System Requirements 132kV AIS Surge Arresters

	Name	Signature	Date
Prepared by:	Ron Aton		13.01.2025
Checked by:	Michael Swisa		13.01.2025
Approved by:	Chen Marchini		13.01.2025

Record of revisions				
Rev.	**Effected pages**	**changes detail (sub-clause)**	**Approved by**	**Published**
01				

Scope of work:

This document describes the 132-kV station AIS Surge Arresters and focuses on the description and threshold requirements that each element must meet.

This document should not be considered as a "132 kV AIS Surge Arresters Specification".

The main objective is to serve as a guide to those interested in carry out a detailed Specification for an appropriate AIS Surge Arresters that fulfill the Local Regulations and Purchaser requirements.

Terms and conditions:

1. Any item, that has not received from NOGA - Israel Independent System operator an official approval of fulfillment of the requirements according to the latest published version of this document, shall not be installed in Israeli electrical grid.
2. The technical data, procedures and regulations in this document should be considered as part of the Threshold Requirements of the System.
3. The final AIS Surge Arresters Specification must be evaluated by the customer and the manufacturer to arrive at the final design of each component, considering the Customer Connection Procedure
4. The customer is responsible for providing all data and information requested in this document, as well as ensuring that all technical requirements are fulfilled by the manufacturer.
5. This document must be approved and signed by:
   5.1. Customer
   5.2. Design body (if applicable)
   5.3. Surge Arresters manufacturer
6. All documents, instructions, test certificates, drawings and meetings with manufacturer/costumer contact person shall be in English or Hebrew
7. The customer will be also responsible for verifying the veracity of all data provided by the manufacturer.

	Name	**Company**	**Date**	**Sign**
Customer				
Design body (if applicable)				
Manufacturer				

Table of Contents

SYSTEM REQUIREMENTS FOR 132kV SURGE ARRESTERS

1. GENERAL

1.1. **Type:** 132kV Surge Arresters.
1.2. **Location:** Outdoor installation (AIS).
1.3. **Required information and documentation:** see following clause 6 'Required documents'.
1.4. **Applicable standards:** see following table, next to the appropriate standard and required value.

2. ENVIRONMENT CONDITIONS

TECHNICAL REQUIREMENTS		
	Description	**Required Value or Applicable Standard**
2.1.	Environmental parameters according to IEC 60721-3-4/2019	4K26,4Z5,4S13, C5(clause 5.5)
2.1.1.	Chemically active substances: corrosively category C5	According to ISO 9223
2.1.2.	Minimum ׀ Maximum	-5 | +50 [°C]
2.1.3.	Yearly average	+27 [°C]
2.1.4.	Monthly average	+37 [°C]
2.1.5.	Spraying water and water jets with water velocity	15 m/sec
2.2.	Seismicity of site:	IEEE 693 & Israeli Standard 413
2.2.1.	Peak horizontal (x, y directions) ground acceleration with an 85% probability not to be exceeded over a 50 years period	0.5g
2.3.	Pollution Conditions	IEC 60815-1
2.3.1.	Pollution severity type	B
2.3.2.	site pollution severity (SPS) class	e (very heavy)
2.4.	Permissible altitude over the sea level	1000 m
2.5.	The equipment shall be vermin proof	

