

# Technical Questionnaire 9.101/6 Transformer Test System



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Quotation number: \_\_\_\_\_  
(will be filled in by HIGHVOLT)

## Personal Data

Name: \_\_\_\_\_  
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## Application

Test field, stationary           research institute           mobile on-site

## Test of

Power transformer  up to ..... MVA ..... kV  
Special transformer  up to ..... MVA ..... kV  
Shunt reactor  up to ..... MVA ..... kV    please offer additional technical data in appendix 1

## Delivery scope

Replacement of motor-generator set     please offer technical data of existing components in appendix 2  
Complete transformer test system

## Further requirements

- Tapped transformer is required  no    please offer additional technical data in appendix 2  
 yes
- HV capacitor-bank is required  no    please offer additional technical data in appendix 2  
 yes    manually operated  
 yes    off-load automatically operated
- power measuring system is required  no  
 yes
- PD measuring system is required  no  
 yes
- Temperature measuring system is required  no  
 yes
- Advanced control system using computer  no  
 yes
- Consultancy for designing test field is required  no  
 yes

## Planned tests

	Should be part of offer		Remarks
	YES	NO	
<b>Routine tests</b>			
Measurement of winding resistance			
Measurement of transformer ratio and vector group			
Measurement of no load current and no load losses			
Measurement of short circuit impedance and load losses			
Applied voltage test (AV)			
Induced voltage withstand test (IVW)			
Induced voltage test with partial discharge measurement (IVPD)			
Line terminal AC withstand test (LTAC)			
Tap-changer test under load			
<b>Type tests</b>			
Temperature rise test			
Lightning impulse test (LI)			
Switching impulse test (SI)			
<b>Special tests</b>			
Noise level measurement			
Zero-sequence test			
Measurement of insulation resistance			
Measurement of dissipation factor ( $\tan \delta$ )			
Measurement of power taken by the fan and oil pump motors			

## General data of the test objects

		unit	single-phase object		three-phase object	
			smallest object	largest object	smallest object	largest object
Applied test voltage range		kV				
Induced AC withstand voltage range (phase to earth)		kV				
Rated power range		MVA				
HV- Voltage (Um) range		kV				
MV- Voltage (Um) range		kV				
LV- Voltage (Um)	range	kV				
	other LV-Voltages					
Short-circuit impedance $U_{sc}$	HV-LV	%				
	HV-MV	%				
	MV-LV	%				
Load losses		kW				
No-load current at 100 % of rated voltage		%				
No-load current at 110 % of rated voltage		%				
No-load losses		kW				

## Typical transformers (1)

Object number	0 (example)	1	2	3	4	5
Phase number (1 or 3 phase)	3					
Rated power (MVA)	750					
Rated frequency (Hz)	50					
Rated voltage HV (kV)	420					
Rated voltage MV (kV)	-					
Rated voltage LV (kV)	20					
Vector group	YNd1					
Power frequency withstand voltage (kV / 1 min.)	line terminal	630				
	neutral	75				
Induced AC withstand voltage (phase to earth) (kV)	$420 \cdot 1.8 / \sqrt{3}$					
Short-circuit impedance $u_{sc}$ (HV-LV) (%)	14 %					
Short-circuit impedance $u_{sc}$ (HV-MV) (%)	-					
Short-circuit impedance $u_{sc}$ (MV-LV) (%)	-					
Load losses (kW)	1470					
Load losses at temperature rise test (kW)	1770					
Steps of on-load tap-changer (OLTC)	$\pm 8$					
Step voltage of OLTC (%)	0.94 %					
Type name of OLTC	GIII2002Y					
Maximum rated through-current of OLTC (A)	2000					
Transition resistance of OLTC ( $\Omega$ )	1.19					
Position „-2“ of TC	rated voltage (kV)	412				
	short-circuit impedance $u_{sc}$ (%)	14.21 %				
Position „+2“ of TC	rated voltage (kV)	428				
	short-circuit impedance $u_{sc}$ (%)	14.45 %				
No-load test at 100 % of rated voltage	voltage (kV)	20				
	losses (kW)	300				
	current (%)	0.05 %				
	3rd harmonics (%)	19 %				
	5rd harmonics (%)	40 %				
	7rd harmonics (%)	24 %				
No-load test at 110 % of rated voltage	9rd harmonics (%)	2 %				
	voltage (kV)	22				
	losses (kW)	423				
	current (%)	0.23 %				
	3rd harmonics (%)	11 %				
	5rd harmonics (%)	64 %				
Windings capacitance (nF)	7rd harmonics (%)	41 %				
	9rd harmonics (%)	1 %				
Windings capacitance (nF)	HV to MV+LV+Tank	20				
	MV to HV+LV+Tank	-				
	LV to HV+MV+Tank	60				

