



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 17 of 32

**1e.2.2 Test procedure of Type test and Short-circuit withstand test**

Each transformer, as delineated by its own unique serial number, is required to pass a complete type test and short-circuit withstand test following the procedures listed below:

- (1) Prior to short circuit testing, each individual transformer must pass the routine test, measurement of no-load loss and current at 90 % and 110 % of rated voltage and temperature-rise tests. Criteria for the temperature-rise test is presented in **1c.8 "Limits of temperature-rise"**
- (2) Upon successfully passing the temperature-rise test, each transformer must then successfully pass a short circuit withstand test
- (3) Finally, lightning impulse shall be tested and all the routine tests including measurement of no-load loss and current at 90 % and 110 % of rated voltage shall be repeated. Each transformer shall pass the routine test, measurement of no-load loss and current at 90 % and 110 % of rated voltage and lightning impulse test.

The impulse test sequence is applied to each of line terminal of the tested winding in succession. The other line terminals of the transformer shall be earthed directly or through an impedance.

If the laboratories intend to use PEA's power system as power supply for the short-circuit withstand testing, the transformer's manufacturer or the laboratories shall submit technical documents of the test such as test procedure, test circuit diagram, test and protection equipment, testing date and calculation of voltage drop in PEA's power system caused by the test to PEA for consideration and approval before the tests are proceeded.

It is responsible of the laboratories to compensate all failure or damage occurred to PEA's power system caused by the test.

PEA reserves the right to send representatives to witness the test.

**The cost of all tests and reports shall be borne by the bidders/manufacturers/contractor.**

**1e.2.3 Type test and short circuit test report**

For 50 to 250 kVA transformers, the bidders have to submit the type test and short circuit test report of the identical transformer (purchased transformer) with the bid, otherwise shall be rejected

For transformers which rated power more than 250 kVA, the bidders have to submit the following document with the bid, otherwise shall be rejected.

- (1) The type test report of the identical transformer (purchased transformer), and
- (2) The short circuit test report of identical transformer (purchased transformer) or the reference transformer according to **1e.2.2 Test procedure of Type test and Short-circuit withstand test**, and
- (3) The calculation report<sup>(1)</sup> and others information according to **APPENDIX 1**.

**Note**

- <sup>(1)</sup> In case of the bidders submit the short circuit test report of the reference transformer, calculation report and others information shall be submitted.



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 18 of 32

The type test and short-circuit withstand test report of the transformers which are conducted or inspected by Thailand's national laboratories/institutes shall be valid within five (5) years count from the issued date in the test reports to the bid closing date.

For the type test and short-circuit withstand test report of the transformers which are conducted or inspected by laboratories/institutes, with in other countries shall be valid within ten (10) years count from the issued date in the test reports to the bid closing date.

PEA will also accept other documents instead of the type test and short-circuit withstand test reports in the following conditions:

- (1) In case the proposed transformer has been supplied to PEA and get the order from PEA's Procurement Department or Substation Work Department or Transmission and Distribution System Work Department (from PEA's head office), the Purchase Order (PO) or Contract with List of suppliers or Proposal form can be submitted, or
- (2) In case the proposed transformer has been registered for PEA Product Acceptance, the not-expired registration certificate counted to the bid closing date can be submitted, or
- (3) In case the proposed transformer has been registered for Product lists for substation turnkey project, the not-expired registration certificate counted to the bid closing date can be submitted instead

However the document in case (1), (2) and (3) shall be proved that the transformer specified in the PO or Contract with List of suppliers or Proposal form or registration certificate shall be the same product, type/model and all ratings as the proposed transformer for this bid.

**The cost of all tests and reports shall be borne by the bidders/manufacturers/contractor.**

**1e.3 Acknowledged independent testing laboratories**

The type test and short-circuit withstand test shall be conducted or inspected by the acknowledged testing laboratories/institutes as follows:

- (1) Laboratories/institutes which are members of the Short-circuit Testing Liaison (STL) or independent laboratories/institutes which are accredited according to TIS 17025 or ISO/IEC 17025 with the scope of accreditation covered the relevant test items, standards and equipment. The certification and scope of accreditation of the independent laboratories/institutes shall be submitted with the bid for consideration.