3. RATINGS

TECHNICAL REQUIREMENTS		
	Description	**Required Value**
3.1. System Conditions		
3.1.1.	Rated system voltage (line to line)	161 kV
3.1.2.	Highest system voltage (line to line)	170 kV
3.1.3.	Rated phase-to-earth voltage	93 kV
3.1.4.	System neutral	effectively earthed
3.1.4.1.	Temporary overvoltage with duration not more than1 sec (load rejection + earth fault) (p.u.)	1.4
3.1.5.	Frequency	50 Hz
3.1.6.	Symmetrical short circuit current not less than	50 kA r.m.s.
3.1.7.	Single phase short circuit current not less than	50 kA r.m.s.
3.1.8.	Rated peak withstands current	125 kA peak
3.1.9.	Rated duration of short circuit	1 sec
3.1.10.	Insulation level	
3.1.10.1.	power-frequency withstand voltage	325 kV
3.1.10.2.	lightning impulse withstand voltage	750 kV
3.1.11.	Line insulation (critical flashover 1.2/50 µs wave)	1350 kV
3.1.12.	Length of line up to	200 Km
3.2. Electrical Requirements from SA		
3.2.1.	Rated arrester voltage. (Ur)	132 kV
3.2.2.	Continuous operating voltage (Uc)	106-108 kV
3.2.3.	Maximum residual voltage at 8/20 µs lightning impulse current	
3.2.3.1.	20 kA (peak)	
3.2.4.	Arrester classification [Table 1 acc. to IEC 60099-4/2014]	Station type
3.2.4.1.	Designation	SH
3.2.4.2.	Nominal discharge current not be less than (KA)	20
3.2.4.3.	Switching impulse discharge current (kA)	2
3.2.4.4.	repetitive charge transfer rating Qrs(C) ≥	2.4
3.2.4.5.	thermal energy rating Wth(kj/kV) ≥	10
3.3. Function		
3.3.1.	Pressure-relief device of an arrester should be existing if the gas filled gap between the MO resistors and the housing	
3.3.2.	Grading ring of an arrester should be existing if the length of the SA about two meters and above	
3.3.3.	If exists monitoring device, Surge counters, monitoring spark gaps, Leakage current indicators should be existing insulating base	
3.4. Housing		
3.4.1.	Terminals aluminum or silver or silver-plated aluminum	
3.4.2.	creepage distance phase to ground not less than	53.7 mm/kV (5270 mm)
3.4.2.1.	Minimum arcing distance	1500 mm
3.4.3.	Minimum specified short time load (SSL)	5500 N
3.4.4.	Minimum specified long-term load (SLL)	2200 N
3.4.5.	Guaranteed mean value of breaking load (MBL) 120% SSL not less than	6600 N
3.4.6.	Torsional strength (Nm)	

TECHNICAL REQUIREMENTS		
	Description	**Required Value**
3.4.7.	Lightning insulation withstand voltage (wave 1.2/50 µsec) in dry conditions	750 kV
3.4.8.	Power frequency withstand voltage in dry and wet conditions	325 kV
3.4.9.	Mechanical calculation stresses	
3.4.9.1.	Safety factors of insulators routinely expected load including: - mass 100%, - rated terminal load 100% (tensile force on conductors, weight of conductors and load due to wind on conductors) - load do to wind on SA 30% (please indicate required value for each unit)	>2.1
3.4.9.2.	Safety factors of insulators rarely occurring extreme loads including: - mass 100%, - rated terminal load 50% (tensile force on conductors, weight of conductors and load due to wind on conductors), - load do to wind on SA 100%, - short circuit load 100% (please indicate required value for each unit)	>1.2
3.4.9.3.	Safety factors of insulators rarely occurring extreme loads including: - mass 100%, - rated terminal load 70% (tensile force on conductors, weight of conductors and load due to wind on conductors), - load do to wind on SA 10%, - seismic load 100% (please indicate required value for each unit)	>1.2
3.5. Name plate drawings		
3.5.1.	Each Surge Arresters, shall be provided with a weather and corrosion-proof nameplate, made of suitable material, including the mandatory markings and all data engraving by laser	
3.5.2.	Arrester identification according to IEC 60099-4/2014 Section 4.1, include Project name/ Specification No.	

4. TESTS

TECHNICAL REQUIREMENTS			
	Description	**Applicable Standard**	**Required Value**
4.1. General			
4.1.1.	Contractor shall perform Production Tests to check the quality and uniformity of the workmanship and materials used in the manufacture of the surge arrester		
4.1.2.	Contractor shall also submit test data to prove that the design has the capability to meet all the ratings as specified in Section 6 as well as relevant type test reports		
4.1.3.	The Contractor is required to submit with the tender type test reports of offered type of Surge Arresters performed by a neutral laboratory accredited to the last applicable accreditation requirements of ISO/IEC 17025/2017 by an Accreditation body which is a member of ILACMRA (eg. APLAC, EA, IAAC, A2LA). Furthermore, the Laboratory scope of accreditation must include the required specific test methods used for the above-mentioned type tests		
4.1.4.	Contractor shall submit with the test reports a list of all measuring instruments, including their accuracy class and type, test equipment and test circuits The measuring equipment shall meet the requirements of		
4.1.5.	The test reports shall include the acceptance criteria, excepted values with tolerances and the test result		
4.1.6.	The test reports shall include a description of the test method with test circuits (if applicable).		
4.1.7.	The reference to the appropriate sub-clause of the standard must include		
4.2. Type and Other Tests for Surge Arrester with Porcelain Insulator		IEC 60099-4/2014 Subclause:	
4.2.1.	Insulation withstand tests on the arrester housing		
4.2.1.1.	Lightning impulse withstand voltage test	8.2.6	
4.2.1.1.1.	To earth (kV peak)		>1.3 maximum residual voltage of the arrester at nominal discharge current
4.2.1.2.	1 min – Power frequency withstand voltage test in wet conditions:	8.2.8	

