

Recommendation 3

Technical terms and conditions etc. for arc-suppression coils for 10-60 kV system voltage

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1. SCOPE

This recommendation applies to oil-immersed arc-suppression coils with normal accessories for use in 10-15-20 kV and 50-60 kV networks.

The arc-suppression coil must be designed for outdoor and indoor installation at air temperatures in the range -25 ... +40°C. Furthermore, the monthly average temperature must not exceed 30°C, and the annual average temperature must not exceed 20°C.

The recommendation is published in Danish and English. In case of discrepancy between the two versions the Danish version shall prevail.

2. GENERAL REQUIREMENTS

The arc-suppression coil must comply with applicable Danish legislation.

The arc-suppression coil must be made in accordance with DS/EN 60076-6. The general requirements and test requirements in relevant standard issued by CENELEC, CEN and IEC standards at the time of the invitation to tender must be fulfilled.

It is the responsibility of the user of this recommendation to ensure that the current version and any applicable amendments to legislation, regulations and standards are used when preparing invitations to tender. Information about the applicable version of a standard and any addendums is available from Danish Standards, CENELEC or IEC.

The terminology used in this recommendation is in accordance with the definitions given in the above mentioned standards.

3. ELECTRICAL MAIN DATA

3.1. Rated frequency 50 Hz

3.2. Rated voltage

Nominal system voltage [kV]	Rated voltage of arc-suppression coil [kV]
10	$11/\sqrt{3}$
15	$16/\sqrt{3}$
20	$22/\sqrt{3}$
50	$52/\sqrt{3}$
60	$66/\sqrt{3}$

3.3. Rated current

The rated current according to the following tables must be stated in invitations to tender. Rated currents refer to the maximum current settings.

Nominal system voltage [kV]	Rated current [A]													
	16	25	31,5	40	50	63	80	100	125	160	200	250	300	400
10														
15	11	17	22	27	34	43	54	68	87	108	135	173	217	
20	12,5	16	20	25	31,5	40	50	63	80	100	125	160	200	300

Nominal system voltage [kV]	Rated current [A]													
10														
15														
20	400	500												

Nominal system voltage	Rated current [A]													

[kV]													
50	21	27	33	42	53	67	83	105	133	167	210	300	
60	17	21	26	33	42	52	66	83	105	131	165	210	300

3.4. Regulation range

Arc-suppression coils are categorised as follows according to the regulation method:

3.4.1. Arc-suppression coils for continuously regulation (adjustable air gap)

Unless otherwise agreed, the regulation range must be:

Nominal system voltage [kV]	Regulation range
10-15-20	1:5 to 1:12,5
50-60	1:12,5

3.4.2. Arc-suppression coils for stepwise regulation

These must have the following regulation ranges and tapplings, unless otherwise specified in the invitation to tender:

Rated current < 50 A: current tapplings at 40-50-63-80 and 100% of the rated current.

Rated current \geq 50 A: Current tapplings must be placed so that the difference in current between two consecutive tapplings does not exceed 10 A or 20% of the smaller of the two current values. The lowest current tapping must be 40% of the rated current of the arc-suppression coil.

With the recommended regulation ranges, more tapplings may be required to meet the step and touch voltage requirements in the Executive Order on safety for the realisation of electrical installations [in Danish: *Bekendtgørelse om sikkerhed for udførelse af elektriske anlæg*] and DS/EN 50522.

3.5. Tolerances

The purchaser reserves the right to reject the arc-suppression coil if the difference between the agreed and measured current value, see section 6.1.2, is greater than $\pm 5\%$ at the maximum current setting or $\pm 10\%$ in one or more of the other positions, see 6.1.2.

3.6. Load time

3.6.1. 10-20 kV arc-suppression coils must be dimensioned to carry the rated current continuously. The maximum temperature rise for the winding is 80 K.

3.6.2. 50-60 kV arc-suppression coils must be dimensioned to carry the rated current for two hours. The maximum temperature rise for the winding is 100 K.

