

# System Requirements

## 170 kV Disconnectors



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This document defines the minimum compulsory requirements for 170kV disconnectors and earthing switches. 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.

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# SYSTEM REQUIREMENTS FOR 170 kV DISCONNECTORS

## 1 GENERAL

### 1.1 Applicable Standards

IEC 62271-1/2017- HV switchgear – Common specification.

IEC 62271-102/2018-Alternating current disconnectors and earthing switches

IEC TR 62271-207/2012 - High-voltage switchgear and control gear: Seismic qualification for gas-insulated switchgear assemblies for rated voltages above 52 kV.

IEC TR 62271-300/2006 - High-voltage switchgear and control gear - Part 300: Seismic qualification of alternating current circuit-breakers.

IEC 62271-305/2009-Capacitive current switching capacity of air-insulated disconnectors for rated voltage above 52 kV.

IEC 60721 -3-4/2019- Classification of environmental conditions.

IEC 60273/1990 – Characteristic of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V

IEC 60529/2013 - Degrees of protection provided by enclosures (IP Code).

IEC 62262/2021 - Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).

IEC 60168/2001 – Tests on indoor and outdoor post insulators of ceramic material with nominal voltage above greater than 1000 V.

IEC TS 60815-1/2008 - Selection and dimensioning of high-voltage insulators intended for use in polluted conditions. Part 1: Definitions, information of general principles.

IEC 60815-2/2008 - Selection and dimensioning of high-voltage insulators intended for use in polluted conditions. Part 2: Ceramic and glass insulators for AC systems.

IEEE 693/2018 - Seismic Design of Substations

ISO 9001/2015 - Quality management systems — Requirements

ISO/IEC 17025/2017- General requirements for the competence of testing and calibration laboratories

ISO 14001/2015- Environmental management systems

ISO 2409 – Paints and varnishes - Cross-cut test

ISO 9223 - Corrosion of metals and alloys — Corrosivity of atmospheres — Classification, determination and estimation

### 1.2 Definitions

All definitions are as specified in applicable standards

## 2 SERVICE CONDITIONS

TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION		
	Description	Required Value or Applicable Standard
The design shall be according to the following		
2.1.	Permissible ambient air temperature:	
2.1.1.	Maximum	+50°C
2.1.2.	Minimum	-5°C
2.1.3.	Average, measured over a period of 24 hours	+35°C
2.2.	Permissible humidity:	
2.2.1.	Low relative / absolute humidity	4% / 0.9 g/m <sup>3</sup>
2.2.2.	High relative / absolute humidity	100% / 27 g/m <sup>3</sup>
2.3.	Rain intensity	15 mm/min
2.4.	No-rain, dry period (months).....	7
2.5.	Site Pollution Severity (SPS, for dimensioning purposes)	Class E, IEC TS 60815-1 – 2008, Clause 8.3
2.6.	Site Pollution Characterization	High Pollution/High NSDD site
2.7.	Type of Pollution: Desert-Coastal, high inert content	mixed A+B, A - prevalent IEC TS 60815-1 - 2008
2.8.	Prevalent Pollution Type:	Saharan Blowing Dust
2.9.	Low / High air pressure	84 kPa / 106 kPa
2.10.	Heating effects of solar radiation W/m <sup>2</sup>	1120 W/m <sup>2</sup>
2.11.	Maximum wind velocity measured 10 m above ground (bare area) at 3 sec duration	4Z5 (50 m/sec)
2.12.	Environmental parameters according to IEC 60721-3-4/2019, par.5.2	4K26
2.13.	Chemically active substances according to	ISO 9223 (C5)
2.14.	Mechanically active substances:	IEC 60721-3-4/2019, ed.3, Table 4, CLASS 4S13
2.14.1	Sand	18 mg/m <sup>3</sup>
2.14.2	Dust (suspension)	18 mg/m <sup>3</sup>
2.14.3	Dust particles size range, (µm) ...	1-100
2.15.	Seismicity of site:	
2.15.1	Peak horizontal (x, y directions) ground acceleration with an 85% probability not to be exceeded over a 50 years period	0.5g
2.16.	Permissible altitude over the sea level	1000 m
2.17.	The equipment shall be vermin proof	

### 3 RELIABILITY

See Appendix 1 - RAM requirements: RELIABILITY, AVAILABILITY, MAINTAINABILITY and Safety (RAMs) for DISCONNECTORS.