TECHNICAL REQUIREMENTS			
	Description	**Applicable Standard**	**Required Value**
4.2.1.2.1.	To earth (kV r.m.s.)		>1.06 switching impulse protection level
4.2.2.	Residual voltage tests:	6.3 & 8.3	
4.2.2.1.	Steep current impulse residual voltage test	8.3.2	
4.2.2.1.1.	Is an inductive correction is required		No/<2%/>2%& <20%/>20%
4.2.2.2.	Residual voltage at lightning impulse current wave	8.3.3	
4.2.2.3.	Residual voltage at switching impulse current wave	8.3.4	
4.2.3.	Test to verify long term stability under continuous operating voltage	8.4	
4.2.4.	Test to verify the repetitive charge transfer rating, Qrs	8.5	
4.2.5.	Heat dissipation behavior of test sample	8.6	
4.2.6.	Operating duty tests	8.7	
4.2.7.	Power-frequency voltage-versus-time test	8.8	
4.2.8.	Short-circuit tests	8.10	
4.2.8.1.	High current short circuit test	8.10.4	
4.2.8.2.	Low current short circuit test	8.10.5	
4.2.9.	Test of the bending moment	8.11& Annex G	
4.2.9.1.	Mean value of breaking load (MBL)		≥1.2xSSL
4.2.9.2.	Specified short-term load (SSL)		≥5500 N
4.2.10.	Test on insulating base and mounting bracket	8.11.6	
4.2.11.	Seal leak rate test	8.13	
4.2.11.1.	The maximum seal leak rate		$<1x10^{-6}Pa \cdot m^3/s$
4.2.12.	Radio interference voltage (RIV) test	8.14	
4.2.13.	Test to verify the dielectric withstand of internal components	8.15	
4.2.14.	Test of internal grading components	8.16	
4.2.14.1.	Test to verify long term stability under continuous operating voltage		
4.2.14.2.	Thermal cyclic test		
4.2.15.	Seismic qualification test	IEEE 693-2018 And Annex. K	Moderate level
4.2.16.	Environmental tests	8.12	
4.2.16.1.	Temperature cycling test	8.12.3.1	
4.2.17.	Salt mist test	8.12.3.2	
4.2.17.1.	Artificial pollution test with respect to the thermal stress on porcelain housed multi-unit metal-oxide surge arresters	Annex C	
4.2.17.2.	Slurry method	C.7.1	
4.2.17.3.	Salt fog method	C.7.2	
4.2.18.	Type Tests on Porcelain Insulators	IEC 62155/2003	
4.3. Type and Other tests for Surge Arrester with composite insulator		IEC 60099-4/2014 Subclause:	

