

Islamic Republic of Iran
Vice Presidency for Strategic Planning and Supervision

**General Technical Specification and
Execution Procedures for Transmission
and Subtransmission Networks
Disconnectors and Earthing Switches
at HV Substations**

NO: 407-1

**Office of Deputy for Strategic Supervision
Bureau of Technical Execution System
<http://tec.mporg.ir>**

**Energy Ministry - Tavanir Co.
Power Industry Technical Criteria
Project
www.tavanir.ir**

CONTENTS

<u>DESCRIPTION</u>	<u>PAGE</u>
1- General	3
2- Requirements	3
3- Requirements of operating mechanism	5
4- Name Plate	6
5- Spare Parts and Special Tools	7
6- Tests	7
7- Transportation, Storage, Installation and Commissioning Tests	8
7.1-Storage	8
7.2- Installation	9
7.2.1. Necessary Items For Disconnecter And Earthing Switch Installation	9
7.2.2. Installation Consequences	9
7.3- Commissioning tests	10
8- Documents and Drawing	10
8.1- Documents to be Given by tenderer	10
8.2- Documents to be Given by contractor / supplier	11

Technical Specification for Disconnectors and Earthing Switches



1. GENERAL

This specification covers the minimum requirements for design, material, construction, inspection, factory testing, marking, packing, transportation, storage, installation and commissioning tests of disconnectors and earthing switches in 63 to 400 kV substations.

Disconnectors and earthing switches shall be designed, manufactured and tested according to the applicable requirements of the latest edition of IEC 62271-102, 60694 and ISO 1461 standards and their amendments, supplements and reference publications.

The disconnector and earthing switchers shall be according to DS (I) for proper operation and shall be suitable for the specified environmental conditions of the substation.

2. REQUIREMENTS

The disconnecting and earthing switches shall be suitable for operation at the site elevation and under the ambient air temperature and environmental conditions as specified.

Disconnecting and earthing switches shall be designed to carry the specified rated current continuously without any temperature rise.

Disconnecting switches shall be designed for motor operation and they shall also be equipped with provision of manual operation.

Disconnecting switch shall be so designed that lubrication is not necessary.

The minimum total length of the air-gap between terminals of one pole and distance between phases when the disconnecting switch is in open position shall be designed to withstand the voltage levels as specified.

Disconnecting and earthing switches shall be capable of withstanding the mechanical and thermal effects due to passing the rated short time current through them without any damage or burning the contacts.

Disconnecting switch shall be capable of opening and closing when it is under rated mechanical load.

Service conditions require that the disconnecting switches remain alive and in service without any operation and maintenance for period of at least 3 years. Therefore the contacts shall be expected to carry the rated load and short circuit currents without overheating or welding and after such period the maximum torque required to open the disconnecting switch by operating handle should be within capability of one man.

All side fittings shall be made of stainless steel.

There shall be no extra vibration or noise during the operation of the disconnector.

No cast iron fitting shall be used and all switch parts above the top insulator cap shall be made of non-ferrous material.

The connections between phases and vertical axis shall be strong enough that can bear repeated opening and closing and undesired conditions.

The design of disconnecting and earthing switch contacts shall be such to maintain constant pressure and be suitable for further operation after carrying rated current.

A suitable flexible braid type connector shall be provided on the hinge end of the earthing blade with a clamp connector for connection to substation grounding system.

The surface of earthing switch shall be dry and self cleanable. The pressure on this contacts shall be so that all of them can move with each other.

The performance of switches shall not be affected by pollution on external insulation. Therefore suitable design shall be considered for the types of insulators and hot washing capabilities.

The disconnector shall be provided with bearing at the of end each rotating column.

All disconnecting and earthing switch parts shall be of corrosion resistant material with respect to all weather conditions and all types of atmospheric pollution which may occur.

Steel parts of disconnectors and operating mechanisms shall be hot-dip galvanized which shall be carried out in accordance with ISO 1461.

For the safety of the personals, disconnecting and earthing switch shall be equipped with nested plates for connection to substation grounding system.

Blades and fittings of the switches shall be designed to reduce corona discharge to minimum and uniform the distribution of voltage gradient.

Disconnector operating mechanism shall be as specified (IP54 or IP55) and it's operating mechanism shall be so designed that the birds can not make nest on it.

The manufacturer shall provide all required loading information for the purchaser.

