UNIT, BUSINESS AREA
GSH

OUR REFERENCE
TR13-03-02

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2019-04-30

CONSULTATIONS
GF, GI, GS, NA, NL, NP, NS, NT, SD, SK

TECHNICAL GUIDELINE

REVISION
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APPROVED
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Supplements, clarifications and special applications of ESA

This technical guideline contains the supplements, clarifications and special applications of ESA which apply to works on or next to Svenska kraftnät's electrical plants. The requirements apply to all types of building, civil engineering and maintenance work, storage operations, consultancy services in planning and design, and other similar assignments.

REVISION	Change note	Date
TR10-01 rev. (B)		2006-12-28
TR10-01 rev. (C)	The revision is primarily prompted by Svenska kraftnät's modified electrical safety organization per 01/04/2009. In connection with the revision. a review of the various necessary distances and voltage 500 kV has been introduced	2009-12-01
TR10-01 rev. (D)	Organisation Chart page 7 revised Elanläggningsansvarig (Operation) after modified line organisation	2010-01-01
TR10-01 rev. 5	New function Elsäkerhetsledare introduced page 9. Rakel listed as communication options page 12. Table 2 deleted. Table 3 renamed to table 2 where the vertical safety distance revised existing 500 kV. Figure 2 revised	2011-08-24
TR10-01 rev. 6	Larger revisions prompted by changes in the Swedish standard for maintenance of electrical installations EN 50110-1 exp. 3, including revised ESA	2015-06-01
TR13-03-02 rev.1	The revision was prompted by HMSK-TR being collected under common technical guideline entitled TR13. TR10-01 therefore changes designation to TR13-03-02. Some texts dealing with organisational issues have been moved to internal governing document. New risk and vicinity zone boundaries for relevant voltages have also been introduced in the document. Likewise, clearer training requirements have been added. Section on blasting revised. Likewise, the section on cable installations and HVDC-plants.	2016-09-13
TR13-03-02 rev.2	Revision prompted by introduction of new ESA Instructed Person. Supplements added to procedures concerning work on underground cables. Certain editorial changes also made.	2019-04-30

Contents

1 Definitions

With regard to other definitions, please refer to the ESA Principles

Permit for special work	Written approval that non electrical work may commence on the building project
Nonconformity	Adverse incident or non-fulfilment of requirements: > Event where accident or incident has occurred or could occur > Observation of an error, a risk or a deficiency that can lead to an accident or emergency (risk-sighting) > Departure from working methods, practices, routine, legal requirements, etc. > Deficiency in product, service and delivery
Customer	The party who orders a product or service
Building and Civil Engineering Work	Work or activities which the Supplier carries out in the field under contract with Svenska kraftnät, cf. AFS 1999:3.
Operation notification	Written notice with information on planned changes to the operation that is not caused by electrical work.
Contractor	Companies that deliver more or less complete construction or maintenance services. Services may include materials.
HSEQ:	Work environment, electrical safety, environment and quality (security is excluded).
HVDC link	High voltage direct current link.
Consultant	Consulting company that provides services. Includes the role of Project Planner.
Supplier	Collective term for any company that has a contract with Svenska kraftnät and is supplying products/services. It includes Contractor and Consultant. Subcontractors can be different things but Svenska kraftnät is never party to the agreement.
Maintenance work	Maintenance of substations, lines, line corridors, cables, technical sheds and other installations, and safety rounds, where maintenance is a combination of technical and administrative measures, including monitoring, designed to maintain or restore an element to a state enabling it to perform a required function.
Subcontractor	Company that is a contractor or consultant, and party to agreement with a Svenska kraftnät's contracted Supplier.

2 Scope and responsibility

This guideline includes supplements and extensions when performing electrical work on, or in connection with, Svenska kraftnät's power plants, in addition to the requirements in the electricity industry's common electrical safety instructions ESA. 'ESA' refers to ESA (Principles + Work), ESA Instructed Person, ESA Clearing in line corridor – Forest, ESA Industry and Installation, and documents belonging to these publications. ESA, together with these supplementary guidelines, enables the employer, in cooperation with Svenska kraftnät's elanläggningsansvariga[1], to work safely on, in the vicinity of, or next to Svenska kraftnät's electrical plants.

In this guideline, the term supplier is used in instead of the term contractor which otherwise is used in ESA.

Systematic HSEQ requirements for building, civil engineering and maintenance work, storage operations, consultancy services in planning and design, and other similar commissions for Svenska kraftnät, can be found in TR13 -01, and apply in parallel with this guideline. Other HSEQ requirements are specified in Svenska kraftnät's technical guidelines series TR13-02.