### 4 OPERATIONAL EXPERIENCE

The proposed Manufacturer's plant should have at least 9 years of experience in production of 170kV to 245 kV disconnectors and earthing switches.

The bidder will provide contact details of at least 5 different purchasers of the bidder's 170-245 kV Disconnectors and earthing switches, whose purchase from the last 7 years (more than 1-year experience with bidder's disconnectors).

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. Only countries with an electrical transmission system of 170KV and above will be accepted.

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.	170-245 kV Disconnector data	Quantity	Purchaser name & address	Supplied date	Energizing date	Contact details
1						
2						
3						

## 5 Technical Proposal

The technical proposal must be filled in entirely and signed by the manufacturer plant representatives.

The Manufacturer plant Company should also sign on the proposal.

The Bidder and the Manufacturer are required to fill in and to sign the attached declaration concerning requirement for technical English fluent speaking engineer:

To: NOGA - Israel Independent System Operator

SUBJECT: Declaration for language communication conformance

We the undersigned below, \_\_\_\_\_  
undertake to provide at least one technical English or fluent speaking engineer, during all the entire 170 kV disconnectors and earthing switches life duration, on each of the following teams, involved in the under discussion of 170 kV disconnectors and earthing switches project:

Design, supervising, operation, maintenance, after sale services and Subcontractors.

	Bidder	Manufacturer
Company name:	_____	_____
Name of signing officer	_____	_____
Title of signing officer	_____	_____
Signature:	_____	_____
Date:	_____	_____

Stamp:

## 6 RATINGS

TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION		
	Description	Required Value or Applicable Standard
6.1	Rated voltage $U_r$	170 kV
6.1.1	Rated lightning impulse withstand voltage:	
6.1.1.1	Phase to earth and between poles	750 kV peak
6.1.1.2	Across isolating distance	860 kV peak
6.1.2	Rated 1 minute power frequency withstand voltage in wet conditions:	
6.1.2.1	Phase to earth and between poles	325 kV r.m.s.
6.1.2.2	Across isolating distance	375 kV r.m.s.
6.1.2.3	Rated frequency $f_r$	50 Hz
6.1.3	Rated continuous current $I_r$ at maximum ambient temperature 50°C shall be according to relevant Single Line Diagrams approved by Israel Independent System operator (taking into account the temperature rises in IEC 62271-1 Table 14 reduced by 10°C):	
6.1.3.1	Rated short-time withstand current for disconnector and earthing switches $I_k$	50 kA r.m.s.
6.1.3.2	Rated duration of short circuit $t_k$	1 sec
6.1.3.3	Rated peak withstands current for disconnector and earthing switches $I_p$ kA peak	125 kA
6.1.3.4	Rated bus transfer current	1600 A
6.1.3.5	Rated bus transfer voltage	200 V r.m.s.
6.1.4	Classification of earthing switches for induced current switching:	
6.1.4.1	Earthing switch to be used in circuits having relatively short sections of line or low coupling to adjacent energized circuits	Class A
6.1.4.2	Earthing switch to be used in circuits having relatively long sections of lines or high coupling to adjacent energized circuits	Class B
6.1.4.3	Classification of disconnectors for mechanical endurance	M2
6.1.4.4	Classification of earthing switches for mechanical endurance	M1
6.1.4.5	Classification of earthing switches for electrical endurance	E1

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
6.1.5	Rated mechanical terminal load:	
6.1.5.1	Rated static mechanical terminal load	2700 N
6.1.5.2	Rated dynamic mechanical terminal load	6700 N