3.7. Insulation level

Rated voltage [kV]	Rated withstand voltage at the network connection terminal		Rated withstand voltage at the earth terminal
	Alternating voltage [kV]	Impulse $\leq 1,2/50 \mu s$ [kV]	Alternating voltage [kV]
$11/\sqrt{3}$	28	75	28
$16/\sqrt{3}$	38	95	38
$22/\sqrt{3}$	50	125	50
$52/\sqrt{3}$	95	250	28
$66/\sqrt{3}$	95	250	28

4. CONSTRUCTION

4.1. Regulation equipment

4.1.1. Arc-suppression coils with continuously regulation

The arc-suppression coil must be designed for regulation during operation and made for mechanical and electrical local control as well as for electrical remote control. The electrical control – local as well as remote – must be blocked during mechanical control. In the case of local control, it must be possible to operate the arc-suppression coil from the ground.

The arc-suppression coil must be prepared for connection of a control unit for automatic regulation of the arc-suppression coil during operation. If such equipment is to be included in tenders, this must be indicated in the invitation to tender with the requirements concerning the equipment.

The current setting of the arc-suppression coil must appear on an indicator which is mechanically connected to the iron core. It must be possible to read the indicator at a safe distance from live parts.

The regulating motor must be a three-phase short circuit motor protected by a motor protection device. The motor, control circuits and associated auxiliary equipment must be made for 230/400 V AC (but DC for signal contacts). The arc-suppression coil must be equipped with a limit switch and must not be damaged if an electrical limit switch fails. The motor etc. must have a class IP 55 enclosure and be dimensioned for a lifetime of at least 10 years in intermittent operation.

4.1.2. Arc-suppression coils with stepwise regulation

Switching between the tapplings described in 3.4.2. must take place while the arc-suppression coil is in the de-energised state with a tap-changer built into the main tank. The tap-changer must be easy to operate by means of a handle placed outside the arc-suppression coil tank.

The step positions of the tap-changer must be clearly marked with the numbers 1, 2, 3, ... etc. The number 1 indicates the lowest coil current.

If more steps than usual are required, see section 3.4.2, two tap-changer may be used if necessary.

The relationship between the position of the tap-changer and the current setting of the arc-suppression coil must be indicated on the rating plate.

4.2. Cooling equipment

The cooling system of the arc-suppression coil must be made for natural oil and air circulation (ONAN).

4.3. Bushings

4.3.1. 50-60 kV nominal network voltage

The invitation to tender must indicate whether open type bushings or plug-in type bushings are to be used.

4.3.1.1 Open type

Bushings must be dimensioned for rated current of the arc-suppression coil. and must be made and tested as prescribed in DS/EN 60137.

The invitation to tender must indicate whether the outer insulator of the bushing must be made of porcelain or a polymer material. The invitation to tender must indicate whether the inner insulation must be of the type RIP (resin impregnated paper) or RIS (resin impregnated synthetic).

In the case of porcelain insulators, brown-glazed porcelain dimensioned for full vacuum (100 Pa) must be used.

The insulators must be suitable for use in an environment corresponding to SPS class d or e, see DS/IEC TS 60815-1. Annex 2 contains examples of typical environments corresponding to SPS class d and e. The requested SPS class must be indicated in the invitation to tender.

The minimum creepage distance for the insulators must be as follows regardless of the material:

Highest voltage for winding [kV]	Minimum creepage distance [mm]	
	SPS class d	SPS class e
72,5	1812	2248

The insulator connected to the earth terminal bushing must have the same creepage distance as a network connection terminal for 10 kV rated network voltage, see section 4.3.2.1.

Connection pins must be of silvered copper and have a minimum diameter of 30 mm and a free length of at least 80 mm.

The internal connection of the windings to the insulators must be secured to prevent nuts loosening.

4.3.1.2 Plug-in type bushings

Plug-in type bushings must be dimensioned for an overload of at least 150% with reference to the rated power of the transformer and must be realised and tested as prescribed in DS/EN 50673.

It must be possible to inspect and replace the bushings without the need to raise the cover of the transformer.

The bushings must be placed and marked as shown in annex 1. The marking must use raised letters on the transformer cover at each of the bushings. The distance between the bushings must adhere to the minimum values shown in the annex.

4.3.2 10-15-20 kV nominal network voltage

The invitation to tender must indicate whether outdoor type bushings or plug-in type bushings are to be used.

4.3.2.1 Outdoor type

Bushings must be dimensioned for rated current of the arc-suppression coil and must be made and tested as prescribed in DS/EN 50180-1.

The insulators must be suitable for use in an environment corresponding to SPS class d or e, see DS/IEC TS 60815-1. Annex 2 contains examples of typical environments corresponding to SPS class d and e. The requested SPS class is indicated in the invitation to tender.