Svenska kraftnät has adopted the electricity industry's common electrical safety instructions ESA. In accordance with ESA Svenska kraftnät makes the requirement that a supplier, who performs work on or near an electric plant, has adopted ESA.

Svenska kraftnät recommends that specific risk management measures are being taken as regards pregnant employees by work in connection with electrical equipment.

The requirements include the activities undertaken by Supplier under contract with Svenska kraftnät. Requirements also apply to all Subcontractors and consultants working on the assignment. The Supplier, with whom Svenska kraftnät has signed an agreement, is responsible for ensuring that the requirements in this document are followed.

Contractor and Designer/Consultant are referred to below as Supplier and Svenska kraftnät as Customer.

[1] Person responsible for an electrical installation (see section 6.2)

3 Specific requirements for electrical maintenance measures

3.1 Introduction

This guideline focuses on personal safety responsibility, and the supplements and adapted applications of ESA required for the Customer to meet regulatory requirements when carrying out maintenance operations on grid plants.

This guideline is designed to correspond to the section structure of ESA Principles and Work, ESA Instructed Person and ESA Clearing in line corridors - Forest. Because the guideline primarily addresses the supplements to and nonconformities from the ESA, some sections may be missing where Svenska kraftnät has no supplements or nonconformities in these sections.

Supplements, clarifications and special applications of ESA Principles

4 Terminology and tables

4.1 Vicinity and live working zone

4.1.1 Overhead line

The following tables are a complement to table 1 and table 2 of the ESA Principles with respect to overhead lines. Both following tables as well as tables in ESA are adapted to AC-system voltage (main voltage), but is also representative of the corresponding DC terminal-*to-earth voltage*.

Table 1. Minimum acceptable distance in mm to live working zone and vicinity boundaries. Nominal voltages used in Svenska kraftnät. The table complements the corresponding table 1 of the ESA Principles.

	220 kV (AC)	**400 kV (AC)**	**285 kV (DC)**	**300 kV (DC)**	**450 kV (DC)**	**500 kV (DC)**
Live working zone (mm)	1,600	2,700	2,000	2,200	3,000	3,400
Vicinity zone (mm)	3,000	4,300	4,000	4,000	5,500	6,400

Table 2. Safety distance from electric plant element without applying any working method. The table complements the corresponding table 2 of the ESA Principles. See also Figure 1.

	Lateral direction in metres(S)	**Height in metres(H)**
220-399 kV	6	4
400-440 kV	6.5	5.5
> 440 kV	7.5	7

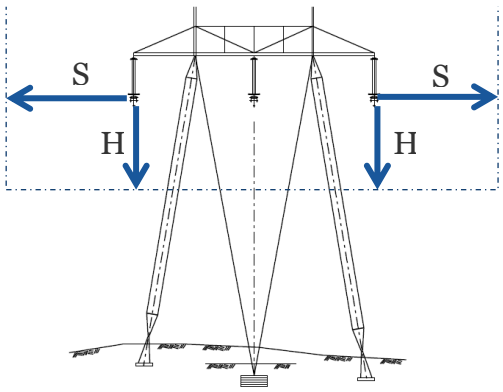

Figure 1 Sketch of safety distance definition in height (H) and lateral direction (S) from a line

4.1.2 Underground cables

In order to minimise various types of electrical risks, the Customer has introduced a *protection zone* of 15 metres from underground cables (see fig. 2). The Customer shall in good time be contacted for all ground works within this distance. The Customer also has a *safety distance for cables* of three (3) metres from the nearest cable. It must be possible for a representative of the Customer to be present inside this distance, to carry out risk management and to monitor the work. If risk management shows a high electrical risk, an elsäkerhetsledare [2]must be appointed. If necessary, the works must be interrupted so that the cable can be de-energised and the work can continue in a safe manner.

Within one (1) metre, uncovering of cables must be done with great care. Methods

[2] Nominated person in control of a work activity (see section 6.6)

of careful uncovering may include digging by hand, sand suction or other suitable method.