## 7 DESIGN

TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION		
	Description	Required Value or Applicable Standard
7.1	<b>General</b>	
7.1.1	The disconnectors and their accessories shall be constructed as to comply with the ratings and to meet all test requirements laid down herein with respect to insulation strength, current carrying capacity and mechanical operation	
7.1.2	Disconnectors and earthing switches shall be such, that they cannot come out of their open or closed position by rated static stresses (gravity, wind, pressure, vibrations, etc) reasonable shocks or accidental touching of the connecting rods of the operation mechanism	
7.1.3	The rated peak withstands current and the rated short-time withstand current, carried by the disconnectors or earthing switches in closed position shall not cause separation of contacts, contact welding, material mechanical damages and a temperature rise likely to damage the insulation	
7.1.4	The auxiliary and control equipment shall be designed acc. to	
7.1.5	The graphical symbols used in drawings and diagrams shall be according to	IEC 60617
7.2	<b>Main contacts and blades</b>	
7.2.1	Contacts shall be of the high-pressure contact type, and shall open and close with sufficient positive action to remove any film or oxide but shall not cause galling of the contact surface	
7.2.2	The design of disconnectors shall take into account that higher voltages than rated may appear between their contacts during synchronization	

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
7.2.3	The contact system shall be provided with adjusting facilities for current path length by means of which an excessive pull on terminal can be compensated	
7.2.4	Disconnectors blades shall be provided with appropriate rings to prevent corona discharges	
7.2.5	Full contact and current carrying capacity shall be secured during over travel and under travel of the operating mechanism	
7.2.6	All contact surfaces shall be silver plated with minimum thickness of	20 µm
7.2.7	The main system contact shall be maintenance free	
7.2.8	Material of blades of centre-break disconnector shall be	aluminum
7.3	<b>Terminals</b>	
7.3.1	Disconnectors should be so designed that no dangerous leakage currents can pass from the terminals of one side to any of the terminals of the other side of the disconnector	
7.4	<b>Earthing Terminals</b>	
7.4.1	Earthing terminal for disconnectors shall be according to	IEC 62271-102 subcl. 6.3
7.4.2	Each disconnector frame shall be equipped with	two terminals for earthing
7.4.3	Each earthing terminal shall be marked with appropriate graphical symbols acc. to	IEC 60417
7.4.4	The earthing terminals shall be designed to withstand for 1 sec a short-time current of	50 kA
7.5	<b>Insulators</b>	

	TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION	
	Description	Required Value or Applicable Standard
7.5.1	<i>Porcelain Insulators</i>	
7.5.1.1	Porcelain insulator shall be designed according to	IEC 60273 type C figure 4
7.5.1.2	Mechanical strength class according to	IEC 60273 clause 4
7.5.1.3	Insulators shall be suitable for installations on sites with site pollution severity (SPS) class E as defined by  See also Chapter 2 above.	IEC 60815-1/2008
7.5.1.4	Withstand Pollution Stress ESDD, mg/cm <sup>2</sup> NSDD, mg/cm <sup>2</sup> Annual number of dangerous wetting events	0.45 2.0 200
7.5.1.5	The insulator shall be of alternate sheds type	See Appendix 2.
7.5.1.6	Voltage test values for insulator:	
7.5.1.6.1	Dry lightning impulse withstand voltage – 1.2/50 $\mu$ s wave according to	IEC 60168 subcl. 4.5: 750 kV peak
7.5.1.6.2	Power frequency withstands voltage, 1 min wet conditions according	IEC 60168 subcl. 4.8: 325 kV r.m.s.
7.5.1.7	Minimum Reference unified specific creepage distance (RUSCD) <sup>1</sup>	53.7 mm/kV <sub>phase_to_earth</sub>
7.5.1.8	Minimum creepage distance phase to ground not less than	5270 mm
7.5.1.9	Corrected unified specific creepage distance USCD for insulator diameter (K <sub>ad</sub> ):	
7.5.1.9.1	Arcing distance not less than	1500 mm
7.5.1.9.2	Failing load-bending (F) not less than	10000 N

<sup>1</sup> The required value is for insulator with average diameter Da < 300 mm