The bidders or manufacturers who are accredited according to TIS 17025 or ISO/IEC 17025 preferring to carry out the type tests and short-circuit withstand test of the transformers with the laboratories or by the manufacturers themselves, the tests shall be inspected by Thailand's



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 19 of 32

national laboratories, institutes, universities and electric utilities in (2) and other laboratories, institutes, universities or electric utilities approved by PEA.

- (2) Thailand's national laboratories, institutes, universities and electric utilities, as follow:
  - Electricity Generating Authority of Thailand (EGAT)
- (3) Other laboratories, institutes, universities or electric utilities approved by PEA. In this case, the detail of the test facilities of the laboratories 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.

**1e.4 The information in the Test report**

The minimum information of the transformer in the type test and short-circuit withstand test report shall be the following items:

**1. Transformer information**

- (1) Manufacturer's name
- (2) Model
- (3) Manufacturer's serial number
- (4) Number of phase
- (5) Rated voltage of the high-voltage winding
- (6) Rated voltage of the low-voltage winding
- (7) Rated voltage ratio
- (8) Rated frequency
- (9) Rated power
- (10) Rated current of the high-voltage winding
- (11) Rated current of the low-voltage winding
- (12) Short-circuit impedance at 75°C
- (13) Connection symbol
- (14) Cooling method
- (15) Total mass
- (16) Mass of core and winding
- (17) Oil quantity
- (18) Highest voltage for equipment applicable the high-voltage winding
- (19) Highest voltage for equipment applicable the low-voltage winding
- (20) Rated insulation level
- (21) Type of construction
- (22) High-voltage winding type and material



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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 20 of 32

- (23) Low-voltage winding type and material
- (24) Cross-section of the conductor in the high-voltage winding
- (25) Cross-section of the conductor in the low-voltage winding
- (26) Number of strands per turn of high voltage winding
- (27) Number of strands per turn of low voltage winding
- (28) Number of strands radially across the layer (for all turns) of high voltage winding
- (29) Number of strands radially across the layer (for all turns) of low voltage winding
- (30) Total number of turns per phase
- (31) Number of turns each tap

## 2. Drawing

- (1) Overall dimensions of transformer
- (2) Tank dimension
- (3) Drawing of cross section area of core
- (4) Drawing of active part
- (5) Drawing which show the core and coil information according to **Figure 7**

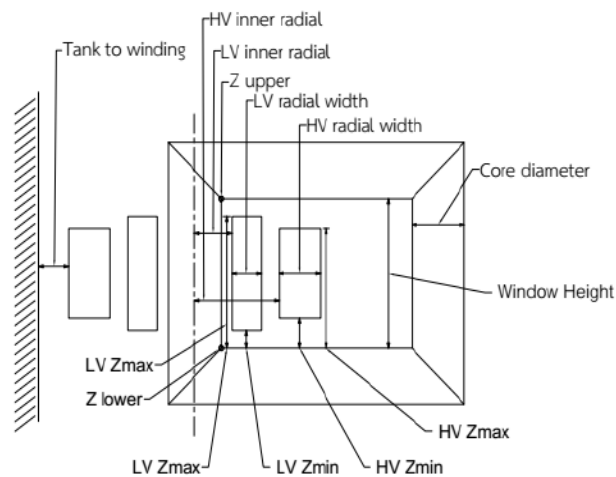


Figure 7: Core and coil constructions.

## 3. Photograph of transformers

The color photograph which reveal transformer construction for out-of-tank inspection before and after short-circuit withstand test shall be in the short-circuit withstand test report.

In case the information in the reports are not completed according to the above requirement, the bidders will be rejected.