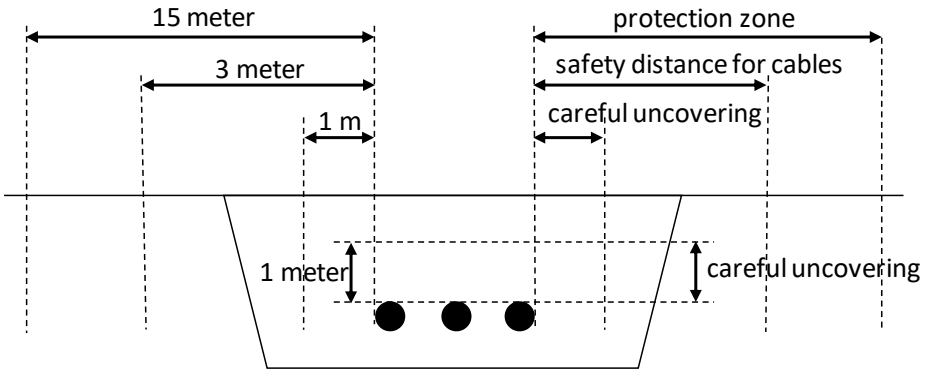

Figure 2 Sketch of how distances from Customer's underground cables are defined. Further information is available in Customer's Guide for operations on underground cables in the national grid.

Vertical drilling, powering down or drilling of pipes, plinths, poles or similar may not be carried out inside the safety distance for cables, i.e. closer than three (3) metres from a cable. More detailed information about the distance between the object and the underground cable can be read in the Customer's documents; Guidance for activities on underground cable in the grid to be found on the Customer's website.

5 ESA Education and skills

5.1 Competency requirements for working on or next to the Customer's electrical installations

All who work on or next to the Customer's electrical installations should have ESA-training according to the conditions and to the extent set out below. It is the responsibility of the Supplier to ensure that any subcontractors have the necessary ESA-training, as well as certified admission rights. Personnel who do not meet this level of training should be accompanied by ESA-trained person.

5.1.1 Execution of electrical work on or next to the Customer's electrical installations AC installations

Primarily relates to the Customer's maintenance suppliers who have experience and knowledge of current electrical installations, and to personnel connected to the Customer's building and construction work in operational plants.

- **Training/information:** ESA Skilled (Principles + Work). Knowledge of local access rules, plant-specific or local requirements, and the electrical hazards that exist for the specified electrical plant.
  For electrically skilled personnel carrying out tasks for the clearing of line corridors, section 12 in ESA Clearing in line corridor -Forest shall also be part of the training.

5.1.2 Execution of electrical work on or next to the Customer's electrical installations HVDC installations

Primarily relates to the Customer's maintenance suppliers who have experience and knowledge of current electrical installations, and to personnel connected to the Customer's building and construction work in operational plants.

- **Training/information:** ESA Skilled (Principles + Work). Knowledge of local access rules, plant-specific or local requirements, and the electrical hazards that exist for the specified electrical plant. For HVDC facilities special education applies, see section 8.3.
  For electrically skilled personnel carrying out tasks for the clearing of line corridors, section 12 in ESA Clearing in line corridor -Forest shall also be part of the training.

5.1.3 Execution of non-electrical work next to the Customer's electrical installations

Relates, for example, to telecom/data technician, personnel assigned to snow clearing, facility caretaking, security patrols, building and construction workers, or machine operators who independently perform tasks in operations areas or line plants.

- **Training/information:** ESA Instructed person. Exchange of ESA Agreement in connection with review of general safety regulations, local access rules, plant-specific or local requirements as well as other electrical or non-electrical hazards that exist for the specified facility. The review is carried out by the Customer's maintenance supplier or of representative appointed by the Elanläggningsansvarig Maintenance at the start up of a contract period, or of a specific job. In addition, profession-specific training may be relevant.

5.1.4 Execution of clearing work in line corridor

Relates to personnel conducting clearing work in the Customer's line corridors

- **Training/information:** ESA Clearing in line corridor -Forest

5.1.5 Execution of non-electrical work by non-professionals in operations areas or on line installations

Refers, for instance, to short-term building and civil engineering works, foundation or rack surveys, transportation, or other types of inspections and checks in operations areas or line corridor, etc.

- **Training/information:** Skilled personnel provide information concerning electrical hazard and a review of access rules and what electrical and non-electrical risk sources are present in the facility. After this, non-professionals must be accompanied by electrical professionals during their entire stay on the site.

5.1.6 Study visits in operations areas, or next to the Customer's electrical installations.

Concerns for instance study visits or other forms of guided tour of the Customer's station facility for electrical laymen

- **Training/information:** Study visits must be supervised by skilled personnel. No training requirements apply to visitors. Before visitors are granted access, a skilled person must go through local access regulations with them.
- **Age requirements:** Visitors under the age of 15 years must not be allowed access to the operations area.

