

Islamic Republic of Iran
Vice Presidency for Strategic Planning and Supervision

General Technical Specification and Execution Procedures for Transmission and Subtransmission Networks Line Traps

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CONNTENTS

<u>Description</u>	<u>PAGE</u>
1- General requirements	3
2- Design and construction	3
3- Rating plate	4
3-1- Main coil rating plate	4
3-2- Tuning device rating plate	5
3-3- Rating plate of protective device (metal – oxide)	5
3-4- Line trap rating plate	5
4- Spare parts and special tools	6
5- Tests	6
5-1- Type tests	6
5-2- Sample tests	6
6- Drawing and documents	7
6-1- Documents to be given by tenderer	7
6-2- Documents to be given by contractor / supplier	7
7- Warehousing	8
8- Inspection	8
9- Erection	9
10- Commissioning	9
10-1- Commissioning tests	10



Line Traps Technical Specification



1- General requirements

This technical specification covers minimum requirements for the design, manufacturing, factory testing, packaging, marking warehousing, erection and commissioning of 63 to 400 kV line traps.

Line trap shall be designed, manufactured and tested according to the latest edition of the following standard:

- IEC 60353: Line traps for ac power systems.

All amendments, supplements and references that mentioned in IEC 60353 shall be considered. Line traps shall be as specified in schedule (I).

2- Design and construction

Line trap shall be appropriate for outdoor condition operation. The line trap shall be dry type, no core or air core type. The line trap shall be designed for mounting on top of capacitive voltage transformers, on pedestals or alternatively in suspension insulator strings. For correct operation, the line trap shall be perfect and have all associated support. The line trap shall conform to installation weather conditions.

The line trap and its terminals shall be so designed and constructed to withstand all static and dynamic forces specified in schedule. The line trap insulation materials shall withstand moisture with pollution. The line trap shall tolerate UV rays. Bird barrier for prevention from bird entrance shall be used if it's required.

The line trap shall be able to preserve its property operation under various weather conditions such as: sun rays, rain, fog, ice, snow and etc. Under pollution conditions the operation of the line trap shall agreed upon by the manufacturer and the purchaser.

Altitude standard for the line trap installation is lower than 1000 meter above sea level and at the higher height the installation condition shall be agreed upon the manufacturer and the purchaser. The line trap shall work properly at mentioned temperature in line trap schedule (I). The testing voltage for the air insulations shall be increased in accordance with IEC 60071-1, in the cases that the line trap installed at the altitude over 1000 m and tested in the lower than 1000 m.

The line trap shall be so designed and manufactured to operate in a polluted atmosphere with relative humidifies and specified outdoor temperature after warehousing under specified conditions. The equipment shall be so designed to operate correctly after being stored in an environment with temperatures ranging between – 10 °C and 60 °C.



Insulating materials shall be moisture and fungus resistant. Insulating of the main coil and tuning device of the line trap shall be conform to the weather condition and temperature of the installation site.

The line trap blocking impedance curves and its trapping losses versus, frequency shall be sent to employer or his / her consultant engineer for submission.

Line traps shall be of robust construction and all metallic parts of the shall be of non-magnetic materials. Sharp corners shall be avoided, on the line trap construction. The line trap shall include surge arrester and lifting eye. The color of the line trap shall withstand the specified weather conditions. The line traps shall be so designed to allow easy access to the tuning device and protective device by maintenance personnel while the line traps is deenergized.

The line trap shall withstand seismic force that is produced from specified seismic acceleration. Contractor shall provide necessary documents to prove this matter.

Main coil power losses (ohmic and iron loss) after calculation and correction at 75 °C shall be sent to employer or his / her consultant for submission.

Rated discharge current of the surge arrester of the line trap shall not be lower than the discharge current of substation surge arrester. However this current shall not be lower than 5 kA. The line trap shall be so selected that the temperature rise or produced magnetic field by rated current, fault current or emergency overload current from main coil don't have any effect on its protective characteristics. The surge arrester shall not operate at developed power - frequency voltage across the line trap produced by the rated short time current. The surge arrester shall remain in operation after a response to a transient overvoltage.

The self resonant frequency of the line trap shall be greater than 500 kHz unless the rated inductance of the line trap is greater than 0.5 mH.