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 21 of 32

**1e.5 Acceptance test items and acceptance test procedures**

**1e.5.1 Acceptance test items**

The sample of transformers shall pass the following tests in accordance with the IEC 60076 and IEC 60156 standards:

- (1) Measurement of winding resistance (IEC 60076-1)
- (2) Measurement of voltage ratio and check of phase displacement (IEC 60076-1)
- (3) Measurement of short-circuit impedance and load loss (IEC 60076-1)
- (4) Measurement of no-load loss and current (IEC 60076-1)
- (5) Applied voltage test (IEC 60076-1 and IEC60076-3)
- (6) Induced voltage withstand test (IEC 60076-1 and IEC60076-3)
- (7) Oil Dielectric Breakdown voltage test (IEC 60156)
- (8) Temperature-rise test (IEC 60076-2)<sup>(1)</sup>
- (9) Full wave lightning impulse test (IEC 60076-3)<sup>(1)</sup>
- (10) Short-circuit withstand test (IEC 60076-5)<sup>(2)</sup> (only for transformer rating of 50-250 kVA)
- (11) Dry film thickness test, the dry film thickness test procedure shall be according to **1c.12.1**

**Painting system**

**Note**

<sup>(1)</sup> The Items (8) and (9) shall be tested on one (1) unit for each contract at the PEA laboratory or Acknowledged independent laboratories approved by PEA as specified in **1e.3 Acknowledged independent testing laboratories** or manufacturer laboratories depending on PEA's acceptance committee

<sup>(2)</sup> The Items (10) shall be tested on one (1) unit for each contract at Acknowledged Independent laboratories depend on PEA's acceptance committee approved by PEA as specified in **1e.3 Acknowledged independent testing laboratories**.

Any transformers which are out-of-tank for inspection in short-circuit withstand test, the insulating oil shall be dehydration at manufacture's factory and oil dielectric breakdown voltage shall be retested. The report of oil dielectric breakdown voltage test shall be submitted to PEA before shipment/delivery, for each ordered transformer.

**1e.5.2 Acceptance test procedures**

PEA's acceptance committee will select the sample of each lot, the number of transformer per lot according to **Table 10**. All sampling units shall be transported to PEA laboratory or Acknowledged independent laboratories for testing according to **1e.5.1 Acceptance test items**. The transportation shall be carried out by the contractor.



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 22 of 32

**Table 10 The number of sample and criteria for consideration**

Number of transformer per lot (Unit)	Sample size of transformers for acceptance test (Unit)	Maximum number of sample failing in the acceptance test (Unit)
2 to 15	2	0
16 to 25	3	0
26 to 90	5	0
91 to 150	8	0
151 to 500	13	1
More than 500	20	1

The number of failing units shall not more than the maximum number of failing sample in the acceptance test according to **Table 10**. Otherwise, the transformers in that lot shall be rejected.

In case the failing units are not more than the maximum number of failing sample in the acceptance test according to **Table 10**, the contractor has to take responsibility as following procedure.

- (1) The contractor has to recheck all delivered transformers in that lot and repair or fix the defective transformers in that lot.
- (2) The contractor shall analyze the problem and send the report to PEA's acceptance committee before the lot accepted.
- (3) The transformers which are repaired or fixed in that lot shall be retested only in the relevant test items according to **1e.5.1 Acceptance test items**.

After the test, the transformers shall be rebuilt completely by the contractor with free of charge and send back to PEA with the same amount of the samples.

**1f Inspection**

To ensure about the quality of transformers, the inspection shall be carried out by the PEA's representative (PEA's witness committee) at following two stages:

- At anytime during receipt of raw material and manufacture/ assembly whenever the PEA desires.
- At finished stage i.e. transformers are fully assembled and are ready for dispatch.