5.1.7 Recommendation when electrically unqualified members of the public carry out work next to the Customer's electrical installation.

The recommendation refers to various types of work performed by an electrical layman near an electrical installation. Requester/ performer can be, for example, landowners, municipalities, government agency or supplier on behalf of any of these. The purpose can be, for example, land or construction work under power lines.

- **Training/information:** When presence next to an electrical installation has been requested or noticed, information on electricity hazard and applicable safety rules, local risks, as well as access restrictions, shall be given by The Customer's maintenance supplier or by representative appointed by the Elanläggningsansvarig [3]Maintenance. In order to clarify the electrical risks and provide a basis for a safe work approach the Customer recommends that staff is trained in ESA Instructed person.

[3] Person responsible for an electrical installation (see section 6.2)

5.2 Minor

Person under 18 years of age may, with the following exceptions, not be given access to operations areas:

- When the purpose is part of an instructor-led practice within secondary education or equivalent education for work with electric power plant
- When the task is performed by young people who have completed secondary education or equivalent education for work with electric power plant
- Study visits under supervision of skilled staff members appointed by the Elanläggningsansvarig Maintenance.

6 ESA functions

6.1 Organisation

Svenska kraftnät's Director General is proprietor and responsible for the operation and maintenance of electrical plants. In this position the Director General has delegated tasks to departmental heads in Svenska kraftnät.

6.2 Elanläggningsansvarig[4]

Within Svenska kraftnät the responsibility for electrical plant maintenance is organisationally divided among Elanläggningsansvarig Operations (head of operations) and Elanläggningsansvarig Maintenance (head of plant).

6.3 Eldriftledare[5]

In Svenska kraftnät, the on-duty operations operator at Nätdriftcentral Nord and Nätdriftcentral Syd are appointed as eldriftledare.

6.4 Switching supervisor

For work in the station installation's auxiliary power plant, the task of connection manager is procured from the Customer's maintenance suppliers.

6.5 Switching operator

The switching operator task is procured from the Customer's maintenance suppliers.

[4] Person responsible for an electrical installation
[5] Nominated person in control of an electrical installation during activities

6.6 Elsäkerhetsledare[6]

Elsäkerhetsledare in the Customer's electrical responsibility area must be Swedish-speaking. Exceptions to the Swedish-speaking requirement are made in the case of the Customer's foreign connections.

When an electrical coordination manager (see 6.7) has been appointed, the Elsäkerhetsledare need not be Swedish-speaking. Elsäkerhetsledare must, however, be able to communicate without difficulty with other participants in the team and with electrical coordination manager in a predetermined language.

6.7 Electrical coordination manager

The Customer does not require the Electrical coordinating manager and Elsäkerhetsledare to be employees of the same company.

Within the Customer the electrical coordinating manager task is to coordinate all Elsäkerhetsledare within the working area. If a BAS U is appointed, the electrical coordinating manager shall be his subordinate. The electrical coordinating manager should be Swedish-speaking but also able to communicate with the relevant Elsäkerhetsledare in a common, predetermined language. The electrical coordinating manager should have electrical safety skills equivalent to Elsäkerhetsledare. Unlike the Elsäkerhetsledare, the Electrical coordinating manager need not be in the workplace. In addition to what is specified in ESA, the electrical coordinating manager shall:

- coordinate electrical safety planning and risk management of works in collaboration with the BAS U, suppliers, customer, and any Elanläggningsansvarig for adjacent networks
- ensure that all electrical safety leaders have sufficient expertise
- be responsible for all communications with Eldriftledare
- receive the permit-to-work from Eldriftledare before the work and to provide permit-to-work to subordinate electrical safety leaders before the work
- receive Certificate of commissioning from subordinate Elsäkerhetsledare after finishing work, and leave the final Certificate of commissioning to the Eldriftledare
  after having received the Certificate of commissioning from Elsäkerhetsledare
- notify subordinate Elsäkerhetsledare about upcoming powering

[6] Nominated person in control of a work activity

7 Planning of work activities

7.1 Risk management

In risk management (Risk-Pl and Risk-Pe), particular consideration must be taken if the work must be carried out without all relay protection features functioning. The Eldriftledare shall immediately inform the Elsäkerhetsledare if a protection or safeguard interaction is out of order so that new risk assessment can be performed.

7.2 Tools, equipment and devices

For work with machinery and equipment next to energised electrical installations, it is important that these are earthed for work and potential equalised in order to reduce the effects of influence and induction.