Disconnecting and earthing switches including their operating mechanisms, shall be so designed that they can not come out of their normal positions by gravity force, wind pressure, vibrations and forces due to short circuit .

3. REQUIREMENTS OF OPERATING MECHANISM

Disconnecting and earthing switches shall be operated either by one mechanism for three-phase gang operated or separated mechanisms for single phase operated.

Motor operated mechanism of disconnecting and earthing switches shall be provided with electromotors suitable for operation on substation auxiliary ac or dc supplies as specified which shall be isolated by motor protective circuit breakers.

Each electromotor shall be provided with thermal overload protection and in case of three-phase electromotors with phase unbalance protection.

The operating mechanism shall be provided with a device for choice between manual or motor operation.

The open and closed positions of the disconnecting and earthing switches shall be indicated mechanically on the operating mechanism.

The complete assembly of the mechanism shall be enclosed in a weather – proof housings which should provide easy access to all parts.

Motor operated disconnecting and earthing switches shall be provided with local / remote / disconnect selector switch and open / neutral / close control switches.

The handle of manual operation shall be placed at least 1 meter above the ground level.

The operating mechanism shall be designed so that needs minimum energy for operation and any movement is done in a controlled, uniform and easy way.

The manual operation shall be done by a handle in a simple and quick way without using excessive force.

The entire operating mechanism shall be so designed that all three blades are in control throughout the operation cycle, (misadjustment, three phase gang operation, non corrosion on contacts, etc,...) therefore after the final adjustment it shall be impossible for any individual part of the mechanism to be displaced to cause improper operation of the switch.

The entire operating mechanism shall be so designed to permit locking in both open or close positions.

The operating mechanism shall be provided with a place for locking. At the bottom of the operating mechanism a gland plate shall be provided for entering cables.

The operating mechanism of disconnecting and earthing switches shall be interlocked relative to each other to make sure that the earthing switch can be operated only when the disconnecting switch is open and feeder is de energized.

Disconnecting Switch blades movement should be in opposite side of operating mechanism box position.

During the manual operation and when disconnecter is in open position the supply of motor circuit shall be disconnected.

The auxiliary switches shall be designed to meet the operation position indication, signaling, alarm and interlocking system requirements.

Auxiliary switches shall be mechanically operated and the number of normally open and normally closed auxiliary contacts required for interlocking system in addition to the contacts used in control circuits of disconnecting and earthing switches shall be as specified. Additionally, at least 4 extra NO and NC auxiliary contacts shall be provided as spare.

For proper operation of the operating mechanism, all the necessary auxiliaries such as limit switches, contactors, interlocking magnets, ... shall be provided. Further more, the operating mechanism shall be equipped with the under voltage relay, anti – condensation heater, heater which shall be controlled by an adjustable thermostat, door limit switch and MCB for the lighting and heaters.

Early and late acting auxiliary switches shall be provided as required by control scheme. The timing of these switches in relation to movement of the main contacts shall be as follows:

- Early close contacts- these shall close before the main contacts close and open after the main contacts open by a margin of not less than 20% of the main contacts travel.
- Late close contacts- these shall close after the main contacts close and open after the main contacts open.
- Late open contacts- these shall open after the main contacts close and close before the main contacts open.
- Early open contacts- these shall open before the main contacts close and close after the main contacts open by a margin not less than 30% of main contacts travel.

Auxiliary contacts shall be designed so that provide the proper operation of position indicator and protection requirements.

All control circuits shall be connected to terminal block. The block shall be positioned so as to facilitate the connection of all wiring and to avoid interfering with equipment installed in mechanism box. The terminal block shall be chosen for the connection of single wire conductors of 2.5 to 10 mm² area with the proper wire shoe.

In terminal blocks, isolating plates shall be used for isolating the ac and dc terminals of each other.

All non-galvanized metal parts shall be completely cleaned and coated with a proper paint a suitable for environmental conditions of the site. The final color code according to ANSI61 is bright gray.