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
7.5.1.10	The insulators shall be subject to the tests specified in IEC 60168	IEC 60168
7.5.1.11	Type, sample and routine test reports shall be supplied for offered insulators	
7.6	<b>Stresses on mounted disconnectors</b>	
7.6.1	Permissible values of loading for terminals connected to other equipment by rigid or flexible conductors:	
7.6.1.1	Static terminal load (sum of all loads occurring simultaneously in service: conductor pull, conductor weight and wind, short-circuit excepted) in any direction in space not less than	2700 N
7.6.1.2	Testing load for 60 sec, applied to the midpoint of the terminal perpendicularly to the insulator axis	4700 N
7.6.1.3	Short-time load (sum of all loads occurring simultaneously in case of short-circuit) in any direction in space not less than	6700 N
7.6.2	Dynamic seismic withstand capability (simultaneous earthquake acceleration applied at the base of the support disconnector):	Moderate level
7.6.2.1	Horizontal	0.5 g
7.6.2.2	Testing methods acc. to	IEEE 693-2018
7.7	<b>Accessories and fittings</b>	
7.7.1	Each disconnector and its operating mechanism shall be complete with all necessary shafts, cranks, links, bearings and fittings required for operation	
7.8	<b>Motor operating mechanism</b>	

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
7.8.1	The disconnecter and earthing switches shall have individual electrical operating mechanism	
7.8.2	The motor drive cabinet will include the motor drive, position indicator device, auxiliary switches, local/remote selector switch, command push buttons for local opening and closing, heating elements, motor relays, interlocking relays, etc.	
7.8.3	The three phases of each disconnecter or earthing switch shall be operated simultaneously	
7.8.4	Operating mechanism shall be designed to absorb any shock incident to the operation of disconnecter and earthing switch and to ensure a smooth, quiet and continuous transmission of motion to main contacts	
7.8.5	The design shall be such that minimum energy is required for operation and one man shall be able to operate the isolators without undue effort	
7.8.6	Crank(s) for emergency manual operation of disconnecter main blades and earthing switches shall be provided	
7.8.7	The connection of hand crank to operating mechanism shall ensure safe interruption of the central energy to the operating mechanism	
7.8.8	Maximum force required for manual operation shall be less than	120 N
7.8.9	Linkage system shall have the following properties:	
7.8.9.1	Easily adjustable with possibility of reliable fixing of set position	
7.8.9.2	Simple readjustment of previously set and fixed position	

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
7.8.9.3	Linkage system shall be drilled to accurate fit so as to maintain the minimum amount of slack and lost motion in the entire mechanism	
7.8.9.4	Linkage system parts shall be manufactured so as to withstand all mechanical stresses appearing in normal operation	
7.8.10	Motor drive mechanism, auxiliary switches, auxiliary contactors and other auxiliary equipment shall be accommodated in a vermin proof cabinet having a degree of protection	IP 54
7.8.11	The degree of protection of the above cabinet against mechanical impact shall be	IK 07
7.8.12	The motor drive shall be protected with a thermal-magnetic type overload protection	
7.8.13	Rating of motor drive:	
7.8.13.1	Rated & control voltage – system standard, other values pending NOGA's permission.	220 V DC.
7.8.14	Heaters shall be provided in each motor drive cabinet to prevent condensation:	
7.8.14.1	Rated voltage of heater	230 V AC
7.8.15	Locking devices and interlocks:	
7.8.15.1	Locking devices shall be designed according to	IEC 62271-102 subcl. 6.12
7.8.15.2	Disconnectors and earthing switches shall have provision for locking mechanically and electrically, in both the open and closed positions	
7.8.15.3	When the disconnector is locked in either the open or closed position, the external influence of wind, short circuit or other cause shall not bring it out of this position	

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
7.8.15.4	Disconnecter and associated earthing switches shall be electrically and mechanically interlocked to prevent either of them closing unless the other is open	
7.8.15.5	The mechanical interlock shall be independent and additional to the electrical interlock	
7.8.15.6	Disconnecter blades and earthing switches shall each have their own separated electrical and mechanical interlocking devices	
7.8.15.7	In case of loss of auxiliary DC voltage for interlocking purposes, the manual operation of the disconnector shall be avoided	
7.8.15.8	Remote control switch, push buttons for closing and tripping shall not be installed in the disconnector's local cubicle	Appendix 4
7.9	<b>Earthing switches</b>	
7.9.1	Design of the Centre Break Disconnector with one set of earthing switches should permit the addition of a set of earthing switches in the future on the other side	
7.10	<b>Spare parts</b>	
7.10.1	Spare parts for disconnectors and earthing switches shall be available for a period of life duration of disconnectors	