The tuning device shall be so arranged to permit it's repair without removing the line trap. Tuning device shall be so designed that temperature rise or magnetic fields dose not affect on it's characteristic.

3- Rating plate

Line trap shall have four rating plates as the following:

3-1- Main coil rating plate

The plate shall include the followings:

- Manufacturer's name and year of production
- Type
- Serial number
- Rated inductance [mH]
- Power – frequency inductance [mH]
- Rated continuous current [A]



- Rated power frequency [Hz]
- Rated short –time current [kA] and duration [Sec]
- Total weight [kg]

3-2- Tuning device rating plate

The plate shall include the followings:

- Manufacturer's name and year of production
- Type
- Serial number
- Frequency bands [Hz]
- Minimum blocking impedance [Ω]
- Minimum blocking resistance [Ω]
- Rated impulse withstand voltage [kV]
- Rated inductance [mH] and serial number of main coil (optional)

3-3- Rating plate of protective device (metal – oxide)

The plate shall include the followings:

- The manufacturer's name and trade mark, type and identification
- The year of production
- Continuous operating voltage [kV]
- Rated voltage [kV]
- Residual voltage [kV]
- Rated frequency [Hz]
- Nominal discharge current [kA]

3-4- Line trap rating plate

This plate shall have all information of the mentioned rating plates and so attach that comfortably visible and available under energization condition. When line trap installed on pedestal its rating plate shall attach to the down side of the support insulator.



Rating plate shall be made of stainless steel or anodize aluminum. The words shall engrave on the plate. The size of the rating plate and sequence of the information shall be confirmed by the consultant.

4- Spare parts and special tools

The spare parts for 5 years trouble free operation and any special tools deemed necessary for erection, maintenance operation and repair shall be provided by the manufacturer.

5- Tests

Tests shall include the following:

5-1- Type tests:

- Temperature rise test
- Measurement of radio influence voltage
- Impulse voltage test
- Power frequency voltage test on tuning device
- Short – time current test
- Measurement of power frequency inductance of the main coil
- Measurement of the rated inductance of the main coil
- Measurement of blocking resistance and blocking impedance
- Measurement of tapping loss

5-2- Sample tests:

- Appearance inspection
- Power frequency voltage test on tuning device and primary transformer of line impedance unit
- Measurement of the rated inductance of the main coil
- Measurement of the power frequency inductance of the main coil
- Measurement of the blocking resistance and blocking impedance
- Measurement of tapping loss

Consultant engineer shall have access to the calculations. The consultant shall estimate that the specification of the constructed equipment conform to the technical specifications. The consultant shall attend at inspection and tests done by the contractor if required.



The contractor shall present the certification of equipment conformation with design and success in sample and type tests.

The employer reserves the right to have a representative during functional testing. The contractor shall inform the test date to the employer / consultant with appropriate time interval in accordance to the contract.

6- Drawing and documents

6-1- Documents to be given by tenderer:

- Filled line trap schedule (II)
- Catalog and technical pamphlets
- Detailed summary of exceptions to tender specification
- Dimensional drawings
- Spare part and special tool lists

6-2- Documents to be given by contractor / supplier:

The electrical and mechanical design, fabrication, factory testing, working and packing, transportation, erection, site test, operation and maintenance drawings, documents and manuals shall be submitted not limited to the followings:

- Necessary calculations for sufficiency proving of the equipments of any aspects
- Dimensional drawings, detail specification of circuit, high voltage terminals and cross section
- Assembly drawing
- Packaging details
- Test reports and certifications
- Drawings of rating plates
- Loading on foundation
- Shipping, warehousing, assembly, erection, commissioning, operating, repairing and maintenance instruction manuals
- List of equipment
- Monthly work progress report
- Drawings list
- Required test sheet in the location of the substation



7- Warehousing

It is essential that the warehousing of line trap be performed in accordance with instructions given by the manufacturer.

The instructions for the warehousing should be given before delivery.

The line trap can be stored in a covered or open air condition according to manufacturer instructions. If the line trap are stored in an open air, at least they shall be covered with plastic tissues. These plastic tissues shall not be put directly on galvanized surfaces. Air channel shall be mounted to prevent any water condensation.

