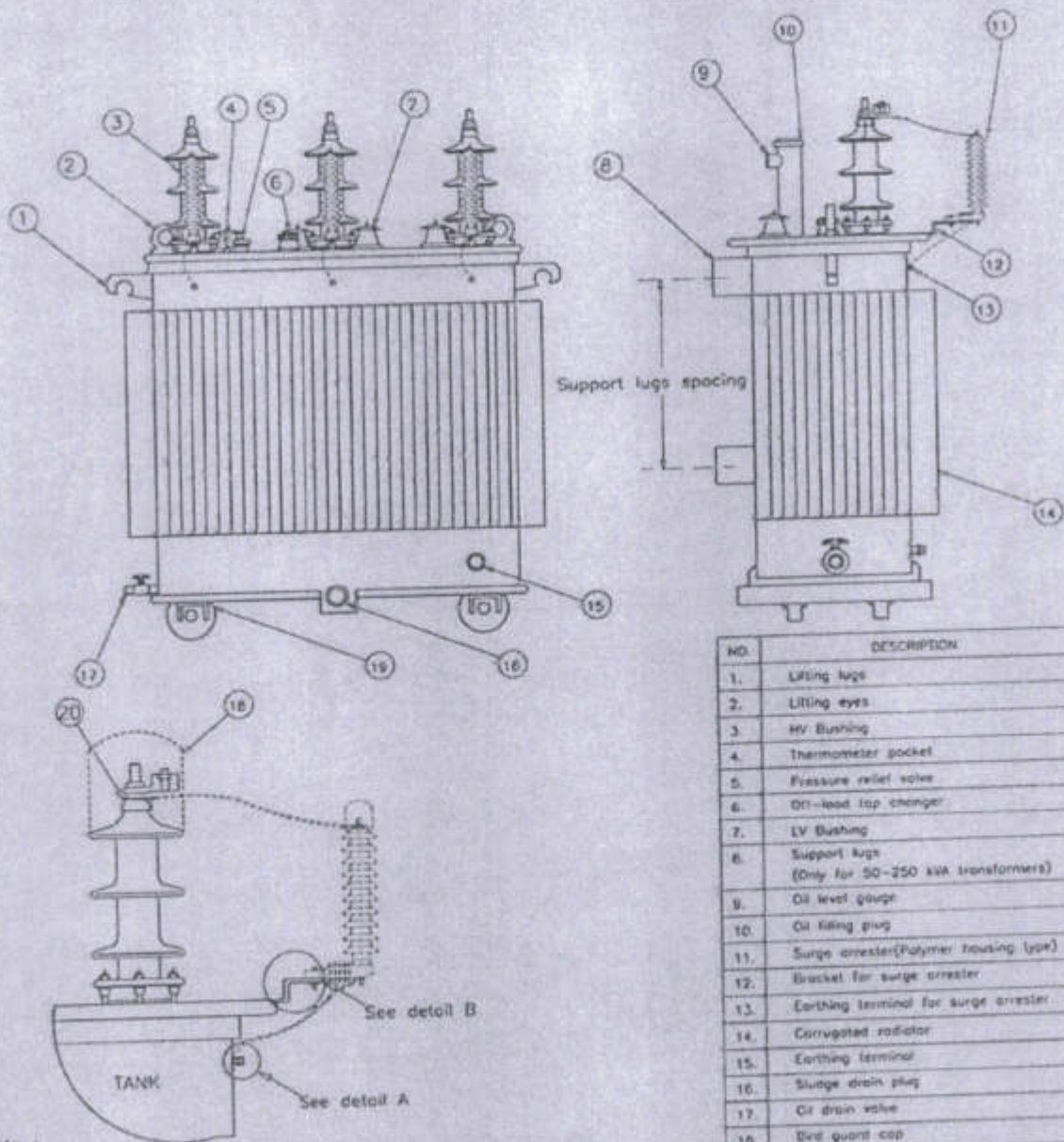
**C4 Price schedule**

**Invitation to Bid No.:**

Item	PEA Material No.	Catalogue No.	Description	Quantity	Unit Cost (See details & conditions attached)	Total Cost (See details & conditions attached)
22	1050010146		800 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		
23	1050010147		1,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		
24	1050010148		1,250 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		
25	1050010149		1,500 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		
26	1050010150		2,000 kVA, three-phase transformer, conservator system type, withstand short-circuit, 33,000-416/240V, symbol Dyn11.	set(s)		
<b>I</b>						