7.3 Request for permit-to-work

Request for permit to perform electrical work shall be in the hand of the Customer's support function Operational planning under Elanläggningsansvarig Operations no later than ten (10) business days prior to start of work.
Comprehensive works at the Customer's cables, cable tunnels or cable culvert that require electrical safety measures, for example take out automatic reclosing system of operation, should also be applied for to Operational planning, ten (10) days before the start of the work.

Departure from this can be done by breakdown or other unforeseen events.

7.4 Operating order

Operating orders are issued within the Customer by Elanläggningsansvarig Operations for all planned switching in connection with electrical work; if time permits even by disturbances that require electrical work. If an order cannot be issued, a written directive is issued in the form of a switching order.

An operating order issued by the Customer is normally checked by two persons. A switching order made out by the Customer should always be checked by a person other than the issuer.

Operating orders should be in the hand of the staff concerned within three (3) working days before the switchings commence.

A change to an operating order issued by the Customer must be made in writing by means of a change notice or a new operating order. Change notice should always be checked and signed by other than the issuer.

New operating orders should be issued in the following cases:

- By more than two change notes
- Where new switching is required, such as change to delimitation
- In case of substantial changes in the operating order (e.g. several deletions/additional points).

Changes concerning the date, time and name of the elsäkerhetsledare may be made verbally, but must be stated clearly in the operating order.

7.4.1 Operating orders that involve switching actions in connection with nuclear power plants

Operating orders that include Forsmarks Kraftgrupp AB (FKA) and OKG AB (OKG) plant elements connected to Svenska kraftnät's 400 kV switchgear

According to special agreement the Customer's Elanläggningsansvarig Operations handles operational planning, switching and the issuing of operating orders, operating messages, and switching schedules for the Customer's plant elements in consultation with FKA and OKG.

FKA and OKG are responsible for operational planning, switching and the issue of operating orders and switching schedules for nuclear power plants, in consultation with the Customer.

The following applies for maintenance measures on interface equipment between the Customer and FKA alternatively OKG 400 kV system, unless otherwise agreed:

- Each company provides permit-to-work only for own equipment
- Each company never suspends blocking made in another's operating order
- The Customer disconnects and earth connects the 400 kV busbar and then submits switching confirmation to FKA or OKG for the busbar. Subsequently, FKA alt. OKG cancels the blockage and performs maintenance on the interface equipment.

Operating orders that include Ringhals AB (RAB) plant elements connected to Svenska kraftnät's 400 kV switchgear

Under a special agreement between Elanläggningsansvarig Operations in RAB and Elanläggningsansvarig Operations at the Customer's, the following principles apply, unless otherwise agreed in each specific case.

For VK51 Ringhals 400 kV switchgear the following applies:

- RAB is responsible for operational planning, switching and the issue of operating orders and switching schedules. This is done in consultation with the other Elanläggningsansvarig Operations in the facility.

For 400 kV lines between VK51 Ringhals and FT182 Strömma alt. FT58 Horred the following applies:

- The Customer is responsible for operational planning in consultation with RAB
- RAB establishes operating orders for the lines
- When working at 400 kV-lines or on line equipment in FT182 Strömma alt. FT58 Horred, the Customer issues a supplementary operating order for the work to be carried out.

7.5 Operation notification

Operations notice is not defined in ESA.

Within the Customer operations notice is issued by Elanläggningsansvarig Operations ahead of planned changes in the operating schedule that is not caused by the electrical work.

Operation notice may also be issued for:

- jobs that require a permit-to-work in writing,
- blasting in proximity to a grid facility,
- changes in the principles for operations monitoring, or
- changes in functions for system shield or relay protection and other control works (according to Svenska kraftnät's operations routines D1002 for control works for operations reliability).

Person(s) who have received an operations notice for action shall:

- Check these as appropriate
- Request explanation or a written change notice if anything is perceived as unclear or incorrect

  Confirm that the operations notice was received.

An operations notice shall include information on:

- Who issued the operations notice
- To whom is the operations notice intended
- Purpose and scope of the notice
- Notice validity period (maximum 1 year).

7.6 Switching confirmation

Switching confirmation or cancellation of switching confirmation to connected neighbouring countries may take place via prescribed confirmations in the Customer's operating order or standard forms established in the agreed language. The forms shall be exchanged with telefem routines.

7.7 Exchange of permit

7.7.1 Speech communication

For safety reasons, communications must always be maintained with Eldriftledare when working on or in connection with the Customer's electrical grid elements. This holds regardless of the nature of the work, such as forest clearing or similar. In places with poor mobile phone coverage other communication systems must be used, such as Rakel, or satellite communications.