4. NAME PLATE

Disconnector shall be equipped with a stainless steel or anodized sheet of aluminum name plate, fixed in a visible position showing the following information:

- Name of the manufacturer
- Type of design
- Serial number
- Year of construction
- Rated voltage
- Lighting impulse withstand voltage
- Switching impulse withstand voltage (for 400 kV disconnectors)
- Rated current
- Rated short time withstand current
- Rated duration of short circuit
- Mechanical withstand class of disconnector
- Electrical withstand class of earthing switch
- Rated bus transfer current (in case of using disconnectors with capability of making and disconnecting bus transfer current).
- Rated bus transfer voltage (in case of using disconnectors with capability of making and disconnecting bus transfer current).

- Rated induced current (in case of using disconnectors with capability of making and disconnecting induced current).
- Rated induced voltage (in case of using earthing switches with capability of making and disconnecting induced current).
- Rated supply voltage of auxiliary circuits.
- Static mechanical load
- Rated frequency

5. SPARE PARTS AND SPECIAL TOOLS

The manufacturer's recommended spare parts for 5 years trouble free operation and any special tools necessary for erection and operation should be provided.

6. TESTS

Disconnectors and earthing switches shall pass all the following type and routine tests:

a) Type Tests:

- Dielectric tests.
- Radio interference voltage (RIV) tests.
- Measurement of resistance of the circuit
- Temperature rise tests (only applicable for disconnecting switches).
- Short time withstand current and peak withstand current tests
- Electromagnetic compatibility tests.
- Testes to prove the short circuit making performance of earthing switches.
- Operating and mechanical endurance tests
- Operating under sever ice conditions
- Operating at within the temperature limits
- Test to verify the proper functioning of position-indicating devices
- Bus transfer current switching tests
- Induced current switching tests
- Verification of the protection

b) Routine Tests

- Dielectric test on the main circuit
- Dielectric test on auxiliary and control circuit
- Measurement of the resistance of the main circuit
- Design and visual checks
- Mechanical operating tests

7- TRANSPORTATION, STORAGE, INSTALLATION AND COMMISSIONING TESTS

It is essential that the transport, storage, installation and commissioning of disconnector and earthing switch be performed in accordance with instructions given by the manufacturer.

The instructions for the transport and storage should be given before delivery.

The instructions for the installation and commissioning should be given by the time of delivery at the latest.

7.1. Storage

Disconnector and earthing switch can be stored in a covered or open air condition according to manufacturer instructions. If disconnector and earthing switch are stored in open air, at least they shall be covered with plastic tissues. These plastic tissues shall not be put directly on galvanized surfaces and an air channel shall be mounted to prevent any infiltration of water.

Storage is called to a place that:

- It has a ceiling
- Its floor is firm and uniform.
- Air humidity shall be less than 50%
- Air temperature 20 ± 10 °C

To prevent water from reaching the disconnector and earthing switch, it shall be stored in an elevation upper than floor level. To prevent any corrosion caused by the infiltration of water, the plastic cover shall be removed (not for spare parts).

After receiving of each disconnector and earthing switch, the following items shall be checked:

- Disconnector and earthing switch delivery is according to order documents.
- There is no damage or shortage in the delivered disconnector and earthing switch

If there is any damage, the box shall be opened and all damages shall be photographed. These shall be reported.

Storage of a disconnector and earthing switch in moist and not well ventilated air may cause the change of color of galvanized surfaces. This change of color which is generally named white corrosion, is not a reason for rejecting the good.

All parts shall be stored in a way are always accessible. The surrounding ambient of disconnecter and earthing switch shall be clean of any dust, smoke, flammable or corrosive gasses, steam or salt. In this condition, the storage shall be cleaned before storing process.

For storing the disconnecter and earthing switch, the original box shall be used but the plastic cover shall be removed.

Spare parts shall be kept in their original boxes and stored in storage. This is specially important for plastic parts (for water proofing and etc). These parts shall be kept away from sunlight to prevent them drying. Spacer washers can be stored for just a short time in the storage.

7.2. Installation

The manufacturer should provide required information for unpacking and lifting safely to the buyer. All units should be clearly marked and drawings showing the assembly of these parts should be provided by the disconnecter and earthing switch.

Instructions for mounting of disconnecter and earthing switch, should include sufficient details of locations. and foundations.

Mounting and installation of disconnecter and earthing switch shall be specifically according to manufacturer's instructions and drawings.

The disconnectors and earthing switches shall be carefully checked at the arrival to the destination. Any damage or shortage occurred in the transportation shall be detected.