Only for 50-500 kVA transformers

PRELIMINARY



NO.	DESCRIPTION
1.	Lifting lugs
2.	Lifting eyes
3.	HV Bushing
4.	Thermometer gasket
5.	Pressure relief valve
6.	Oil-load tap changer
7.	LV Bushing
8.	Support lugs (Only for 50-250 kVA transformers)
9.	Oil level gauge
10.	Oil filling plug
11.	Surge arrester(Polymer housing type)
12.	Bracket for surge arrester
13.	Earthing terminal for surge arrester
14.	Corrugated radiator
15.	Earthing terminal
16.	Sludge drain plug
17.	Oil drain valve
18.	Oil vent cap
19.	Transport rollers (Only for 315-500 kVA transformers)
20.	Cable lug

Note :

1. Surge arrester, line lead and ground lead, supplied by PEA
2. Earthing terminal for surge arrester shall be eye-bolt type or socket type.
3. Position of earthing terminal for surge arrester shall be suitable for flexible copper insulated ground lead size 16 sq.mm, 430 mm long.
4. Not to scale

กองมาตรฐานระบบไฟฟ้า  
ฝ่ายมาตรฐานและความปลอดภัย

การไฟฟ้าส่วนภูมิภาค

ผู้เขียน...วิมลจิต เพ็ญศรี

ส่วนประกอบหม้อแปลงไฟฟ้า 3 เฟส

ผู้สำรวจ.....

วิศวกร.....

หัวหน้าแผนก.....

ผู้อำนวยการกอง.....

ผู้อำนวยการฝ่าย.....

DETAIL OF 3 PHASE TRANSFORMER

ใช้แทนแบบ.....

ถูกแทนโดยแบบ.....

เขียนเสร็จวันที่ 8 มิ.ย. 2552

แก้ไขเมื่อวันที่ 26 พ.ค. 2554

มีดีเป็น.....

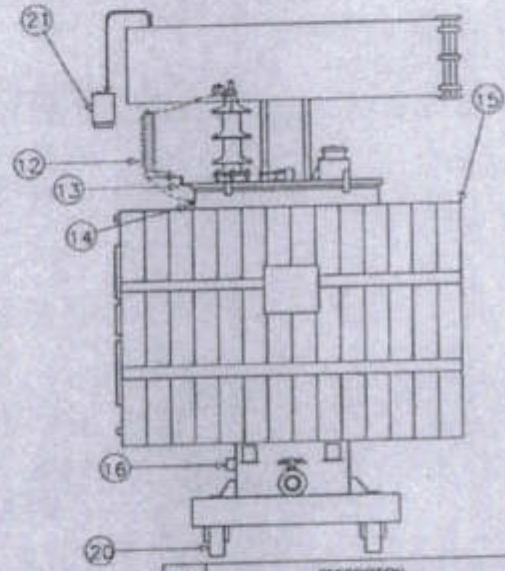
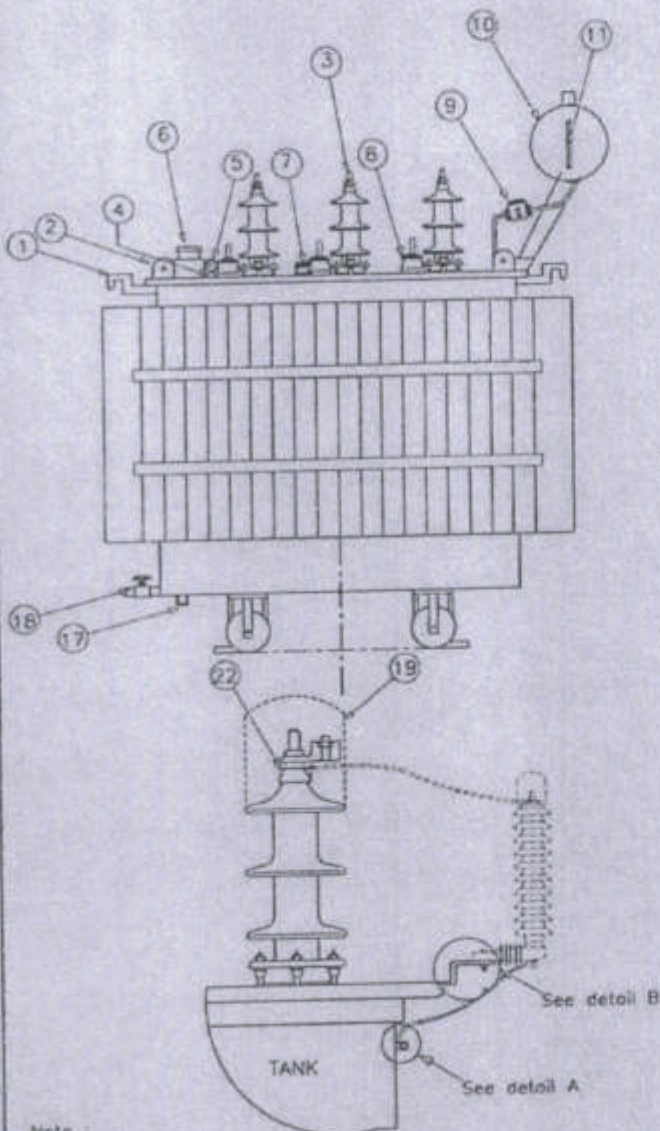
มาตรฐานส่วน.....