## Typical transformers (2)

Object number		6	7	8	9	10	11
Phase number (1 or 3 phase)							
Rated power (MVA)							
Rated frequency (Hz)							
Rated voltage HV (kV)							
Rated voltage MV (kV)							
Rated voltage LV (kV)							
Vector group							
Power frequency withstand voltage (kV / 1 min.)	line terminal						
	neutral						
Induced AC withstand voltage (phase to earth) (kV)							
Short-circuit impedance $u_{sc}$ (HV-LV) (%)							
Short-circuit impedance $u_{sc}$ (HV-MV) (%)							
Short-circuit impedance $u_{sc}$ (MV-LV) (%)							
Load losses (kW)							
Load losses at temperature rise test (kW)							
Steps of on-load tap-changer (OLTC)							
Step voltage of OLTC (%)							
Type name of OLTC							
Maximum rated through-current of OLTC (A)							
Transition resistance of OLTC ( $\Omega$ )							
Position „-2“ of TC	rated voltage (kV)						
	short-circuit impedance $u_{sc}$ (%)						
Position „-2“ of TC	rated voltage (kV)						
	short-circuit impedance $u_{sc}$ (%)						
No-load test at 100 % of rated voltage	voltage (kV)						
	losses (kW)						
	current (%)						
	3rd harmonics (%)						
	5rd harmonics (%)						
	7rd harmonics (%)						
No-load test at 110 % of rated voltage	voltage (kV)						
	losses (kW)						
	current (%)						
	3rd harmonics (%)						
	5rd harmonics (%)						
	7rd harmonics (%)						
Windings capacitance (nF)	HV to MV+LV+Tank						
	MV to HV+LV+Tank						
	LV to HV+MV+Tank						

## Supply conditions

	low-voltage mains	medium-voltage mains
Mains voltage	.... / .... V	.... kV
Frequency	.... Hz	
Available power: single-phase	..... kVA	..... kVA
three-phases	..... kVA	..... kVA
star point earthed	yes <input type="checkbox"/> no <input type="checkbox"/>	yes <input type="checkbox"/> no <input type="checkbox"/>

## Test field

Layout (Lx W x H), if application for test shop* <sup>1</sup> )	Test field	m x m x m	
		Shielded	yes <input type="checkbox"/> no <input type="checkbox"/>
	HV capacitor-bank	m x m x m	
Ambient conditions	altitude above sea level	m	
	min. ambient temperature	°C	
	max. ambient temperature	°C	
	relative humidity	%	

\*<sup>1</sup>) a drawing about the layout of the test field is favored

## Special mains conditions / restrictions by buildings

## Erection of the transformer test system on-site

Supervision required    yes        no

## Appendix 1: Additional questions for shunt reactor test

### 1) Planned tests

	Should be part of offer		Remarks
	YES	NO	
<b>Routine tests</b>			
Measurement of winding resistance			
Measurement of insulation resistance			
Measurement of capacitance and dissipation factor ( $\tan \delta$ )			
Measurement of reactance at rated voltage and rated frequency			
Measurement of loss at rated current and rated frequency			
Induced a. c. withstand voltage test			
Applied voltage test			
Lightning impulse test (LI)			
<b>Type tests</b>			
Temperature rise test at maximum operating voltage and rated frequency			
Measurement of acoustic sound level			
Measurement of power taken by the fan and oil pump motors			
Switching impulse test (SI)			
<b>Special tests</b>			
Determination of linearity of reactance up to maximum operating voltage			
Measurement of magnetic characteristic by using DC current charging-discharging method (see Annex B. in IEC 60076-6)			
Measurement of zero-sequence reactance on three-phase reactors			
Measurement of mutual reactance on three-phase reactors			
Measurement of harmonics of the current			