7.2.1. Necessary Items For Disconnecter And Earthing Switch Installation

- Lifting device
- Rope
- Drawings of dimensions and installation
- disconnecter and earthing switch components according to installation drawings
- Needed wrenches

7.2.2. Installation Consequences

It shall be checked that the structure which the disconnecter is going to be installed on it shall be totally balanced. Installation process shall be done using proper devices with extensive care for lifting the device without damaging it.

Current carrying blades and connecting arms shall be installed and balanced according to the height specified in installation shall be installed.

Operating mechanism shall be installed.

position of contacts shall be regulated in relation to each other. In a way that they can easily lock together and separate from each other.

No excessive force shall be used for closing the disconnecter. This may damage the contacts.

Few operation shall be done with motor mechanism.

Earthing switch shall be installed and regulated.

Corona ring shall be installed (if any)

Connections of conductors shall be made.

It shall be assured from tightness of bolts and nuts.

7. 3. commissioning tests

- Visual inspection and ensuring of proper mounting and installation, checking the electrical and mechanical connections.
- Ensuring that there is direct contact between the metal case and the earthing system.
- Insulation test with megger
- Resistance measurement of main and earthing switches contacts.
- Tests of synchronous operation of poles
- Measurement of required force to open the disconnector.
- Test of disconnector and earthing switch operation.
- Measurement of complete opening and closing time of disconnector.
- Tests of mechanical and electrical interlocks in motor and manual modes of operation.
- Tests of mechanical and electrical interlocks between disconnector and earthing switch
- Test of electrical interlocks between earthing switch and high voltage
- Test of instruments and calibrating them, including indicators, meters and protection devices.
- Test of insulation resistance of control and auxiliary with meggr
- Test of marshaling box for protection, accessories and wiring
- measurement of motor current in different modes of operation.

8. DOCUMENTS AND DRAWING

8.1. Documents To Be Given By Tenderer

- Filled SCHEDULE DS (II)
- Catalogue and technical pamphlets
- Summary of type test reports
- Outline drawing

- Detailed summary of exceptions to technical specifications
- List of spare part
- Reference list
- List of special tools

8.2. Documents To Be Given By Contractor/Supplier

The electrical and mechanical design, fabrication, factory testing, marking, packing transportation, ware – housing, erection, site tests, operation and maintenance documents and manuals shall be submitted not limited to the followings:

- Calculation sheets to establish adequacy of disconnecting and earthing switches in any respect.
- Outline dimension including components, arrangements and terminals.
- Loading on structure and foundation
- Assembly drawings
- Mounting details
- Name plate drawings
- Shipping, packing and ware housing, assembly, erection, operating and maintenance instruction manuals
- Electrical & interlocking drawings
- Setting manual
- Site test instruction manuals
- List of components
- Packing details
- Routine test certificate reports
- Type test documents
- Work schedule and monthly progress report
- Drawing list
- Final as built DOC/DWG

SCHEDULE DS(I)
RATINGS AND CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
1	<u>Particulars of system</u>				
1.1	Highest system voltage kV	420	245	145	72.5
1.2	Nominal system voltage kV	400	230	132	63(66)
1.3	Nominal system frequency Hz	50	50	50	50
1.4	System neutral earthing	Solidly grounded	Solidly grounded	Solidly grounded	Solidly grounded / Non solidly grounded
1.5	Number of phases	3	3	3	3
2	<u>Service conditions</u>				
2.1	Max. ambient temperature °C	40/45/50/55	40/45/50/55	40/45/50/55	40/45/50/55
2.2	Min. ambient temperature °C	-25/-30/-35/-40	-25/-30/-35/-40	-25/-30/-35/-40	-25/-30/-35/-40
2.3	Max. average daily temperature °C	*	*	*	*
2.4	Altitude above sea level M	1000/1500 /2000/2500	1000/1500/2000 /2500	1000/1500/2000/2500 00	1000/1500/2000/2500
2.5	Pollution level	L/M/H/VH	L/M/H/VH	L/M/H/VH	L/M/H/VH
2.6	Max. wind velocity m/s	30/40/45	30/40/45	30/40/45	30/40/45
2.7	Wind velocity at ice condition m/s	20	20	20	20
2.8	Ice coating thickness mm	5/10/20/25	5/10/20/25	5/10/20/25	5/10/20/25