Storage is called to a place that:

- It has a ceiling
- Its floor is firm and uniform.
- Air humidity is less than 50%
- Air temperature is $20 \pm 10 \text{ C}^{\circ}$

To prevent the line trap from water penetration, it shall be stored in an elevation upper than floor level.

To prevent any corrosion caused by the water condensation, the plastic cover shall be removed.

After receiving of each line trap the following items shall be checked:

- Line trap delivery is according to order documents.
- There is no damage or shortage in the delivered line trap.

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

Storage of a line trap in moist and imperfectly air ventilation may cause the change of color of galvanized surfaces. The change of color is generally named white corrosion and is not a reason for rejecting the goods.

All parts shall be stored in a way that can be accessed easily. The surrounding ambient of line trap 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 line trap, the original box shall be used but the plastic cover shall be removed.

All parts of the line trap and its associated support shall be conformed to the manufacturer submitted list.

The line trap shall be maintained in vertical manner.

8- Inspection

Line traps shall be checked carefully after carrying to destination.



9- Erection

It is essential that the erection of line trap be performed in accordance with the instructions given by the manufacturer.

Erection instructions should be given by the time of delivery at the latest.

The line trap may be installed in two types, one is suspension type and other is on pedestal type. If the line trap is on pedestal type, it can be installed on support insulator, coupling capacitor or CVT.

Most important factors in selecting the type of installation, are weight and dimensions of line trap and mechanical loading. The nominal, continuous, short time current, and nominal inductance of line trap are the most important factors in determination of line trap weight and dimension. If line trap is installed in suspension position it shall be attached to the gantries. In this case, the clearances to ground and adjacent phases is important.

In installing time of the suspension line trap, the tension should not be more than the specified value at the rating plate. If there is a risk of vibration, the line trap shall be supported by anchor ring.

The role of pedestal is to make electrical and mechanical connections with coupling capacitor or CVT. So it should be careful that the surface of the pedestal is not covered by paint or other offal materials.

Large line traps shall be installed on separate support insulator and should not be installed on CVT or coupling capacitor. In order to move the line trap, rings (which improvised for this purpose) shall be used. The rings shall be installed before installing accessories such as bird barrier, corona rings and etc. These elements shall be installed conform to the manufacturer instructions. Before making electrical connection it is necessary all terminals is perfectly cleaned. In order to do that it is better to use conductor grease.

10- Commissioning

It is essential that the commissioning of line trap be performed in accordance with the instructions given by the manufacturer.

The instruction for the commissioning should be given by the time of delivery at the latest.

After a line trap has been installed and all connections have been completed, commissioning tests are recommended to be performed to confirm that transportation and storage have not made any damage on the line trap.

The manufacturer shall produce a program of site commissioning checks and tests. Repetition of the full program of routing tests, already performed in the factory, shall be avoided. The purpose of commissioning tests is for confirmation of :

- Existence of no damage
- Compatibility of separate units
- Correct assembly
- Correct performance of the assembled line trap.

For this purpose the commissioning tests shall include, but not limited to the following items. The results of the tests shall be recorded in a test report.



10-1- Commissioning tests

- Visual inspection
- Checking that all bolts of tuning device, protective device, pedestal, support insulator, line droppers securely fasten with appropriate torque moment.
- Ensuring of appropriate installation and electrical connections.
- Ensuring that metal body is directly connected to the ground grid.
- Insulating resistant test with megger.
- Inspection of connection accuracy of tuning device.
- Measurement of blocking frequency band.