The minimum creepage distance for the insulators must be as follows regardless of the material:

Highest voltage for winding [kV]	Minimum creepage distance [mm]	
	SPS class d	SPS class e
12	300	372
17,5	437	543
24	600	744

Insulators connected to the earth terminal bushing must have the same creepage distance as an insulator for a network connection terminal bushing.

Dimensions of connecting bolts and nuts etc. are indicated in the invitation to tender.

Connection flanges must be included in the delivery and be of silvered copper or a material with similar electrical and mechanical properties. Bolts and nuts must be of stainless steel.

The internal connection of the windings to the insulators must be secured to prevent nuts loosening.

4.3.2.2 Plug-in type bushings

Plug-in type bushings must be dimensioned for rated current of the arc-suppression coil and must be made and tested in accordance with DS/EN 50180-1.

4.3.3 Marking of bushings

The network connection bushing must be marked A and the earth bushing must be marked B. The marking must be weatherproof and oil resistant.

4.4. Main tank

4.4.1. The main tank (including cooling elements if any), gaskets etc. must be dimensioned so that they are able to withstand without permanent deformation oil filling and also an internal overpressure corresponding to an oil column of the same height as the internal height of the tank. The arc-suppression coil must hereby remain oil-tight.

In the case of 50-60 kV arc-suppression coils, the main tank, cooling elements if any, gaskets etc. must be able to withstand a vacuum of 100 Pa without permanent deformation.

4.4.2. The main tank, conservator and cooling elements must be designed to prevent air pockets forming.

4.4.3. Cooling ribs made of corrugated sheet metal must be braced to each other at the top and bottom if the ribs are more than 100 mm deep.

4.4.4. The main tank must have two connecting points for earth conductors, one on each side of the tank. The connection point must be either an M12 earthing screw, length 35 mm, with two nuts, or a clamp connection for 95 mm² cable. The screws etc. must be made of stainless steel.

4.5. Protection against corrosion

All items including screws, nuts and other fastenings, valves, terminals, terminal blocks etc. must be dimensioned for a lifetime of at least 20 years in an environment corresponding to corrosion class 3, high aggressiveness, industrial and coastal areas. For 10-20 kV arc-suppression coils for indoor installation, however, corrosion class 1 may be specified in the invitation to tender. Surface treatment etc. is realised in accordance with annex 1.

4.6. Box for auxiliary equipment and wiring etc.

Possible auxiliary equipment and external connections to it and to measuring circuits etc. must be placed in the same cabinet made of steel. Condensation of the air humidity in the cabinet must be prevented by a heating element for 230 V AC.

There must be a weather-proof circuit diagram on the inside of the door. The type of terminals must be specified in the invitation to tender. All conductors must be plastic insulated. Cables must be reinforced or otherwise protected against mechanical damage.

4.7. Protective earth connection

There must be a protective earth connection between the main tank and auxiliary equipment for voltages of 500 V or less if there is no other effective and reliable electrical connection.

It must be realised in accordance with the "Executive order on safety for the realisation of electrical installations" [in Danish: *Bekendtgørelse om sikkerhed for udførelse af elektriske anlæg*] and DS/EN 50522.

5. ACCESSORIES

The arc-suppression coil must be equipped with the accessories listed below. If the oil system of the arc-suppression coil is hermetically sealed, section 5.1 up to and including 5.4 are not applicable. If the arc-suppression coil is not hermetically sealed and the main tank etc. is dimensioned for an oil volume which is at least 10% greater than the oil volume corresponding to the lowest permissible oil level, section 5.1 and 5.2 are not applicable.

5.1. Oil conservator

5.1.1. The oil conservator must have a volume which is at least 10% of the oil volume with which it is connected. The bottom sump of the conservator must make up 5 ... 10% of the conservator volume. It must have a refill pipe stub with blind flange or plug. It must be possible to drain the contents of the bottom sump.

5.1.2. The oil conservator is equipped with an oil level glass (or oil level indicator) made of non-combustible material. There must be markings showing the normal oil level at oil temperatures of +20, 0 and -20°C respectively.

5.2. Gas relay etc.

If so required for an arc-suppression coil in the invitation to tender, a gas relay must be incorporated in the connection pipe between the main tank and the oil conservator. The gas relay must have two free make and/or break contacts of which one must activate with light gas accumulation and the other with heavy gas accumulation.