7.7.2 Permit-to-work

The permit-to-work should always include information about for which ESA-work method the permit applies.

7.7.3 Permit for special work

Permit for special work is not defined in ESA.

Permit for special work must be requested from Elsäkerhetsledare of relevant Eldriftledare. A written risk management must be attached to the request. Permit for special work is issued immediately after a special evaluation by the Eldriftledare to the person responsible for the work.

Permit for special work;

- is a written authorisation that non-electrical work may commence on grid elements that may affect personal or operational reliability of the primary system, for example,
  - a switch actuator,
  - a relay protection circuit or similar
  - shall be issued for entry to tunnel, culvert or other space which is owned by the Customer and where the Customer's power cable is placed
  - shaft work within one meter from the underground cable
- also means that any specified safety measure will remain in place until the permit is cancelled

8 Operating measures

8.1 General

Arrival at and departure from an operations area, line corridor, cable tunnel or cable culvert must always be notified to the eldriftledare.

8.2 Switching

8.2.1 Switching with disconnectors

When operations are adjusted for reconstruction of the grid after a disturbance (test connecting) or in the event of load redistribution, the disconnector's contact status may be assessed by indication.

Manual operation of disconnectors, known as hand operation, may be carried out only in exceptional cases and only after completion of risk assessment and permission from Eldriftledare.

8.2.2 Emergency disconnection

Emergency disconnection is defined in ESA as immediate disconnection of supply voltage for rescue actions.
At the Customer's the measure is used as follows;

- as quickly as possible to raise the safety margins for rescue activity (for example when extinguishing land or forest fire in a line corridor, fire in switchgear, to bring person down from pole)
- emergency disconnection can also be performed as a direct switching action associated with acute and serious fault in an electrical installation. For emergency disconnection Eldriftledare disconnects the grid-part concerned with switch only. The plant element can, however, have a lower but still dangerous potential and must not be touched. If a completely electrically safe facility is required, disconnectors shall be opened and blocked and the plant element earthed for work according to normal procedures. If the emergency disconnection affects other Elanläggningsansvarig, he shall be notified without delay.

8.3 HVDC links

Electrical characteristics of HVDC links differ significantly from AC power plants. Similarly, the technical structures of individual HVDC plants differ from each other. The plant's technical conditions and specific risks therefore pose specific demands on the knowledge and skills of operations and maintenance personnel.
Only specially trained personnel with good knowledge of the actual system and its technical features may perform maintenance operations on the plant.

8.3.1 Maintenance measures in HVDC system

For maintenance operation in HVDC transmission facility, it is important to consider the following;

- Different plants and various components in each facility (ex. inverters, DC switchgear, cables, filter-components, etc.) have different discharge times. Functional control of discharge equipment shall be made before voltage test.
- Switching is made in varying extent of sequential switching activities where disconnection, blocking and earthing are elements in a chain of measures. These measures do not always follow the sequence given in ESA. Operation of individual
  elements is possible, but should be avoided for safety reasons, and should be done only with the permission of Eldriftledare. Before the switching confirmation is submitted to Eldriftledare, visual inspection shall be made that intended switching position is achieved.
- An interlocking device ensures that the HVDC facility valve halls are always disconnected on all sides and earthed for work before access is possible.
- Neutral lead on the SwePol Link is system earthed in Stärnö. These must always
  be earthed for work before being separated from the neutral point in Stärnö.

8.4 Cable installations

For operations on high-voltage cable risk management must take into account possibly parallel cables being deployed. Special consideration should be given to adjacent cable joints and the possible effect of induction. If risk assessment finds that the risk of injury is high, affecting power cable shall be taken out of service or the work should be stopped. If risk management allows, additional safety measures shall be carried out with shielding in order to limit any influence of joint breakdowns.

When refilling after maintenance actions on underground cable, certificate of commissioning shall be submitted only after protective refilling has been completed.

Supplements, clarifications and special applications of ESA work

9 Dead working – AUS

9.1 Planning for dead working

When working on the Customer's grid, account shall be taken that the line network can always be influenced by induction, either by its own parallel line stretches or by lines belonging to other Elanläggningsansvarig.

9.2 Risk management by demolition, pulling down and dismantling of electrical installation

Before the demolition of a the Customer's power plant, the Elanläggningsansvarig Operation shall ensure that disconnection measures are carried out. The Elanläggningsansvarig Maintenance is responsible for ensuring that the facility is subsequently dismantled by personnel
with knowledge of the electrical safety and under good electrical engineering practice. In this context, it is important to point out that the electrical system may constitute an electric danger from risks
such as;

- induction from parallel lines,
- crossing power lines,
- meteorological conditions, or
- other electrical risk.