LINE TRAP SCHEDULE (I)
RATING AND CHARACTERISTIC OF CONDUCTOR

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
1	<u>System characteristic</u>				
1-1	Nominal system voltage kV	63/66	132	230	400
1-2	Min. system voltage kV	72.5	145	245	420
1-3	Nominal system frequency Hz	50	50	50	50
1-4	System neutral earthing	Resistance earthed/ solidly earthed	Solidly earthed	Solidly earthed	Solidly earthed
1-5	Number of phases	3	3	3	3
1-6	Max. duration of short time current Sec	1-3	1-3	1-3	1-3
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	-40/-35/-30/-25	-40/-35/-30/-25	-40/-35/-30/-25	-40/-35/-30/-25
2-3	Average value of daily temperature °C	*	*	*	*
2-4	Altitude above sea level m	1000/1500/2000/2500	1000/1500/2000/2500	1000/1500/2000/2500	1000/1500/2000/2500
2-5	Pollution level	Low/medium/high Very high/special	Low/medium/high Very high/special	Low/medium/high Very high/special	Low/medium/high Very high/special
2-6	Solar radiation w/m ²	*	*	*	*
2-7	Max. wind velocity m/s	30/40/45	30/40/45	30/40/45	30/40/45
2-8	Wind velocity at ice condition m/s	20	20	20	20
2-9	Ice coating thickness mm	5/10/20/25	5/10/20/25	5/10/20/25	5/10/20/25

LINE TRAP SCHEDULE (I)
RATING AND CHARACTERISTIC OF CONDUCTOR

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
2-10	Seismic acceleration m/s^2	0.2/0.25/0.3/0.35	0.2/0.25/0.3/0.35	0.2/0.25/0.3/0.35	0.2/0.25/0.3/0.35
2-11	Relative humidity %	90/95/greater than 95	90/95/greater than 95	90/95/greater than 95	90/95/greater than 95
3	<u>Characteristic of line trap</u>				
3-1	Class / construction	Outdoor/dry/ /fixed/wideband/ one frequency/ horizontal/ vertical	Outdoor/dry/ /fixed/wideband/ one frequency/ horizontal/ vertical	Outdoor/dry/ /fixed/wideband/ one frequency/ horizontal/ vertical	Outdoor/dry/ /fixed/wideband/ one frequency/ horizontal/ vertical
3-2	Method of mounting	Suspension/ on pedestal/ on CVT	Suspension/ on pedestal/ on CVT	Suspension/ on pedestal/ on CVT	Suspension/ on pedestal/ on CVT
3-3	Main coil rated continuous current at standard condition A	800/1250/2000	1250/2000/3150	1250/2000/3150	2000/3150/4000
3-4	Rated short time current kA_{rms}	25/31.5/40	31.5/40	31.5/40/50	40/50/63
3-5	Rated dynamic current kA_{rms}	64/80/102	80/102	80/102/128	102/128/161
3-6	Rated inductance of the main coil (measured at 100 kHz) mH	0.2-0.315	0.2-0.315-0.5	0.315-0.5-1	0.5-1-2
3-7	Frequency bandwidth kHz	*	*	*	*
3-8	Max. tapping loss within specified bandwidth dB	2.6	2.6	2.6	2.6
3-9	Power loss kW	**	**	**	**

LINE TRAP SCHEDULE (I)
RATING AND CHARACTERISTIC OF CONDUCTOR

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
3-10	Type of coupling	ph-gr/ph-ph/ph-ph-ph	ph-gr/ph-ph/ph-ph-ph	ph-gr/ph-ph/ph-ph-ph	ph-gr/ph-ph/ph-ph-ph
3-11	Line trap blocking characteristic:				
3-11-1	Min. blocking impedance within the specified band with Ω	600	600	600	600
3-11-2	Min. blocking resistance within the specified frequency Ω	400	400	400	400
3-12	Bird barrier provided? Yes/No	***	***	***	***
3-13	Rated discharge current of protective device kA_{peak}	**	**	**	**
3-14	Type of protective device	Zno	Zno	Zno	Zno
3-15	Max. radio interference voltage level measured at 1.15 max. phase to ground voltage (kV) and at 1 MHz μV	—	2500	2500	2500
3-16	Static and dynamic mechanical withstand forces of HV terminal N	1000/2000	1000/2000	1000/2000	1000/2000

* These will be specified by communicational consultant recommendations.