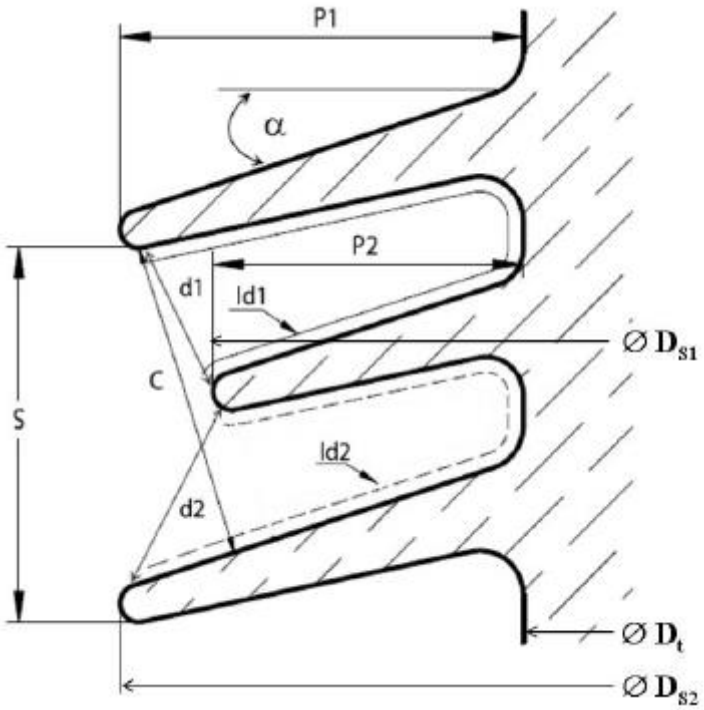
TECHNICAL REQUIREMENTS			
	Description	**Applicable Standard**	**Required Value**
4.3.1.	Insulation withstand tests on the arrester housing		
4.3.1.1.	Lightning impulse withstand voltage test	8.2.6	
4.3.1.1.1.	To earth (kV peak)		>1.3 maximum residual voltage of the arrester at nominal discharge current
4.3.1.2.	1 min – Power frequency withstand voltage test in wet conditions:	8.2.8	
4.3.1.2.1.	To earth (kV r.m.s.)		>1.06 switching impulse protection level
4.3.2.	Residual voltage tests:	6.3 & 8.3	
4.3.2.1.	Steep current impulse residual voltage test	8.3.2	
4.3.2.1.1.	Is an inductive correction is required		No/<2%/>2%& <20%/>20%
4.3.2.2.	Residual voltage at lightning impulse current wave	8.3.3	
4.3.2.3.	Residual voltage at switching impulse current wave	8.3.4	
4.3.3.	Test to verify long term stability under continuous operating voltage	8.4	
4.3.4.	Test to verify the repetitive charge transfer rating, Qrs	8.5	
4.3.5.	Heat dissipation behavior of test sample	8.6	
4.3.6.	Operating duty tests	10.8.7	
4.3.7.	Power-frequency voltage-versus-time test	10.8.8	
4.3.8.	Short-circuit tests	10.8.10	
4.3.8.1.	High current short circuit test		
4.3.8.2.	Low current short circuit test		
4.3.9.	Test of the bending moment	10.8.11 & Annex G	
4.3.10.	Seal leak rate test	10.8.13	
4.3.10.1.	The maximum seal leak rate		$<1x10^{-6}Pa \cdot m^3/s$
4.3.11.	Radio interference voltage (RIV) test	8.14	
4.3.12.	Test to verify the dielectric withstand of internal components	8.15	
4.3.13.	Test of internal grading components	8.16	
4.3.14.	Weather ageing test	10.8.17	
4.3.14.1.	Salt fog test	10.8.17.2	
4.3.14.2.	UV light test	10.8.17.3	
4.3.15.	Type tests of composite insulators	IEC 61462/2007	
4.3.15.1.	Design tests	IEC 61462 Subcl.7 and table 3 IEC 62217	
4.3.15.1.1.	Tests on interface and connections	7.2	
4.3.15.1.2.	Tests on shed and housing material	7.3	
4.3.15.1.3.	Tests on tube material	7.4	

TECHNICAL REQUIREMENTS			
	Description	**Applicable Standard**	**Required Value**
4.3.15.2.	Mechanical tests	8	
4.3.15.3.	Special tests		
4.3.15.3.1.	Mechanical and electrical aging test	IEEE 987 Subcl.5	
4.3.15.3.2.	Tests on composite insulation Materials	IEC 62039/2021	
4.3.15.3.2.1.	housing materials		
4.3.15.3.2.2.	core materials		
4.3.15.3.2.3.	structural materials		
4.3.15.3.3.	Additional tests proposed by Manufacturer for silicon rubber insulator		
4.4. Routine Tests and Acceptance Tests		IEC 60099-4/2014 Subclause:	
4.4.1.	Routine tests	9.1	
4.4.1.1.	Contractor shall perform the following routine tests for each surge arrester		
4.4.1.2.	Contractor shall indicate in Routine Test Report the permissible tolerance for each test value and test conditions		
4.4.1.3.	Measurement of reference voltage at reference current		
4.4.1.4.	Residual voltage test		
4.4.1.5.	Internal partial discharge test		<10pC
4.4.1.6.	Leakage check test		
4.4.1.7.	Rated test energy on disks		
4.4.1.8.	Measurement of power losses at 0.8 times rated voltage on disks (W)		
4.4.1.9.	Current distribution test for multi column arrester. (if applicable) (kA)		
4.4.2.	Acceptance tests	9.2	
4.4.2.1.	In addition to the tests mentioned above Manufacturer shall perform on complete arresters the following tests and supply test reports accordingly		
4.4.2.2.	tests shall be made on the nearest lower whole number to the cube root of the number of arresters to be supplied		
4.4.2.3.	Measurement of power frequency voltage on the complete arrester at the reference current measured at the bottom of the arrester		
4.4.2.4.	Measurement of lightning impulse residual voltage at nominal discharge current		
4.4.2.5.	Internal partial discharge test		
4.4.2.6.	Special thermal stability test		
4.4.3.	Routine and sample tests on porcelain insulators	IEC 62155/2003 Subclause:	
4.4.3.1.	Sample tests	9.2	
4.4.3.1.1.	Verification of dimensions	7.1	
4.4.3.1.2.	Porosity test	7.4	