SCHEDULE DS(I)
RATINGS AND CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION		TECHNICAL PARTICULARS			
			420 kV	245 kV	145 kV	72.5 kV
2.9	Ground seismic acceleration	m/s ²	0.2g/0.25g/0.3g/0.35g	0.2g/0.25g/0.3g/0.35g	0.2g/0.25g/0.3g/0.35g	0.2g/0.25g/0.3g/0.35g
2.10	Relative humidity	%	90/95/more than 95	90/95/more than 95	90/95/more than 95	90/95/more than 95
2.11	Solar radiation	W/m ²	*	*	*	*
3	<u>Disconnecter switch</u>					
3.1	Number of poles		3	3	3	3
3.2	Class (outdoor, indoor)		Outdoor	Outdoor	Outdoor	Outdoor
3.3	Rated voltage	kV	400	230	132	63(66)
3.4	Rated insulation level at site condition:					
3.4.1	Rated lightning impulse withstand voltage					
3.4.1.1	To earth and across open switching device	kV (peak)	1300/1425	850/950/1050	550/650	325
3.4.1.2	Across the isolating distance	kV (peak)	1300(+245)/142 (+240)	950/1050/1200	630/750	375
3.4.2	Rated switching impulse withstand voltage:					
3.4.2.1	To earth across open switching device	kV (peak)	900/1050	-	-	-
3.4.2.2	Across the isolating distance	kV (peak)	900(+345)	-	-	-
3.4.2.3	Between phases	kV (peak)	1425/1575	-	-	-
3.4.3	Rated one minute power frequency withstand voltage:					
3.4.3.1	To earth and between poles	kV (rms)	520	360/395/460	230/275	140
3.4.3.2	Across the isolating distance	kV (rms)	610	415/460/530	265/315	160

SCHEDULE DS(I)
RATINGS AND CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
3.5	Rated frequency Hz	50	50	50	50
3.6	Rated normal current at site condition A	1250/1600/2000/3150/4000	1250/1600/2000/3150	800/1250/1600/2000/3150	800/1250/1600/2000/3150
3.7	Rated short time withstand current kA	40/50/63	40/50	31.5/40	31.5/40
38	Duration of short circuit Sec	1	1	1,3	1,3
3.9	Rated peak short withstand current kA (peak)	100/125/157.5	100/125	78.75/100	78.75/100
3.10	Mechanical terminal load:				
3.10.1	Horizontal N	1600/2000/4000	800/1000/1250/1600	500/800	400/800
3.10.2	Vertical N	530/660/800/1600	270/330/400/500	170/200	130/200
3.11	Type "vertical, pantograph, double break, center break"	*	*	*	*
3.12	Operating mechanism				
3.12.1	Method of operation	Motor – Manual	Motor – Manual	Motor – Manual	Motor – Manual
3.12.2	Group deriving type 1 phase /3 phase	*	*	*	*
3.12.3	Heater voltage V	*	*	*	*
3.12.4	Motor voltage V	*	*	*	*
3.12.5	Type of interlock Mechanical/Electrical	*	*	*	*
3.12.6	Number and type of spare auxiliary switches:				
3.12.6.1	Normally open	*	*	*	*
3.12.6.2	Normally close	*	*	*	*
3.12.7	No. of early contacts	*	*	*	*
3.12.8	No. of late contacts	*	*	*	*

SCHEDULE DS(I)
RATINGS AND CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
3.12.9	Rated supply voltage & rated frequency:				
3.12.9.1	AC voltage V	230/400(50HZ)	230/400(50HZ)	230/400(50HZ)	230/400(50HZ)
3.12.9.2	DC voltage V	100/125	100/125	100/125	100/125
3.12.10	Max. operating time Sec	15	15	15	15
3.13	Max. inductive current breaking capacity A	*	*	*	*
3.14	Max. capacitive current breaking capacity A	*	*	*	*
3.15	Max. RIV at 1 MHz and 10% over voltage μ v	2500	2500	2500	2500
3.16	Min. creepage distance mm/kV	16/20/25/31	16/20/25/31	16/20/25/31	16/20/25/31
3.17	Class of disconnecter	M0/M1/M2	M0/M1/M2	M0/M1/M2	M0/M1/M2
4	<u>Earthing switch</u>				
4.1	Number of poles	3	3	3	3
4.2	Class (indoor, outdoor)	Outdoor	Outdoor	Outdoor	Outdoor
4.3	Rated voltage	400	230	132	63
4.4	Rated insulation level at site environmental condition				