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
<b>8</b>	<b>Nameplates</b>	
8.1	Each disconnector, earthing switch and its operating device shall be provided with a weather and corrosion-proof nameplate, made of suitable material, including the mandatory markings according to  (see example in Appendix 3)	IEC 62271-102
<b>9</b>	<b>Tests</b>	
9.1	<b>Type tests</b>	
9.1.1	<b>General</b>	
9.1.1.1	Type tests shall be performed on disconnector, linkage system and operating mechanism of the same design as will be provided by the contractor	
9.1.1.2	Type test shall be performed together on the disconnector, linkage system and operating mechanism as a single unit	
9.1.1.3	Type tests reports of offered type of disconnectors and insulators shall be performed by a laboratory accredited to the last applicable accreditation requirements of <b>ISO/IEC 17025</b> by an Accreditation body which is a member of ILACMRA (e.g. APLAC, EA, IAAC, A2LA). Furthermore the Laboratory scope of accreditation must include the required specific test methods used for the above mentioned type tests	
9.1.2	<b>Scope</b>	
9.1.2.1	All compulsory type tests on disconnectors and earthing switches as per	IEC 62271-102
9.1.2.1.1	Standard lighting impulse withstand voltage test 1.2/50msec	sub clause 7.2
9.1.2.1.1.1	To earth and phase to phase (kV peak)	750
9.1.2.1.1.2	Across the isolating distance(kV r.m.s.)	860



	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
9.1.2.1.2	Power frequency (50 Hz) withstand voltage test 1 min dry and wet conditions, according to:	Sub clause 7.2
9.1.2.1.2.1	To earth and phase-to-phase (kV r.m.s.)	325
9.1.2.1.2.2	Across the isolating distance (kV r.m.s.)	375
9.1.2.1.3	Dielectric tests on auxiliary and control circuits according to :	sub clause 7.2.11
9.1.2.1.3.1	Power frequency (50 Hz) withstand voltage test, 1 minute (kV r.m.s)	2
9.1.2.1.4	Radio Interference Voltage test (R.I.V):	sub clause 7.3
9.1.2.1.4.1	Radio interference level at $1.1 \times 170 / \sqrt{3}$ kV shall not exceed (mV)	2500
9.1.2.1.5	Measurement of the resistance of circuits	sub clause 7.4
9.1.2.1.6	Temperature - rise tests	sub clause 7.5
9.1.2.1.7	Short-time withstand current and peak withstand current tests	sub clause 7.6
9.1.2.1.8	Verification of the protection:	sub clause 7.7
9.1.2.1.8.1	Verification of IP coding according to <b>IEC 60529</b>	IP54
9.1.2.1.8.2	Mechanical impact test according to <b>IEC 62262</b>	IK07
9.1.2.1.9	Operating and mechanical endurance tests	sub clause 7.102
9.1.2.1.10	Mechanical endurance test for disconnector class M2 and earthing switch class M1 (10000 operating cycles for M2 class. 2000 operating cycles for M1 class)	sub clause 7.102.5
9.1.2.1.11	Operating test of disconnectors during application of terminal load	sub clause 7.102.4
9.1.2.1.11.1	Number of operating cycles	20
9.1.2.1.11.2	Rated static terminal load (N)	2700
9.1.2.1.12	Operation at minimum and maximum ambient temperature	sub clause 7.104
9.1.2.1.13	Tests to verify the proper function of the position indicating device	sub clause 7.105