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 23 of 32

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

The bidders have to submit the following data and details of transformers and accessories with the bid:

**2a Performance data and guarantee of three-phase transformers. (See pages 26 to 30 of 32)**

**2b Drawing of inside tank and overall transformer with dimensions in mm showing of particulars of normal construction details.**

**2c Drawings, with dimensions in mm, of the following accessories:**

1. HV and LV bushings
2. Terminal connectors, on HV and LV bushings, with description of materials used for the component parts
3. Nameplate with connection diagram
4. Valve, showing the internal construction
5. Earthing terminal connector
6. Dehydrating breather, and details of coupling (if any)
7. Bracket for surge arrester
8. Earthing terminal for surge arrester
9. Lifting lug
10. Lifting eye
11. Pressure relief valve
12. Thermometer pocket
13. Oil level gauge
14. Oil filling plug
15. Supporting lugs
16. Compression type of cable lug
17. Sludge drain plug
18. Accessories according to manufacturer's design, if any

**2d Catalogues and/or drawings with details of the following accessories:**

1. Dial type thermometer
2. Double float Buchholz relay
3. Pressure-relief valve
4. Bird guard
5. Core
6. HV and LV Winding
7. Off load tap changer



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 24 of 32

8. Insulation paper
9. Gaskets
10. Oil drain vale
11. Accessories according to manufacturer's design, if any

**2e Dry film thickness test report**

**2f Type test and Short-circuit withstand test report**

**2g List of routine test**

**2h Drawing of core and coil construction**

**2i Specifications of transformer oil and test report**

**2j HV and LV Bushing test report**

**2k Others necessary information in order to show that the special test report can prove the performance of the proposed transformers.**

**2l Bidders shall propose and quote for recommended spare part list with separate price for each offered item (e.g., bushings)**

**2m Packing details**

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

Number of transformers in one (1) crate or wooden case (one)

Overall dimensions (L x W x H) of each crate or wooden case in cm

Volume of each crate or wooden case in m<sup>3</sup>

Gross weight of each crate or wooden case in kg

Number of crates or wooden cases

**2n Critical documents of the transformers (See page 25 of 32)**

The lists of documents shall be fulfilled and submitted with the bid.





# 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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 25 of 32

#### The Critical documents of the transformers

No.	Required documents	Proposed technical document	Reference document (Page/Item)
1	HV and LV Bushing test report	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2	Dry film thickness test report	<input type="checkbox"/> Yes <input type="checkbox"/> No	
3	List of routine test report	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4	<u>For 50-250 kVA and the reference transformer</u> Type test and Short-circuit withstand test report <u>For transformer more than 250 kVA and is not the reference transformer</u> Type test report and calculation report and accessories information, or	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	The copy of previous Purchase Order (PO) or Contract with List of suppliers or Proposal form, or	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	PEA Product Acceptance registration certificate, or	<input type="checkbox"/> Yes <input type="checkbox"/> No	
	Product lists registration certificate	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5	The TIS 17025 or ISO/IEC 17025 certification and scope of accreditation of the independent laboratories/institutes (in case the independent laboratories/institutes are accredited according to TIS 17025 or ISO/IEC 17025)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6	Performance data and guarantee of the three-phase transformers. (pages 26 to 30 of 32)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7	Drawing of inside tank and overall transformer with dimensions in mm showing of particulars of normal construction details.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8	Drawings, with dimensions in mm according to 2c	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9	Catalogues and/or drawings with details according to 2d	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10	Drawing of core and coil construction according to 2h	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11	Specifications of transformer oil and test report according to 2i	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12	Packing detail(s) according to 2m	<input type="checkbox"/> Yes <input type="checkbox"/> No	

**I The items offered without submitting the critical documents shall be rejected**



# 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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 26 of 32

**Invitation to Bid No.:**

**2a Performance data and guarantee of three-phase transformers**

Item .....