SCHEDULE DS(I)
RATINGS AND CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
4.4.1	Rated lightning impulse withstand voltage:				
4.4.1.1	To earth and between poles kV(peak)	1300/1425	850/950/1050	550/650	325
4.4.1.2	Across the isolating distance kV(peak)	1300(+240)/1425(+240)	950/1050/1200	630/750	375
4.4.2	Raged one minute power frequency withstand voltage				
4.4.2.1	To earth and between poles kV	520	360/395/460	230/275	140
4.4.2.2	Across the isolating distance kV	610	415/460/530	265/315	160
4.5	Rated frequency Hz	50	50	50	50
4.6	Rated short time withstand current KA	40/50/63	40/50	31.5/40	31.5/40
4.7	Duration of short circuit Sec	1	1	1	1
4.8	Mounting condition with disconnecting switch (as one unit, separately mounted)	*	*	*	*

SCHEDULE DS(I)
RATINGS AND CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
4.9	Operating mechanism				
4.9.1	Method of operation	Motor – Manual	Motor – Manual	Motor – Manual	Motor – Manual/Manual
4.9.1.1	Heater voltage	*	*	*	*
4.9.1.2	Motor voltage	*	*	*	*
4.9.1.3	Type of interlock Mechanical / electrical	*	*	*	*
4.9.2	Number and type of spare auxiliary switches:				
4.9.2.1	Normally open	*	*	*	*
4.9.2.2	Normally close	*	*	*	*
4.10	Class of earthing switch	E0/E1/E2	E0/E1/E2	E0/E1/E2	E0/E1/E2

* These will be specified by engineer

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
1	<u>General</u>				
1.1	Manufacturer's name and country				
1.2	Designation				
1.3	Class (indoor / outdoor)				
1.4	Type				
1.5	Applicable standard				
1.6	Conditions and environmental characterizes of site				
1.6.1	Max ambient temperature for design °C				
1.6.2	Min ambient temperature for design °C				
1.6.3	Max. average of daily temperature °C				
1.6.4	Altitude above sea level M				
1.6.5	Pollution level				
1.6.6	Max ice coating thickness allowed mm				
1.6.7	Ground seismic acceleration m/s ²				
1.6.8	Max. wind velocity allowed for design m/s				
1.6.9	Solar radiation w/m ²				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
1.7	Document (test reports, Assembly drawings, erection, operating and maintenance manuals, references list of spare parts)				
2	<u>Rating and specifications</u>				
2.1	Rated voltage KV				
2.2	Rated insulation level				
2.2.1	Rated lightning impulse withstand voltage kV(peak)				
2.2.1.1	To earth and across open switching device kV(peak)				
2.2.1.2	Across the isolating distance				
2.2.2	Rated one minute power frequency withstand voltage:				
2.2.2.1	To earth and across open switching device kV				
2.2.2.2	Across the isolating distance kV				
2.2.3	Rated switching impulse withstand voltage:				
2.2.3.1	To earth kV(peak)				
2.2.3.2	Across the isolating distance kV(peak)				
2.2.3.3	Between phases kV(peak)				
2.3	No of poles				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
2.4	Voltage drop between contacts with 100 A dc				
2.4.1	In disconnector mV				
2.4.2	In earthing switch mV				
2.5	Rated frequency Hz				
2.6	Rated normal current				
2.6.1	At IEC conditions A				
2.6.2	At site conditions A				
2.7	Rated peak withstand current kA				
2.8	Rated peak withstand current kA(peak)				
2.9	Rated duration of short circuit Sec				
2.10	Max temperature – rise				
2.10.1	For contacts °C				
2.10.2	For terminals °C				
2.11	Type (horizontal breaking in one or two point, vertical, etc)				
2.12	Total weight of disconnecting switch kg				
2.13	Corona ring is provided ? Yes/No				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
2.14	Minimum clearances in the air				
2.14.1	Between poles mm				
2.14.2	To earth mm				
2.14.3	For isolating distance mm				
2.15	Max RIV at 1 MHZ and 10% over voltage μ V				
2.16	Time from contact separation to extinction of capacitive arc Sec				
2.17	Total time from initiation of opening operation isolator gap can with stand phase voltage Sec				
2.18	Design or device for insuring from proper position				
2.19	Operating mechanism:				
2.19.1	Type of operating (manual, motor- manual)				
2.19.2	Three/single phase				
2.19.3	In motor operation:				
2.19.3.1	Type of motor				
2.19.3.2	Power of motor W				
2.19.3.3	Voltage of motor V				
2.19.3.4	Rated current of motor A				
2.19.3.5	Starting current A				
2.19.4	Power of heater				
2.19.5	Rated supply voltage				
2.19.5.1	AC voltage V				
2.19.5.2	DC voltage V				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

ITEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
2.19.6	Auxiliary switch				
2.19.6.1	Normally open				
2.19.6.2	Normally closed				
2.19.6.3	No of quick contacts				
2.19.6.4	No of late contacts				
2.19.6.5	Interrupt current				
2.19.6.6	Max allowed operation time				
2.19.7	Thickness of silver coating of main contact				
2.19.8	Material of the main contacts				
2.19.9	Type of interlocks				
2.19.10	Minimum force required for manual operation				
2.20	Overall dimensions (L×D×H)				
2.20.1	Open position				
2.20.2	Closed position				
2.21	Insulators				
2.21.1	Manufacturer				
2.21.2	Type of designation				
2.21.3	Material				
2.21.4	Min. diameter of insulator				
2.21.5	Total creepage distance (protected and unprotected)				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

TEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
2.21.6	Power frequency withstand voltage for 1 min kV				
2.21.7	Lightning impulse withstand voltage kV(peak)				
2.21.8	Switching impulse withstand voltage kV(peak)				
2.21.9	Static failing load bending				
2.21.9.1	Horizontal N				
2.21.9.2	Vertical N				
2.21.10	Tensile failing load N				
2.21.11	Torsional failing load N				
2.21.12	Dynamic bending failing load N				
2.21.13	Washable in service Yes/No				
2.21.14	Number of units in stack				
2.22	Voltage below which corona is not visible kV				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

TEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
2.23	Terminals:				
2.23.1	Type: (pin/module plate)				
2.23.2	Material				
2.23.3	Static bending failing load				
2.23.3.1	Horizontal				
2.23.3.2	Vertical				
2.23.4	Dynamic bending failing load				
2.24	Max. inductive current breaking capacity				
2.25	Max. capacitive current breaking capacity				
3	<u>Earthing switches</u>				
3.1	Number of poles				
3.2	Class (indoor or outdoor)				
3.3	Rated voltage				
3.4	Max temperature rise				
3.5	Rated insulation level				
3.5.1	Rated lightning impulse withstand voltage:				
3.5.1.1	To earth and across open switching device				
3.5.1.2	Across the isolating distance				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

TEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
3.5.2	Rated one minute power frequency withstand voltage:				
3.5.2.1	To earth and across open switching device kV				
3.5.2.2	Across the isolating distance kV				
3.6	Rated short time withstand current kA				
3.7	Rated peak withstand current kA(peak)				
3.8	Rated short circuit making current kA(peak)				
3.9	Mass of complete earthing switch kg				
3.10	Minimum clearance in the air				
3.10.1	Between poles mm				
3.10.2	To earth mm				
3.10.3	Between open contacts mm				
3.11	Operating mechanism				
3.11.1	Type of operation (manual, motor & manual)				

SCHEDULE DS (II)
RATINGS CHARACTERISTICS OF DISCONNECTING & EARTHING SWITCHES

TEM	DESCRIPTION	TECHNICAL PARTICULARS			
		420 kV	245 kV	145 kV	72.5 kV
3.11.2	Supply voltage and rated frequency				
3.11.2.1	AC voltage V				
3.11.2.2	DC voltage V				
3.11.2.3	Frequency HZ				
3.11.3	Rated current A				
3.11.4	Starting current A				
3.11.5	Operating time Sec				
3.11.6	Auxiliary switch				
3.11.6.1	Normally open				
3.11.6.2	Normally closed				
3.11.6.3	No. of quick contacts				
3.11.6.4	No. of late contacts				
3.11.7	Type of interlocks (mechanical / manual)				
3.11.8	Minimum force required for manual operation N				
3.11.9	Power of heater N				
3.12	Overall dimensions (L×D×H) mm				
3.13	Design of the device or description of means for securing the position				
3.14	Type of mechanical interlock between disconnector and its earthing switch				