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
9.1.2.1.14	Bus - transfer current switching tests on disconnectors	sub clause 7.106
9.1.2.1.15	Induced current switching tests for earthing switches	sub clause 7.107
9.1.2.1.16	Additional tests on auxiliary and control circuits	sub clause 7.10
9.1.2.2	Capacitive current switching capability test of disconnector according to	IEC 62271-305/2009
9.1.2.3	All compulsory type tests on porcelain insulators as per	IEC 60168 sub clause 6.1 & Tables 3,4
9.1.2.4	Seismic qualification test shall prove that the disconnector including all accessories will operate fully satisfactory during and after the earthquake with ground acceleration indicated according to	IEEE 693
9.1.2.5	Cross cut test of painting according to	ISO 2409
9.1.2.6	Test report or dynamic analysis which shall prove that the disconnector including all accessories will operate fully satisfactory during and after earthquake with ground acceleration as required in clause	
9.2	<b>Routine and sample tests</b>	
9.2.1	<b>General</b>	
9.2.1.1	Routine test report shall be issued for each disconnector and earthing switch	
9.2.2	<b>Scope</b>	
9.2.2.1	All routine tests on disconnectors and earthing switches as per	IEC 62271-102
9.2.2.2	All routine tests on porcelain insulators as per	IEC 60168
9.2.2.3	Sample tests porcelain insulators as per	IEC 60168
<b>10</b>	<b>Documentation</b>	
10.1	<b>General</b>	
10.1.1	All data and descriptive materials shall be in English	
10.1.2	All documents shall be submitted in doc or pdf formats	

	<b>TECHNICAL REQUIREMENTS AND REQUIRED INFORMATION</b>	
	<b>Description</b>	<b>Required Value or Applicable Standard</b>
10.1.3	All drawings shall be submitted in dwg or pdf formats	
10.2	<b>Technical documents for approval of the specific type</b>	
10.2.1	Description and schematic drawing of completely assembled disconnecter and earthing switches	
10.2.2	Description and drawing of post insulator from insulator Manufacturer	
10.2.3	Description and detail drawings of the operating mechanism	
10.2.4	Drawing of nameplate	
10.2.5	Type test reports according to the requirements in clause 9.2.2	
10.2.6	Example of routine test report for disconnecter	
10.2.7	Example of routine test report for porcelain insulator	
10.2.8	Reliability data as required in	Appendix 1
10.2.9	A valid certificate demonstrating certification to	ISO 9001:2015
10.2.10	Details about environmental management system (EMS) according to	ISO 14001 and ISO 50001
10.2.11	Seismic qualification test report or dynamic analysis as per clause 2.16	
10.3	<b>Technical documents for each item</b>	
10.3.1	All technical documents as listed below shall be provided before shipping the equipment to Israel	
10.3.2	Routine and sample test reports according to requirements in clause 9.1.3.1	

## Appendix 1.

# RELIABILITY, AVAILABILITY, MAINTAINABILITY and Safety (RAMs) for DISCONNECTORS

## 1. Reliability

The Bidder shall present the reliability tasks and methods which are used to improve the design for reliability, and evaluate the MTTF/MTBF for **(\*)Major Failures** only, of the 170 kV disconnector switch components.

The Bidder shall provide expected values for the relevant parameters of the 170 kV disconnector switch components, and shall add their distribution whenever possible.

## 2. Failure Analysis

From his 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 170 kV disconnector switch components **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.

## 3. 170 kV Disconnector Switch RAM DATA

Bidder shall submit the following 170 kV disconnector switch RAM data:

Component	MTBF (Yrs)	EOL (Yrs)	MTTR (Hrs)
1. Centre Break Disconnector			
1.1. Operating mechanism			
1.2. Main contacts			
1.3. Earthing switch contacts			
1.4. Guaranteed Frequency of Occurrence between insulator pollution flashover events			

Where:

MTBF: Mean Time between Failures, For \*Major Failure

EOL: Expected Operating Life.

MTTR: Mean Time To Repair, for Major Failures.