Manufacturer's name and country of origin		
Type or model		
Applied standard		
Rated power	kVA	
Rated frequency	Hz	
Rated primary voltage	V	
Rated secondary voltage	V	
Connection symbol	Dyn11	
Type of oil preservation system	-	
Operation duty: continuous operation (Type DB)	Yes/No	
Max. temperature rise of winding (at full load)	K	
Max. temperature rise of top oil (at full load)	K	
Primary tapping: off-circuit condition	Yes/No	
Number of steps of primary tapping	Steps	
Per cent of rated voltage of each tapping	%	
No-load current & Tolerance	% & %	&
Short-circuit impedance at 75°C & Tolerance	% & %	&
<b>Losses</b> , for each transformer unit		
No-load loss <u>plus positive tolerance</u>	W	
Load loss, <u>plus positive tolerance</u> , at 75°C	W	
Efficiency in %, at 75°C and at load:		
- 1/2 of rated power and P.F. = 1.0	%	
- 1 of rated power and P.F. = 1.0	%	
Voltage regulation at P.F. = 1.0	%	



# 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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 27 of 32

Item .....

<b>Bushings</b>		HV	LV
		- Manufacturer's name	-
- Country of origin	-		
- Applied standard	-		
- Rated current	A		
- Full-wave impulse withstand voltage, or BIL	kV, peak		
- Low-frequency dry 1-minute test voltage	kV, r.m.s.		
- Low-frequency wet 10-second test voltage	kV, r.m.s.		
- Protection class	-		
- Colour of glazing	-		
- Stud thread size, Metric	-		
Secondary neutral point is loaded with rated current	Yes/No		
<b>Terminal connectors</b> on HV and LV bushings			
- Manufacturer's name	-		
- For copper conductor diameter range (HV side)	mm		
- For aluminium conductor diameter range (HV side)	mm		
- For copper conductor diameter range (LV side)	mm		
- For aluminium conductor diameter range (LV side)	mm		
- Number of circuits, take-off (LV side)	Circuits		
- Terminal pads are according to PEA's Drawing No. SA4-015/47002	Yes/No		
<b>Winding</b>		HV	LV
- Manufacturer's name (the bidders have to quote not more than three (3) manufacturers)	-		
- Country of origin	-		
- Material: copper	Yes/No		
- Type of enamel or insulating material of wire	-		
- Size of wire			
- for HV side (diameter)	mm		
- for LV side (dimension)	mm x mm		
- Resistance per phase at 75°C	Ohm		



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 28 of 32

Item .....

- Full-wave impulse withstand voltage, or BIL	kV, peak	
- Power-frequency test voltage, 1 min	kV, r.m.s.	
- Construction of winding	-	
- Current density	A/mm <sup>2</sup>	
- Number of layer per coil	-	
- Number of turns of each coil in tap No.3	Turns	
- Number of turns of each tapping position	Turns	
- Total turns of each coil	Turns	
<b>Core</b>		
- Manufacturer's name (the bidders have to quote not more than three (3) manufacturers)	-	
- Country of origin	-	
<b>Pressure relief valve</b>		
- Manufacturer's name	-	
- Country of origin	-	
- Type or model	-	
- Operating pressure	kg/cm <sup>2</sup>	
- Flow rate at..... kg/cm <sup>2</sup>	cc/sec	
Method of cooling	-	
Total cooling surface	m <sup>2</sup>	
Brand of oil used for initial filling	-	
Completely assembled transformer shall withstand, without permanent deformation, a maximum pressure of	kg/cm <sup>2</sup>	
Colour of tank: grey (RAL 7036)	Yes/No	
Tank finish conforms to PEA's requirement	Yes/No	
Quantity of oil filling	liters	
Mass of core	kg	
Mass of winding	kg	
Mass of the part liftable from tank	kg	
Mass of complete transformer with oil	kg	
Terminal markings and connections conform to PEA's requirement	Yes/No	



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 29 of 32

Item .....