The plant should be regarded as an electrical facility until these electrical risks are completely eliminated. Other requirements for demolition can be found in the Customer's technical guideline TR13-04-01 Requirements for environment and health.

9.3 Blocking (protection against re-energising)

Blocking of the Customer’s disconnecting circuit-breaker is done via remote or distance control. The circuit-breaker is blocked mechanically as well as electrically when manoeuvring via the control system. These two blocks can be done in one or two steps. Signage is done both through reliable indication on the actuator for the blockage, and indication in the control system. Signs and blocking should be inspected visually on the site.

9.4 Voltage testing

In installations with both AC and DC, voltage detectors shall be marked clearly to reduce the risk of mistake.

A voltage test on a DC installation's neutral conductor is, for technical reasons, impossible to conduct.

Voltage detector should be operated and controlled in accordance with the supplier's instructions.

9.4.1 Disconnecting circuit-breaker

Voltage testing according to ESA need not be performed in plants with disconnecting switch when earthing is done via remote or distance control. Before remote or distance control of the earthing for work may be made without prior voltage test, Eldriftledare/switching assistant shall ensure that no staff is present in the switchgear.

9.4.2 HVDC plant

Voltage testing should always be performed on heavy-current equipment for HVDC before work may commence. In connection with this, particular attention must be paid to the longer discharge time compared with AC plants. Voltage testing should be made with reliable voltage detection equipment intended for the current facility and plant part. It should be noted that a risk of mistake exists when selecting voltage detector. Voltage test of alternating current (AC) may take place only with a voltage detector designed for AC, while voltage test of direct current (DC) may only be carried out with equipment designed for direct current.

9.5 Earthing for work and potential equalisation at a work location

In the Customer's operating order, earthing for work is only applied in places from which voltage can be supplied. Elsäkerhetsledare is responsible for earthing for work and any potential equalisation at a work location.

By work which implies that previously applied work grounding loses its safety function, the Elsäkerhetsledare shall ensure that completive work earthing is installed as replacement for the previously applied work groundings. This can be done at work on capacitor units, carrier-frequency barrier, current transformer, jumper (attaching or removal), etc.

For some Customer's power plants, it is not possible to comply with the requirements of the succession laid down in ESA related to earthing for work.

9.5.1 HVDC links

A common feature of the Customer's HVDC links is interlocking devices. The interlocking device is a system whose function is to ensure that the valve halls are safe for people before access is possible.

In order to meet the technical requirements and design of the locking system, certain earthing for work needs, for example, to be mounted before the disconnecting switch is opened.

9.5.2 GIS switchgear

The 400 kV switchgear in Lindbacka is a GIS model and equipped with an interlocking chain that does not allow blocking before earthing for work.

9.5.3 Ajaure and Untra disconnecting circuit-breaker, as well as reactor circuit-breaker in Odensala

In these stations the disconnecting circuit-breaker is designed so that only an electric block takes place ahead of the earthing for work. Earthing for work and mechanical blocking are made thereafter in a single operation.

9.5.4 Sheathed power cable

By earthing for work of power cables in a grid facility, the cable connection points may be earthed for work with earthing tools with area corresponding to potential equalisation provided that the cable has been stripped all-around.

9.6 Earthing tool

Broken earthing tools or tool, which has been exposed to short-circuit/ earth-fault current, shall be scrapped.

9.7 Additional safety measures

By switching where disconnecting switch constitutes the work location boundary, the Elsäkerhetsledare may introduce an additional safety measure by affixing a lock on the actuator mechanical blocking. The Elsäkerhetsledare is responsible for removal of the lock before Certificate of commissioning is issued (or before the permit-to-work is returned).

10 Work in the vicinity of live parts – ANS

10.1 Risk management at performance (Risk-Pe)

For work by the ESA work method 'Work in the vicinity of live parts - ANS', Eldriftledare must, during the work, monitor the functioning of relay protection, relay protection communication, operations data network and operations monitoring system that is important for the execution and safety of the work. Shortcomings in these functions must immediately be notified to Elsäkerhetsledare, who will conduct a new Risk-Pe. If the risk assessment indicates increased risk levels, the work shall be stopped.

11 Live working-AMS

Work by the ESA work method 'Live working - AMS' is not permitted at the Customer's HVDC plants.