#### **4. Field Data**

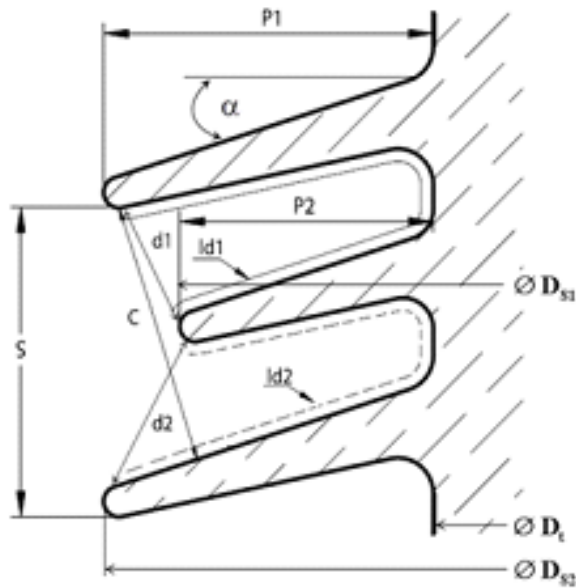
The bidder will fill the following table:

Field RAM Data		2013	2014	2015	2016	2017	2018	2019	2020	2021
Total number of installed DSOM's										
Major Failures										
Specific Part which undergo Major Failure	Operating mechanism									
	Main contacts									
	Earthing switch contacts									
Mean Time to Repair/Replace										

#### **5. 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 could be change according to each individual case and circumstances, as to be decided by NOGA IISO.

## Appendix 2. Aero-dynamic Open Profile: Alternating Sheds



L – Minimum Creepage Distance,

AD = 1500 mm – Minimum Arcing Distance,

CF = L/AD – Creepage Factor.

$D_a = D_a = (2D_t + D_{s1} + D_{s2})/4$  – average diameter

RUSCD - reference unified specific creepage distance as defined by IEC TS 60815-2-3-2008.