แบบเลขที่ SA4-015/50008

แผ่นที่ 1 ของจำนวน 4 แผ่น

Only for 630-2,000 kVA transformers

PRELIMINARY



NO.	DESCRIPTION
1.	U/Ling legs
2.	Lifting eyes
3.	HV Bushing
4.	Thermometer pocket
5.	Dial type thermometer (Only for 1,000-2,000 kVA transformers)
6.	Pressure relief valve
7.	Oil-lead tap changer
8.	LV Bushing
9.	Buchholz relay (Only for 1,000-2,000 kVA transformers)
10.	Conservator
11.	Oil level gauge
12.	Surge arrester (Polymer housing type)
13.	Bracket for surge arrester
14.	Earthing terminal for surge arrester
15.	Radiator
16.	Earthing terminal
17.	Sludge drain plug
18.	Oil drain valve
19.	Wind guard cap
20.	Transport rollers
21.	Dehydrating breather
22.	Cable lug

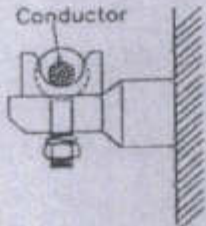
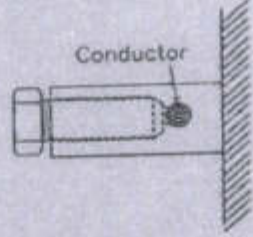
Note :

- Surge arrester, line lead and ground lead supplied by PEA
- Earthing terminal for surge arrester shall be eye-bolt type or socket type.
- Position of earthing terminal for surge arrester shall be suitable for flexible copper insulated ground lead size 16 sq.mm, 430 mm long.
- Only for 1,000-2,000 kVA transformers shall be furnished and equipped with :  
(a) Dial type thermometer with adjustable contact(s)  
(b) Double float Buchholz relay having two (2) contacts (for alarm and tripping)
- Not to scale

กองมาตรฐานระบบไฟฟ้า มาตรฐานและความปลอดภัย	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
ผู้เขียน... มณฑิต เพ็ญศวา..... ผู้สำรวจ..... วิศวกร..... หัวหน้าแผนก..... ผู้อำนวยการกอง..... ผู้อำนวยการฝ่าย.....	ส่วนประกอบหม้อแปลงไฟฟ้า 3 เฟส  DETAIL OF 3 PHASE TRANSFORMER	เขียนเสร็จวันที่ 8 มิ.ย. 2552 แก้แบบวันที่ 26 พ.ค. 2554 มีมติเป็น... มีอธิบดี... มาตรฐาน..... แบบเลขที่ SA4-015/50026 แผ่นที่ 2 ของจำนวน 4 แผ่น

PRELIMINARY

Detail A :