There must be a valve arrangement so that the gas relay can be replaced without the need to empty the oil conservator. Regardless of the valve position, the oil in the main tank must have unimpeded access to the oil conservator. There must be valves for gas sampling and air injection for testing.

5.3. Dehydrating breather

For 50-60 kV arc-suppression coils and 10-20 kV arc-suppression coils with or without an oil conservator, air exchange with the surroundings must take place by means of a dehydrating breather.

The invitation to tender must indicate whether the dehydrating breather is to be of a type with desiccant which is replaced manually (silica gel or similar) or of the self-generating

type. Regardless of the choice of type, the requirements for realisation and testing for the respective type in DS/EN 60076-22-7 must be met.

The dehydrating breather must be placed approximately 1 m above the bottom of the transformer tank and the dehydrating breather must have an oil lock to reduce the exchange of air.

If silica gel is used in a dehydrating breather of the type with desiccant which is replaced manually, the dehydrating breather must also be equipped with a window so that the colour of the desiccant at the top and at the bottom of the dehydrating breather can be checked.

5.4. Valves

5.4.1. 10-20 kV arc-suppression coils must have an oil drain point on the side of the main tank and as low as possible. If indicated in the invitation to tender, draining must take place through a valve.

5.4.2. In 50-60 kV arc-suppression coils, at two diagonally opposite corners of the main tank there must be two valves for filling, draining and recirculation. One valve is installed at the bottom of the main tank such that the bottom layer will also be included in oil circulation. The other valve is at the top of the tank. Alternatively, it may be placed at the bottom, but in that case it must be connected to the top of the tank by means of a rise pipe, and the rating plates of the valves must clearly state which one is for the top oil. The valves must be terminated with a DIN 2533 flange with a bore of 40 or 80 mm².

5.4.3. One valve must be provided for oil test sampling. The valve must be placed at a height of about 10 cm above the bottom of the main tank.

5.4.4. All valves must be equipped with an oil-tight closing cap or blind flange and, if there is more than one valve, with a rating plate describing their use.

5.5. Secondary winding, instrument transformers etc.

5.5.1. Unless otherwise specified in the invitation to tender, a 10-20 kV arc-suppression coil must have a secondary winding intended to be connected to a resistor for increasing the resistive component of the earth fault current.

The rated voltage of the secondary winding must be 500 V with a tolerance of $\pm 10\%$, to be met for all arc-suppression coil settings. For arc-suppression coils with stepwise regulation, see section 3.4.2., the winding is switched together with the primary winding.

The rated power of the secondary winding and the maximum operating time at full load should be indicated in the invitation to tender. If nothing else is indicated, at least 100 kW and an operating time of 90 seconds must be selected.

The temperature of the secondary winding must not exceed the value in DS/EN 60076-5 table III for the temperature of transformer windings after short circuit.

5.5.2. If so requested in the invitation to tender, a current transformer must be incorporated with a rated performance of 15 VA in class 1 with extended current range to 120%. Of the IEC standardised rated currents for current transformers, the rated current for current transformers which is closest to (and less than) the rated current of the arc-suppression coil must be selected as the primary rated current. The secondary rated current must be 5 A.

5.5.3. If so requested in the invitation to tender, a voltage transformer is incorporated with the secondary rated voltage specified herein (100 V or 110 V). The rated performance must be 100 VA in class 3P, unless otherwise agreed.

Alternatively, in arc-suppression coils with an adjustable air gap, a measurement winding is used. In this case, a transformation ratio tolerance of $\pm 15\%$ is allowed, which must be met for all arc-suppression coil settings. The angle error must correspond to class 3P.

5.5.4. Terminals for instrument transformers and the secondary winding must be clearly marked. The markings must be weatherproof and oil resistant.

5.5.5. Possible signal contacts must be available for DC, see the invitation to tender.

5.6. Resistor

The resistor for increasing the resistive component of the earth fault current must be able to be connected to the secondary winding of the arc-suppression coil as described in section 5.5.1. The resistor must be made and tested in accordance with annex G to DS/EN 60076-6.

The resistor must be air-insulated, unless otherwise indicated in the invitation to tender. The invitation to tender must indicate whether the resistor is to be installed indoors or outdoors.