** These will be specified by engineer.

*** Recommended that in the all cases bird barrier is used.

LINE TRAP SCHEDULE (II)
GUARANTEED TECHNICAL SPECIFICATION OF LINE TRAP
(TO BE SUPPLIED WITH TENDER)

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
1	Manufacturer's name and country				
2	Manufacture's type designation				
3	Class and type (outdoor/indoor, insulated/non-insulated, adjusted in wide band width and ...)				
4	Applicable standard				
5	Applicable site and ambient conditions:				
5-1	Max. ambient temperature °C				
5-2	Min. ambient temperature °C				
5-3	Average value of daily temperature °C				
5-4	Altitude above sea level m				
5-5	Pollution level				
5-6	Solar radiation w/m ²				
5-7	Max. allowable ice thickness				
5-8	Seismic acceleration m/s ²				
5-9	Max. allowable wind velocity on line trap m/s				

LINE TRAP SCHEDULE (II)
GUARANTEED TECHNICAL SPECIFICATION OF LINE TRAP
(TO BE SUPPLIED WITH TENDER)

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
6	Documents (test reports/ designs / drawings / catalogues / repairing and installation and operating manuals/ instruction manuals/ references/ list of spare parts				
7	Rated system voltage kV				
8	Rated system frequency Hz				
9	Rated system current (under standard conditions):				
9-1	Rated continuous current A_{rms}				
9-2	Rated short – time current /duration kA_{rms}/Sec				
9-3	Rated dynamic current kA_{peak}				
10	Characteristic of protective device:				
10-1	Manufacturer				
10-2	Type and designation (Zno/conventional/ others)				
10-3	Rated voltage kV				

LINE TRAP SCHEDULE (II)
GUARANTEED TECHNICAL SPECIFICATION OF LINE TRAP
(TO BE SUPPLIED WITH TENDER)

ITEM	DESCRIPTION		TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
			63/66 kV	132 kV	230 kV	400 kV
10-4	Nominal discharge current	kA _{peak}				
10-5	Residual voltage (at nominal discharge current)	kA _{peak}				
10-6	Line discharge class					
10-7	Catalog includes?	Yes/no				
11	Rated insulation level of the tuning device (under standard conditions):					
11-1	Power frequency withstand voltage /duration	kV _{rms} /Sec				
11-2	Lightning impulse withstand voltage	kV _{peak}				
12	Main coil inductance:					
12-1	Rated inductance (at 100 kHz)	mH				
12-2	Power frequency inductance	mH				

LINE TRAP SCHEDULE (II)
GUARANTEED TECHNICAL SPECIFICATION OF LINE TRAP
(TO BE SUPPLIED WITH TENDER)

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
13	Max. impedance at 50 Hz Ω				
14	Emergency over load current as a percentage of continuous current at 40 °C ambient temperature:				
14-1	15 minutes %				
14-2	30 minutes %				
14-3	60 minutes %				
15	Insulation thermal characteristic:				
15-1	Insulation material				
15-2	Thermal class of insulation (according to IEC)				
15-3	Temperature rise $^{\circ}\text{C}$				
16	Radio interference voltage measured at $1.15 \times$ maximum system phase to earth voltage and at 1 MHz μV				

LINE TRAP SCHEDULE (II)
GUARANTEED TECHNICAL SPECIFICATION OF LINE TRAP
(TO BE SUPPLIED WITH TENDER)

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
17	Max. power losses (at nominal current and 75 °C winding temperature) kW				
18	Q factor at 100 Hz				
19	Self resonant frequency kHz				
20	Blocking frequency bandwidth of line trap (600 Ω impedance) kHz				
21	Min. blocking impedance/ resistance guaranteed within specified bandwidth dB				
22	Expected max. loss in tapping loss dB				
23	Expected min. attenuation back into the substation (assume that substation impedance at the specified carrier frequency is 400 Ω resistive and coupling via untrapped phases negligible)				

LINE TRAP SCHEDULE (II)
GUARANTEED TECHNICAL SPECIFICATION OF LINE TRAP
(TO BE SUPPLIED WITH TENDER)

ITEM	DESCRIPTION	TECHNICAL SPECIFICATION FOR SYSTEMS WITH FOLLOWING NOMINAL VOLTAGE			
		63/66 kV	132 kV	230 kV	400 kV
24	Method of mounting (suspension/ on pedestal / on CVT)				
25	Type of insulation of material in contact with main coil				
26	Weight of line trap kg				
27	Overall dimensions of line trap (diameter × height) m×m				
28	Max. shipping dimension m×m×m				
29	Material at conductor				
30	Min. cross section of line trap conductor mm ²				
31	Material, type and size of terminal				
32	Bird barrier provided? (Yes/No)				
33	Tensile strength of suspension system of the line trap kN				
34	HV terminal static / dynamic withstand forces N				