TECHNICAL REQUIREMENTS			
	Description	**Applicable Standard**	**Required Value**
4.4.3.1.3.	Temperature cycle test	7.3	
4.4.3.1.4.	Galvanizing test	7.5	
4.4.3.1.5.	Pressure test	8.2.2	
4.4.3.1.6.	Bending test	8.3.2	
4.4.3.2.	Routine tests	10.2	
4.4.3.2.1.	Visual examination	10.3	
4.4.3.2.2.	Electrical test	10.4	
4.4.3.2.3.	Pressure test	10.6.1	
4.4.3.2.4.	Bending test	10.6.2	
4.4.3.2.5.	Other mechanical tests	10.6.3	
4.4.4.	Routine and sample tests on composite insulators	IEC 61462/2007 Subclause:	
4.4.4.1.	Sample tests	9	
4.4.4.1.1.	Verification of dimensions	9.3	
4.4.4.1.2.	Mechanical tests	9.4	
4.4.4.1.3.	Galvanizing test	9.5	
4.4.4.1.4.	Check of the interface between end fittings and the housing	9.6	
4.4.4.2.	Routine tests	10	
4.4.4.2.1.	Visual examination	10.2	
4.4.4.2.2.	Routine pressure test	10.3	
4.4.4.2.3.	Routine mechanical test	10.4	
4.4.4.2.4.	Routine tightness test	10.5	
4.5. OTHER TESTS			
4.5.1.	In addition to the tests mentioned above, Manufacturer shall perform the following tests on one Surge Arrester and supply test reports accordingly		
4.5.1.1.	Seismic qualification test acc. to IEEE Std 693-2018 shall prove that the surge arrester including all accessories will operate fully satisfactory during and after earthquake with ground acceleration indicated in Annex K in the standard		Moderate level

5. DESIGN AND CONSTRUCTION

	Required Data and Documentation	
	Flat Alternating Sheds	
	The profile parameters shall be according to the following values	



P_1-P_2	> 15 mm
S/P_1	> 0.75
C	> 40 mm
α	7° ≤ α ≤ 14°
D_a	< 300 mm
K_{ad}	1
USCD	53.7 mm/kV
A	> 1500 mm
CF = L/A	3.0 < CF < 4.5
l_1/d_1	2.5 ÷ 4.5
l_2/d_2	2.5 ÷ 4.5

P_1, P_2, S, C, α, ld_1, d_1, ld_2, d_2, D_{s1}, D_{s2}, D_t: see drawing.

$$D_a = \frac{D_{s1} + D_{s2} + 2D_t}{4}$$

L: creepage distance.

A: arcing distance.

6. REQUIRED DOCUMENTS

6.1. General

All the documents listed in the table below shall be provided.
All documents shall be submitted in DOC or PDF formats.
All drawings shall be submitted in DWG or PDF formats.
Noga-ISO reserves himself the right to require all necessary additional data, descriptions, drawings, etc. that may contribute in completing information supplied by Manufacturer about the Surge Arresters.

REQUIRED DOCUMENTS	
	Description
6.2.	ISO certificates
6.2.1.	ISO 9001 for Quality management system (QMS)
6.2.2.	ISO 14001 for environmental management system (EMS)
6.2.3.	ISO 14025 for environmental product declaration (EPD)
6.2.4.	ISO 45001 for occupational health and safety management system (OH&SMS)
6.2.5.	ISO 17025 for testing and calibration laboratories
6.3.	Static, dynamic and seismic calculation stresses according to clause 3.4.9
6.4.	Type test reports as per clause 4
6.5.	Reliability, Availability, Maintainability and Safety (RAMs) for Surge Arresters according to Appendix A
6.6.	Operational Experience according to Appendix B
6.7.	Technical documents for each item
6.7.1.	Main technical data schedule/datasheet should include: all values that appear clause 3.2 & 3.4.1-3.4.8 & drawing number & Insulator drawing number
6.7.2.	All documentation for more functions such as: pressure-relief device of an arrester, grading ring of an arrester, insulating base, monitoring device, Surge counters, Monitoring spark gaps, Leakage current indicators etc.
6.7.3.	Dimensional drawing should include: drawing number and revision number & name of materials & HV & earth terminals
6.7.4.	Manufacturer's insulator drawing should include: all values that appear in clause 3.4.1-3.4.9 & 5
6.7.5.	Name plate drawings as per clause 3.5
6.7.6.	Instruction book including description, operation, commissioning and maintenance
6.7.7.	Inspection & test plan
6.7.8.	Routine Tests and Acceptance Tests as per clause 4.4.1 &4.4.2
6.7.9.	Routine and sample test reports of insulators as per clause 4.4.3/4.4.4
6.7.10.	Seismic qualification test as per clause 4.5.1.1