The resistor must have a rated voltage of 500 V and a rated power which must be specified in the invitation to tender (typical values are around 60 and 100 kW) and must be dimensioned for a minimum 30-second connection time, after which disconnection and cooling may be necessary. The cooling time must be indicated in the tender.

The resistor must have the degree of protection IP23.

The resistor must be protected by a thermal relay.

5.7 Transport arrangements etc.

5.7.1. The invitation to tender must indicate whether 10-15-20 kV arc-suppression coils are to be fitted with transport rollers.

5.7.2. 50-60 kV arc-suppression coils must be fitted with transport rollers or flanged wheels according to the customer's specifications. In the case of flanged wheels, the track gauge must be 1435 mm (internal measurement), see DS/EN 60076-22-7. 4 sets of lock wedges must be supplied for securing to rails.

5.7.3. The frame of 50-60 kV arc-suppression coils must be equipped with the towing lugs necessary for transport.

5.7.4. For 50-60 kV arc-suppression coils, the main tank must be equipped with clearly marked reinforcements or lifting flanges for placing of jacks.

5.7.5. 50-60 kV arc-suppression coils must have loops or hooks for lifting of both the complete oil-filled arc-suppression coil and the core with cover.

5.8. Oil

Unless otherwise specified in the invitation to tender, the oil must be mineral oil and must meet the requirements of DS/EN 60296 for transformer oil type A or type B.

The invitation to tender must indicate whether the transformer oil is to be inhibited.

To minimise the risk of copper sulphides forming in the oil, the oil must be tested as "non-corrosive" in tests prescribed in DS/EN 62535.

5.9. Marking

The arc-suppression coil must have a visible and unambiguous rating plate of a weatherproof and oil-resistant type with the information specified in DS/EN 60076-6.

- Type of reactor (arc-suppression coil)
- Outdoor and/or indoor use
- Reference to EN 60076-6
- Manufacturer
- Serial no.
- Year of manufacture
- Insulation levels
- Rated frequency
- Rated voltage
- Rated no-load voltage for secondary winding (if applicable)
- Maximum continuous voltage
- Rated current and duration
- Type of regulation
- Type of cooling
- Temperature rise for the top oil and average temperature rise of winding at rated current and duration
- Total weight
- Transport weight
- Weight of empty oil tank
- Weight of insulation oil
- Type of insulation oil and possible inhibitor
- Connection diagram for tapplings including current transformers, if any
- Type of tap changer (in the case of stepped regulation)
- Table or graph indicating the regulation range in ampere or as a percentage relative to rated current.

In addition, the weight of the core with winding and cover must appear.

6. TESTS

Before a delivery is approved, the routine and type tests described in DS/EN 60076-6 with the following additions must have been carried out with a satisfactory result.

Protocols with the results of all routine tests must be submitted to the purchaser in duplicate no later than the time of invoicing.

6.1. Routine tests

6.1.1. Measurement of winding resistance. In the case of arc-suppression coils with stepwise regulating, see section 3.4.2, the resistance of the primary winding must be measured in all positions.

6.1.2. Measurement of current throughout the regulation range. For continuously regulated arc-suppression coils, measurements must be carried out at the outer positions and at a sufficient number of points to verify the mechanical indication described in 4.1.1.

The measurement must be carried out as far as possible at the rated voltage and frequency. If this is not feasible, the measurement must be carried out at the highest possible voltage.

6.1.3. Measurement of voltage ratio between the primary and the secondary winding and measurement winding respectively. For arc-suppression coils with stepwise regulation,

measurements must be carried out at all related tapings of the primary and secondary winding. For continuously regulated arc-suppressions coils, at least the outer positions must be measured.

6.1.4. Testing with overvoltage from separate voltage source. The size of the test voltage is shown in the table in section 3.7. In the case of arc-suppression coils with uniform insulation, the voltages in column 2 are used. In the case of graduated insulation, column 4 is used.

6.1.5. Testing with induced overvoltage. The arc-suppression coil is set to the minimum current regardless of regulation method. However, in the case of arc-suppression coils with stepwise regulation, it may be indicated in the invitation to tender that the test is to be carried out at the maximum current setting.

The voltage between the terminals must be twice the rated voltage. In the case of arc-suppression coils with graduated insulation, the bushing for the network connection must simultaneously be tested with the voltage in column 2 of the table in section 3.7.