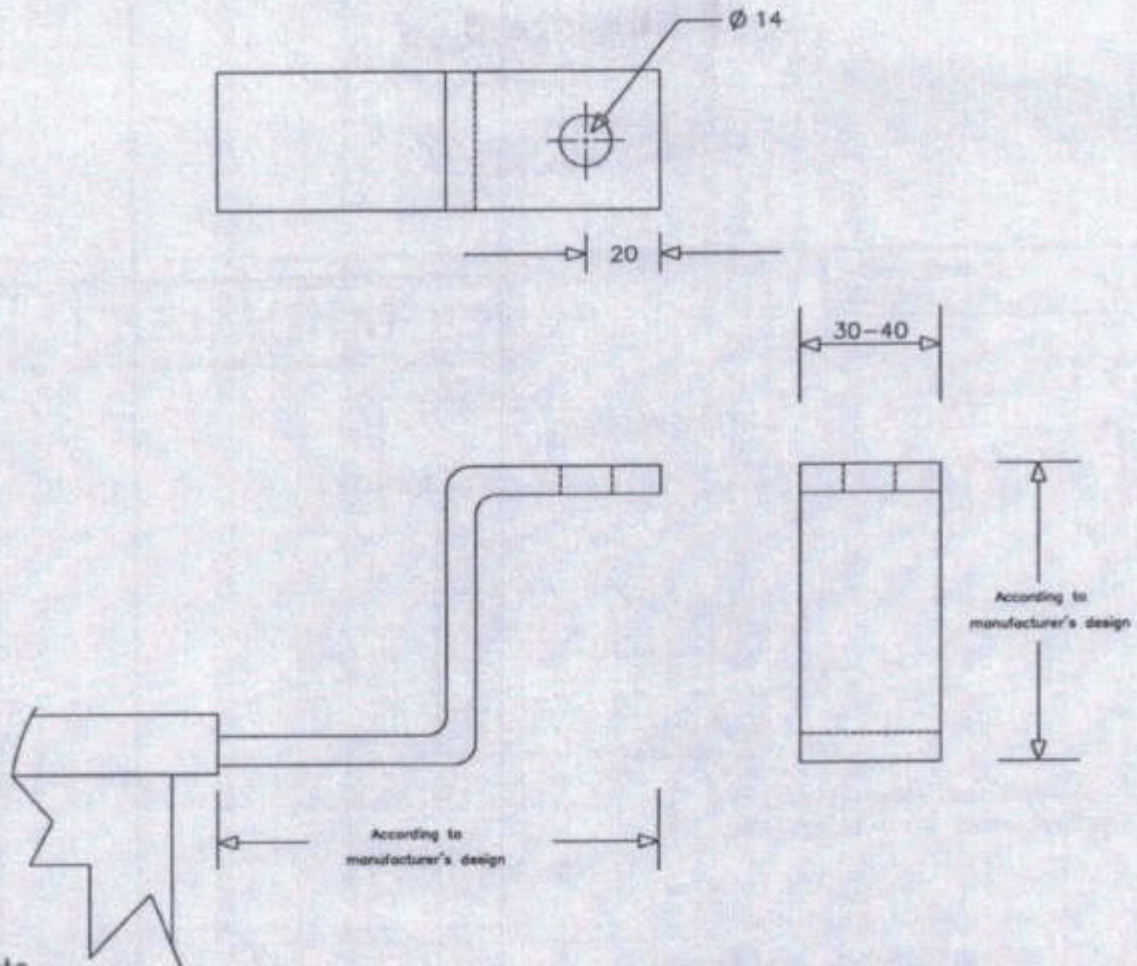
Type of earthing terminal for surge arrester	
 <p>eye-bolt type earthing terminal</p>	 <p>socket type earthing terminal</p>
<p><u>Description</u></p> <p>Eye-bolt type earthing terminal shall be with eye-bolt type connector suitable for flexible copper insulated ground lead size 16 sq.mm ; complete with lock washer of stainless steel or better</p>	<p><u>Description</u></p> <p>Socket type earthing terminal shall be with socket suitable for flexible copper insulated ground lead size 16 sq.mm ; complete with bolt of stainless steel or better for lock conductor.</p>

กองมาตรฐานระบบไฟฟ้า ฝ่ายมาตรฐานและควบคุมผลิตภัณฑ์	<b>การไฟฟ้าส่วนภูมิภาค</b>	ใช้แทนแบบ..... ถูกแทนโดยแบบ.....
ผู้เขียน... นภัสดีศ. เพ็ญตา..... ผู้สำรวจ..... วิศวกร..... หัวหน้าแผนก..... ผู้อำนวยการกอง..... ผู้อำนวยการฝ่าย.....	<b>ส่วนประกอบหม้อแปลงไฟฟ้า 3 เฟส</b>	เขียนเสร็จวันที่ 5 มิ.ย. 2552 แก้แบบวันที่ 26 พ.ค. 2554 มิติเป็น มิลลิเมตร มาตรฐานส่วน..... แบบเลขที่ SA4-015/3007B แผ่นที่ 3 ของจำนวน 5 แผ่น
<b>DETAIL OF 3 PHASE TRANSFORMER</b>		

PRELIMINARY

Detail B :

Detail of mounting bracket for surge arrester



Note.

1. Material of mounting bracket shall be stainless steel or painted with RAL gray color. And paint system shall be system No. A.3.08, according to table A.3 ISO12944-5 which the total thickness not less than 160 um.
2. Shape and dimension of mounting bracket, unless specified shall be according to manufacturer's design.
3. The mounting bracket shall be designed to support up to 8 kg surge arrester.

กองข้อกำหนดทางเทคนิค ฝ่ายวิศวกรรม	การไฟฟ้าส่วนภูมิภาค	ใช้แทนแบบ.....
ผู้เขียนมาตรฐาน เทียมแพงพันธ์	ส่วนประกอบหม้อแปลง 3 เฟส สำหรับจั้งซ่อม	ถูกแทนโดยแบบ.....
ผู้สำรวจ.....		เขียนเสร็จวันที่ 26 พ.ค. 2554
วิศวกร.....		แก้แบบวันที่ 21 พ.ย. 2561
หัวหน้าแผนก.....		ผลิตเป็น..... มิถิลเมตร
ผู้อำนวยการกอง.....	DETAIL OF	มาตราส่วน.....
ผู้อำนวยการฝ่าย.....	REPAIRED 3 PHASE TRANSFORMER	แบบเลขที่ SA4-015/50008
		แผ่นที่ 4. ของจำนวน 4. แผ่น