APPENDIX

A. REIABILITY, AVAILABILITY, MAINTAINABILITY and Safety (RAMs) for AIS SURGE ARRESTERS

a. **Reliability**

The Bidder shall present the reliability tasks and methods which are (will be) used to improve the design for reliability, and evaluate the MTTF/MTBF, for (*)Major Failures only, of the 132 kV AIS Surge Arresters and their components.

The Bidder shall provide expected values for the relevant parameters of the 132 kV Surge Arresters, and shall add their distribution whenever possible.

b. **Failure Analysis**

From this Failure Reporting Analysis and Corrective Action System (FRACAS), Bidder shall present a failure report and the analysis of the failures which occurred during the service life of similar 132 kV AIS Surge Arresters manufactured by him. The report should include the withdrawn conclusion and the corrective actions subsequently undertaken.

(*)IEC 62271-1 3.1.12
major failure (of switchgear and controlgear) failure of switchgear and controlgear which causes the cessation of one or more of its fundamental functions Note 1 to entry: A major failure may result in an immediate change in the system operating conditions, for example, the backup protective equipment will be required to remove the fault or will result in mandatory removal from service within 30 min for unscheduled maintenance.

c. **132 kV AIS Surge Arresters RAM DATA**

Bidder shall submit the following 132 kV AIS Surge arresters RAM data:

Table 1: Surge Arresters Components RAM parameters of similar construction and ratings:

Component	MTBF (Yrs)	EOL (Yrs)	MTTR (Hrs)
Porcelain/Polymeric housing insulators			
ZnO Disc			
Pressure relief			
Insulating Base			
Painting			
Others			

Where:
MTBF: Mean Time between Failures (for *Major Failures).
EOL: Expected Operating Life.
MTTR: Mean Time to Repair (for *Major Failures).

d. **Field Data**

The bidder will fill the following table:

Table 2: Field Demonstrated Ram Data for Surge Arrester (last 9 years)

Field RAM Data		2017	2018	2019	2020	2021	2022	2023	2024	2025
Total number of installed SA's										
Total No. of Major Failures										
Specific Part which undergo Major Failure	Porcelain/Polymeric housing insulators									
	ZnO Disc									
	Pressure relief									
	Insulating Base									
	Painting									
	Others									
Mean Time to Repair/Replace										

e. Unreliability Demonstration Procedure (UDP)/Reliability Test

NOGA IISO could conduct an Unreliability Demonstration Procedure (UDP)/Reliability Test, according to NOGA IISO's Judgement. The manufacturer may request NOGA to see example for a UDP. The final UDP may change according for a specific individual case and circumstances, as to be decided by NOGA IISO.

B. OPERATIONAL EXPERIENCE

a. The proposed Manufacturer's plant should have at least 9 years of experience in production of 132kV Surge Arresters.

b. The bidder will provide contact details of at least 5 different purchasers of the bidder's 132kV Surge Arresters, whose purchase from the last 7 years (more than 1-year experience with bidder's Surge Arresters).
The reference list for the last 9 years shall include at least 50 units of such equipment supplied for at least 3 different clients and operated successfully for at least 1 year, and purchased during last 7 years. At least one of the countries must be from the EU (European Union) and/or OECD.
Only countries with an electrical transmission system of 170KV and above will be accepted.

c. In order to prove compliance with above mentioned, the bidder is required to submit (for example) the following table, duly filled and signed by a qualified officer.

No.	132kV AIS Surge Arresters data	Quantity	Purchaser name & address	Supplied date	Energizing date	Contact details
1						
2						

d. Spare parts - Spare part shall be available for a period of life duration of 132KV SURGE ARRESTERS