## 2) Typical shunt reactors

Object number		0 (example)	1	2	3	4	5
Type (oil-immersed or dry type)		oil					
Number of phases (1 or 3 phase)		1					
Rated voltage $U_r$ ( kV )		$500/\sqrt{3}$					
Maximum operating voltage $U_{max}$ (kV)		$525/\sqrt{3}$					
Highest voltage for equipment $U_m$ ( kV )		550					
Rated power $S_r$ (MVA)		54.4					
Total power losses (kW)		140					
Rated frequency $f_r$ ( Hz )		50					
Power frequency withstand voltage ( kV ) / 1 min.	line terminal	630					
	neutral	230					
Induced voltage test (yes or no)	158 % $U_{rated}$ / 60 min.	yes					
	180 % $U_{rated}$ / 1 min.	-					
	other voltage (phase-earth) / 1 min (kV) (... % $U_{rated}$ / 1 min)	630 (218 % $U_{rated}$ )					
	PD measurement	yes					
Linear range up to ( ...% ) of $U_{max}$		140 %					
Inductance at (H)	100 % $U_{max}$	4.876					
	110 % $U_{max}$	4.876					
	120 % $U_{max}$	4.876					
	130 % $U_{max}$	4.876					
	140 % $U_{max}$	4.876					
	145 % $U_{max}$	4.796					
	150 % $U_{max}$	4.723					



## Appendix 2: Technical data of customer's existing equipment

### 1) Data of set of motor-generator 1

Power rating of motor		kW
Power rating of generator	three-phase	kVA (3~)
	single/two-phase	kVA (1~ or 2~)
Rated frequency		Hz
Rated output voltage	three-phase	kV
	single/two-phase	kV

### 2) Data of set of motor-generator 2 (if available)

Power rating of the motor		kW
Power rating of the generator	three-phase	kVA (3~)
	single/two-phase	kVA (1~ or 2~)
Rated frequency		Hz
Rated output voltage	three-phase	kV
	single/two-phase	kV

### 3) Data of tapped transformer 1

Power rating of tapped transformer		kVA
Total losses (no-load losses + load losses)		kW
Phase of number (single or three-phase)		
Rated frequency		Hz
Operational frequency range (from.....to.....)		Hz
Vector group		
LV voltage		kV
MV voltage (if available)		kV
HV voltage range (from.....to.....)		kV
Steps of the HV voltages		steps
Short-circuit impedance $u_{sc}$ (HV-LV)		%
Short-circuit impedance $u_{sc}$ (MV-LV) (if available)		%
Short-circuit impedance $u_{sc}$ (HV-MV) (if available)		%

#### 4) Data of tapped transformer 2 (if available)

Power rating of tapped transformer		kVA
Total losses (No-load losses + Load losses)		kW
Phase of number (single or three-phase)		
Rated frequency		Hz
Operational frequency range (from.....to.....)		Hz
Vector group		
LV voltage		kV
MV voltage (if available)		kV
HV voltage range (from....to....)		kV
Steps of the HV voltages		steps
Short-circuit impedance $u_{sc}$ (HV-LV)		%
Short-circuit impedance $u_{sc}$ (MV-LV) (if available)		%
Short-circuit impedance $u_{sc}$ (HV-MV) (if available)		%

#### 5) LV/MV inductive compensation unit (if available)

Phase of number (single or three-phase)		
Rated power		kVar
Rated voltage		V
Rated current		A
Rated frequency		Hz
Operational frequency range (from.....to.....)		Hz
Max. power graduation (max. power difference between two steps)		kVar

#### 6) LV/MV capacitive compensation unit (if available)

Phase of number (single or three-phase)		
Rated power		kVar
Rated voltage		V
Rated current		A
Rated frequency		Hz
Operational frequency range (from.....to.....)		Hz
Max. power graduation (max. power difference between two steps)		kVar

#### 7) HV capacitive compensation unit (if available)

Phase of number (single or three-phase)		
Rated power		kVar
Rated voltage		kV
Rated current		A
Rated frequency		Hz
Operational frequency range (from.....to.....)		Hz
Max. power graduation (max. power difference between two steps)		kVar