If a test with induced overvoltage is not feasible, it must be replaced with an impulse voltage test as described in section 6.2.1, and this must be communicated to the purchaser in the tender. For an arc-suppression coil with stepwise regulation, this alternative test is carried out at both the maximum and minimum current setting.

6.1.6. Auxiliary and measurement windings must be tested with 2 kV to earth, 50 Hz, for one minute.

6.1.7. Functional testing of regulation equipment, if any.

6.2. Type tests

6.2.1. Impulse voltage test with the test voltage in column 3 of the table in 3.7. The rise time must not exceed 1.2 μ s and the half time must be 50 μ s. In the case of arc-suppression coils with tapings, the test must be carried out with the arc-suppression coil set to the minimum current.

6.2.2. Temperature rise test. The test must be carried out at the setting which produces the highest losses.

6.2.3. Measurement of current at the rated voltage.

6.3 Special testing

Special tests in accordance with DS/EN 60076-6 may additionally be specified in the invitation to tender.

- Measurement of losses
- Measurement of magnetic characteristics up to and including 1.1 times the rated voltage
- Measurement of sound level
- Endurance test of the regulation mechanism
- Demonstration of ability of the arc-suppression coil to withstand the dynamic effects of the rated current.

7. DATA TO BE PROVIDED IN INVITATION TO TENDER

The following data and information must be provided in the invitation to tender:

- Rated voltage, see section 3.2.
- Rated current, see section 3.3.
- Whether regulation of the arc-suppression coil is to take place off-line or on-line.
- Possible requirements concerning the regulation range or step distances, see section 3.4.
- In the case of off-line regulation, it must be indicated whether continuous regulation is preferred.
- In the case of on-line regulation, it must be indicated whether a control unit for automatic regulation, potentiometer, transmitter/instrument to indicate the position etc. are to be included in the delivery, see section 4.1.1.
- DC voltage for signal contacts etc.
- Whether a current transformer is to be incorporated.
- Whether a voltage transformer/measurement winding is to be incorporated. Requirements concerning rated voltages (and possibly rated power if there is no need for 100 VA).
- Whether a 500 V secondary winding, see section 5.5.1 is to be omitted (10-20 kV) or included (50-60 kV).
- Rated power and operating time at full load.
- Whether the arc-suppression coil is to have a built-in or external neutral point resistor. Rated voltage, rated power, connection time, whether it is to be air-insulated or oil-immersed, and IP class, see section 5.6.
- Requirements concerning protection against corrosion and, if applicable, colour of top coat, see section 4.5.
- Requirements concerning transformer oil, for example whether it is to be of type A or B and whether it is to be inhibited, see section 5.8.
- Requirements concerning valves, see section 5.4.1.
- Whether a gas relay etc. is to be included in the delivery, see section 5.2.
- Whether a hermetically sealed tank or a non-hermetically sealed tank with or without oil conservator is preferred.
- Whether the lid is to be bolted to the tank.
- Requirements concerning the dimensions of the arc-suppression coil.
- Whether the arc-suppression coil is to be equipped with transport arrangements and if so, which ones, see section 5.7.
- If applicable, requirements concerning terminals: measurement bushings, short circuit links, connectors, heaters.
- For arc-suppression coils with stepwise regulation, whether testing with induced overvoltage, see 6.1.5., is to be carried out at the maximum current setting.
- Which spare parts must be included in the delivery.
- Earliest and latest delivery time.
- Place of delivery and approach to the site.
- If applicable, the terms of delivery, which unless otherwise specified is to be carriage paid to place of delivery (Incoterms 2020).
- Deadline for submission of tender and respectively final dimension drawings, circuit diagrams, maintenance instructions etc.
- Whether information is to be provided about a price increase for impulse voltage testing (special test) as described in 6.2.1 (not applicable in the case of arc-suppression coils for 10-20 kV networks).
- Possible requirements concerning warranty period, insurance and deposits.

Details of the commercial terms and conditions should also be provided.