$K_{ad}$  – correction factor for Insulator Diameter

$D_t$  – insulator trunk diameter

$D_{s1}, D_{s2}$  – Insulator sheds diameters

$s/p_1$  – large shed spacing vs. large shed overhang

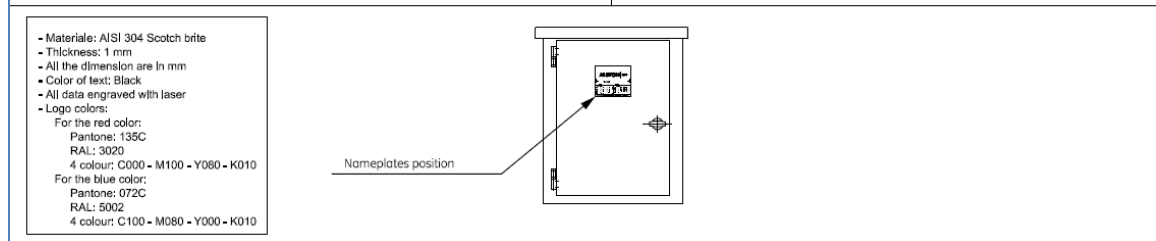
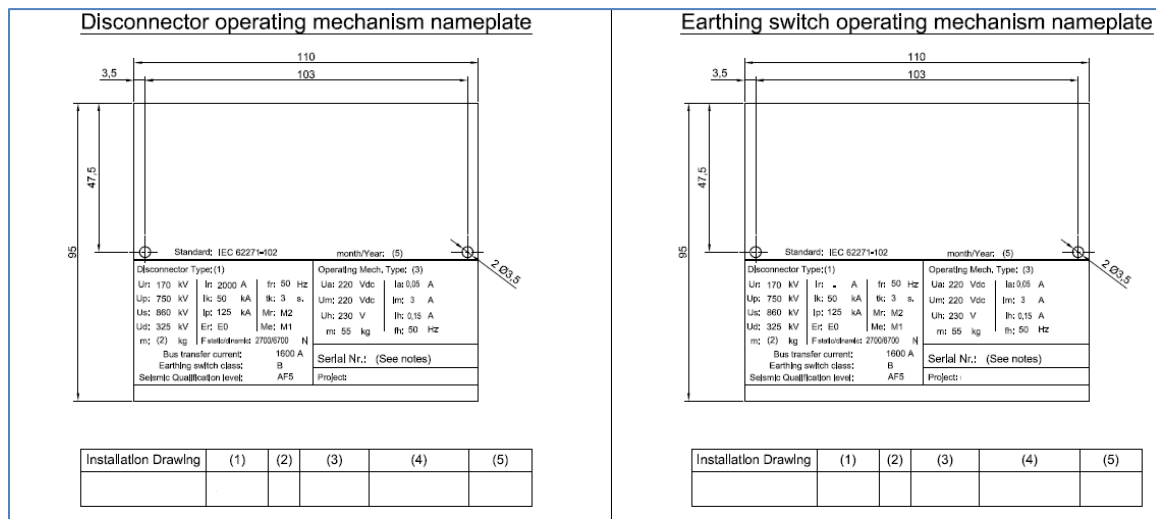
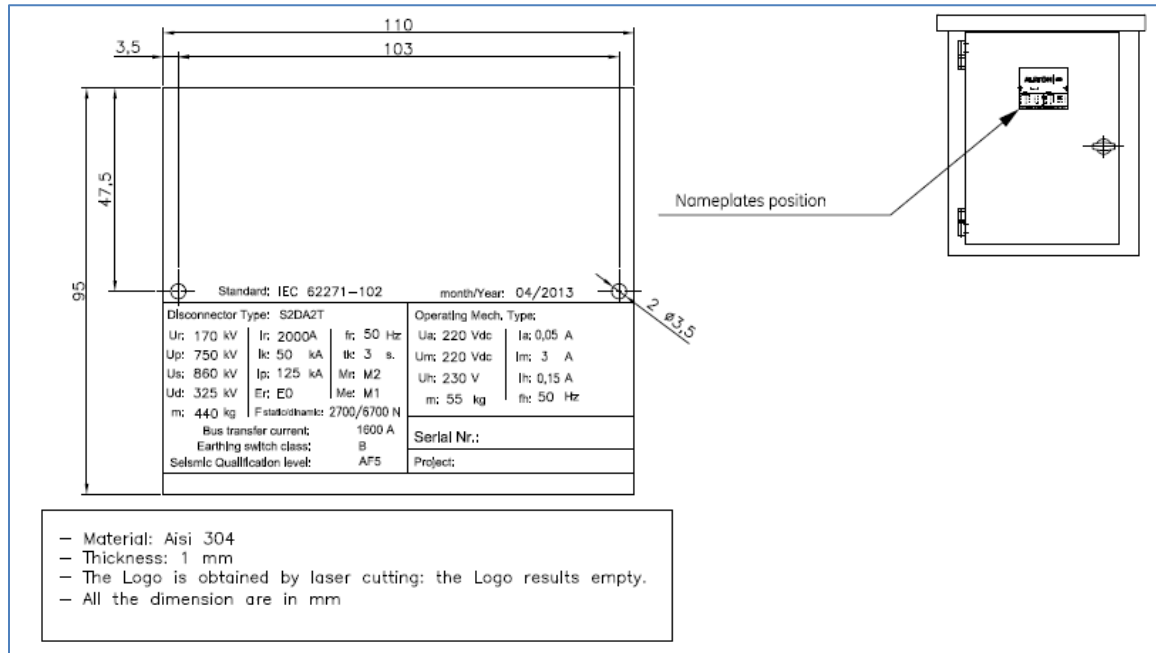
C – inter-shed clearance

$\alpha$  - shed top inclination angle

$l_1/d_1, l_2/d_2$  – creepage distance vs. clearance

REQUIRED		
Profile Parameters		Remarks
p1-p2	$\geq 15 \text{ mm}$	
s/p1	$\geq 0.65$	
c	$\geq 30 \text{ mm}$	
$\alpha$	$= 5^\circ \div 10^\circ$	
kad	$= 1.0$	
Da	$< 300 \text{ mm}$	
RUSCD *	$\geq 53.7 \text{ mm/kV}$	
L *	$\geq 5270 \text{ mm}$	
CF	$= 3.0 \div 4.0$	
$l_1/d_1$	$= 2.5 \div 4.0$	
$l_2/d_2$	$= 2.5 \div 4.0$	

## Appendix 3. Nameplates example



#### Appendix 4. Local control cubicle configuration