<p><b>Tank</b></p> <ul style="list-style-type: none"> <li>- Thickness of side wall</li> <li>- Thickness of top plate</li> <li>- Thickness of bottom plate</li> </ul> <p><b>Internal dimensions</b></p> <ul style="list-style-type: none"> <li>- Height</li> <li>- Width</li> <li>- Depth</li> </ul>	<p>mm</p> <p>mm</p> <p>mm</p> <p>mm</p> <p>mm</p> <p>mm</p> <p>mm</p>	
<p><b>Dimensions of transformer</b></p> <ul style="list-style-type: none"> <li>Overall height</li> <li>Overall width</li> <li>Overall depth</li> <li>Height over cover</li> </ul>	<p>mm</p> <p>mm</p> <p>mm</p> <p>mm</p>	
<p><b>Total dry film thickness</b></p>	<p>µm</p>	
<p><b>Fin</b></p> <ul style="list-style-type: none"> <li>- Fin radiators or Corrugated thickness</li> <li>- Dimension of each fin (LxBxT)</li> </ul> <p><b>Number of Fins per radiator</b></p> <ul style="list-style-type: none"> <li>- Side of tank</li> <li>- Front of tank</li> <li>- Total number of fin</li> </ul>	<p>mm</p> <p>mm</p> <p>-</p> <p>-</p> <p>-</p>	
<p><b>Bushing clearance</b></p> <p>Please fill in the shortest of clearance</p> <ul style="list-style-type: none"> <li>LV to earth</li> <li>HV to earth</li> <li>Between LV bushing</li> <li>Between HV bushing</li> </ul>	<p>mm</p> <p>mm</p> <p>mm</p> <p>mm</p> <p>mm</p>	
<p>Detail documents of Item 1 on Page 31 to 32 of 32 shall be sent to PEA before shipment/delivery</p>	<p>Yes/No</p>	



การไฟฟ้าส่วนภูมิภาค  
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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 30 of 32

Item .....

X/R ratio	-	
<b>Rated short circuit current and withstanding duration</b>		
- Current	kA	
- Duration	s	
<b>Duration of overload</b>		
- 25% overload	Minutes	
- 50% overload	Minutes	
Magnetic flux density	Tesla	
<b>Other :</b>		



**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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 31 of 32

**Note: Conditions for documentation and consideration**

1. The Contractor has to supply the following documents in English and/or Thai, before shipment/delivery, for each ordered transformer:

1.1 Report of routine tests

1.2 Number of turns of each winding, each coil, and each tapping position

1.3 Mass of HV windings and of LV windings

1.4 Type of enamel, temperature class, and size of the enameled wire

1.5 Information for Reference (only one(1) unit per contract). The following information for each transformer shall be submitted for maintenance purpose.

- Coil height for each winding before assembly and after complete assembly.
- Torque value on clamping bolts or pressure for each winding before assembly and after complete assembly.
- Photograph of each coil for each phase and photograph of core and coils assembly. The photograph of each coil shall be taken from the final production process before placing to the core, top view and front view shall be provided. The photograph of core and coils assembly shall be taken just prior to place the completed core and coils assembly into the tank, top view, front view, right view, left view and rear view shall be provided for complete set of photographs. All photographs shall be 216 mm (8-1/2 in) by 280 mm (11 in) gloss prints properly labeled relevant to the view taken.

1.6 Invoice and Test report of the following material and accessories used in each supply shall be submitted.

- Transformer oil
- Silicon steel
- Copper conductor
- Insulation paper and pressboard
- Pressure relief
- Gaskets
- Bushing
- Transformer supervisory equipment



การไฟฟ้าส่วนภูมิภาค  
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 : 30/05/2562

Rev. No. : 5

Form No. 02-3S

Page 32 of 32

The above documents shall be sent to the following address:

Transformer Division  
Provincial Electricity Authority  
200 Ngam Wong Wan Road, Chatuchak  
Bangkok Metropolis 10900  
Thailand

2. If the material and packing data given by bidders, which are mentioned on Pages 23 to 24 of 32 are estimated or approximated, the bid may be rejected.
3. Delivery time is also one of the important factors to be considered.
4. Partial shipment/delivery is allowed.





การไฟฟ้าส่วนภูมิภาค  
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).





การไฟฟ้าส่วนภูมิภาค  
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 2 of 3

**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									
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.





การไฟฟ้าส่วนภูมิภาค  
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 3 of 3

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)				



การไฟฟ้าส่วนภูมิภาค  
PROVINCIAL ELECTRICITY AUTHORITY

# 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

Page 1 of 3

### 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.