8. DATA TO BE PROVIDED IN TENDERS SUBMITTED

Information about the following must be provided in the tenders submitted:

- Price for complete arc-suppression coil carriage paid to place of delivery.
- Price of spare parts and their warranty period.
- Price increase for impulse voltage testing (special test) if the purchaser has requested this information.
- Possible price adjustments.
- Information about customs duties, exchange rates and VAT.
- Terms of payment.
- Data for bushings (creepage distances, insulation level, rated current, manufacturer, type and type test).
- Oil type and, if applicable, inhibitor, in which case data for the base oil.
- Information about surface treatment.
- 500 V secondary winding: rated power and maximum operating time at full load.
- Resistor for increase of the resistive component of the earth fault current: rated voltage, rated power, connection time and cooling time.
- Information about built-in current transformers, if any.
- Information about the sound power level see DS/EN 60076-10 at maximum induction if measurements are carried out.
- Total weight of the arc-suppression coil.
- Weight of core with winding(s) and cover, required crane height to remove it.
- Weight of oil.
- Maximum transport weight.
- Dimension drawings, circuit diagrams, descriptions etc. which are necessary for assessing the construction of the arc-suppression coil, including possible electrical control equipment and regulation equipment, installed neutral point resistor etc.
- Delivery time.
- Warranty period.

In addition, the manufacturer must confirm that the arc-suppression coil meets the requirements stated in the terms and conditions of the invitation to tender. Possible departures from the requirements must be specified in detail.

ANNEX 1: RESISTANCE TO CORROSION

Note: Updating corrosion protection requirements are under consideration.

1. Efforts must be made to obtain a lifetime of 20 years or more.
2. An environmental pollution corresponding to heavy pollution (pollution level III (heavy), see EN 60071-2) must be assumed.
3. All construction parts must be well drained. Profile and plate edges must be rounded off, $r \geq 2$ mm or equal to half the metal thickness. Welding beads and protruding surface defects must be completely removed.

All welds must be fully welded and all welding cinder must be removed prior surface treatment. After welding with coated electrodes, the construction must be carefully washed off with water if the subsequent cleaning is blast-cleaning.

4. Outside surface treatment.
Supplier may choose between following system procedures:

- 4.1 Paint.

The pre-treatment must be sand blast-cleaning, minimum purity degree Sa 2 1/2 according to ISO 8501-1.

The surface treatment must be carried out as follows:

Basic treatment: two-component zinc-rich epoxy or metallisation with zinc
min. 50 μm

Intermediate paint: two-component epoxy
or vinyl or chlorinated rubber
min. 140 μm
160 μm

Paint finish: on epoxy two-component polyurethane or vinyl/acrylic enamel
min. 30
 μm

A thermoplastic intermediate paint must be covered with thermoplastic paint finish. Alternative paint treatments can be offered for evaluation and possible approval by the purchaser.

Adhesion testing according to DS/EN ISO 2409 must result in values Gt 0, Gt 1 or Gt 2. The test requirement must be met both at the time of delivery and at the end of the warranty period.

Pinhole testing with low voltage pinhole detector (9 V, wet sponge, see e.g. DS/R 454) must show max. following number of pinholes:

3 pinholes/m edge length
3 pinholes/m² surface

4.2. Hot dip galvanising (of smaller items).

Hot dip galvanising according to DS/ISO 1459 and 1461 class B.

4.3 Where metal thickness or the construction cause, that neither hot dip galvanising in class B or treatment with paint as described in 4.1 is possible, hot dip galvanising according to DS/ISO 1459 and 1461 class C is preferred to treatment with paint. Any such deviation must be indicated and explained in the tender.

5. The requirements on screws, nuts, washers etc. are stainless steel (AISI 316), screw threads to be rolled. Threads etc. to be greased.

6. Inside treatment.

Rust, cinder and welding pearls in the transformer tank and oil conservator, if any, must be vacuumed and removed. The oil conservator must be painted on the inside with an oil-resistant paint; the same applies to the transformer tank.

Cooling elements must be treated on the inside so that they are clean and free of rust and welding cinder etc.

7. If the supplier offers alternative treatments, the described treatment suggestions must be quality references. In general, larger layer thicknesses of the alternatives are required, especially when they do not include a zinc-

rich basic treatment, Requirements to pinhole occurrence and adhesion remain unchanged.

ANNEX 2:

SITE POLLUTION SEVERITY CLASS (SPS class)

SPS class e

- Within 3 km of a coast
- Within 1 km of a pollution source
- With a greater distance from a coast than 3 km, but dense fog (or drizzle) often occurs after a long (several weeks or months) dry pollution accumulation season

SPS class d

- Within the same distance of a coast as SPS class e, but directly subjected to sea-spray or dense saline fog.
- Directly subjected to contaminants with high conductivity, or cement type dust with high density, and with frequent wetting by dense fog or drizzle.