11.1 Risk management at performance (Risk-Pe)

For work in the vicinity of live parts – AMS, the Eldriftledare shall exercise risk management regarding relay protection communication, and the functioning of the operations data network, and operation monitoring system that is important for the work. Shortcomings in these functions must immediately be notified to Elsäkerhetsledare, who will conduct a new Risk-Pe. If the risk assessment indicates increased risk levels, the work shall be stopped.

Supplements, clarifications and special applications of ESA Clearing in line corridor -Forest

12 Clearing in power line corridor

12.1 General

Forest maintenance operations in all national grid AC-and DC power line corridors should be carried out as non-electrical work provided that necessary safety distances are maintained. If the specified safety distances cannot be maintained, the work should be performed as electrical work under any of ESA working methods Dead working – AUS or Working in the vicinity of live parts – ANS.

For safety reasons, communications must always be maintained with Eldriftledare when working on or in connection with the Customer's electrical grid elements. This holds regardless of the nature of the work, such as forest clearing or similar. In places with poor mobile phone coverage other communication systems must be used, such as Rakel, or satellite communications.

12.2 Work

12.2.1 Work in the vicinity of live parts – ANS

The work should be carried out as Working in the vicinity of live parts – ANS when part of the body, tools or vegetation is likely to come into the vicinity zone without reaching the live working zone.

Examples of such work are topping of tall trees under the phase wires. The work shall then be carried out so that the distance between the vegetation and live phase wire is determined by measuring before topping.

Due to the nature of the work method, topping with helicopter shall be conducted as
Work in the vicinity of live parts – ANS

12.3 Maintenance clearing of power line corridors

12.3.1 Maintenance of tree-safe wire

Tree safe power line denotes an overhead power line whose power line corridor is designed and maintained so that growing trees cannot reach closer to phase-conductors than the safety distance and no falling trees can come closer to any phase-conductor than 1 meter.

Direct current links with live and neutral conductor in the same masts are built with tree-safe power line corridor.

12.3.2 Mechanical clearing

Mechanical clearing must be carried out as non-electrical work, which means that no part of a machine or its load may come within the line's safety distance. If, in risk management in planning (Risk-Pl), it is judged that the work may come within the line's safety distance, the work must be carried out as Work in the vicinity of live parts (ANS) or
Dead working – AUS. In this type of work, it is important that locations for rods and masts are cleared and cleaned up to a diameter of three metres before the rest of the area is cleared by the machine.

12.3.3 Distance

The vegetation-free zone shall be at least equal to the current limit for vicinity zone depending on voltage according to table 1 page 10.

For use of lift in connection with clearing activities, see section 13-6.

Supplements, clarifications and special applications of ESA Instructed Person

13 Non-electrical work

Non-electrical work is any type of work outside the safety distance in question (see 4.1.1 table 2), irrespective of whether the work takes place inside the operations area or next to an electrical installation. ”Next to” refers to all work inside a line corridor. Depending on the design of the assignment, the relevant distance may extend beyond the immediate line corridor, but this will emerge from the employer's planning and Risk-Pl. All those who carry out non-electrical work professionally (Customer's own employees or Supplier's employees) in a station installation (operations area) or in a line corridor must be trained in ESA Skilled or ESA Instructed Person. Any non-professionals must be accompanied during the work by an ESA Skilled person.

13.1.1 Elanläggningsansvarig's representative

The Customer's maintenance supplier has the task of functioning as the elanläggningsansvarig's representative. The Customer's maintenance supplier must, in an internal procedure, ensure which persons have the authorisation to carry out the task of elanläggningsansvarig. Elanläggningsansvarig's representative must fulfil the following requirements:

- be electrically skilled and
- have the skills and experience necessary for the task.

It is the task of the elanläggningsansvarige's representative to inform the instructed elsäkerhetsledare before the start of non-electrical work. It is then the task of the instructed elsäkerhetsledare to pass the information in the agreement on to any additional personnel.

13.1.2 Instructed person

The following applies to an Instructed Person:

- In good time before the start of work, notify this to the Overall responsible for coordination
- Before entry to an operations area, cable tunnel or cable culvert, the elanläggningsansvarig's representative must provide supplementary information to the Instructed Person
- For entry into a line corridor involving:
  - work in a line corridor with machines, vehicles or equipment with a total height exceeding 2.3 metres, or

- work with bulky equipment which is judged to present a risk that a person plus equipment together may come inside the line's safety distance, the elanläggningsansvarig's representative must provide supplementary information to the Instructed Person.

> For work in a line corridor not covered by the above, training in ESA Instructed Person supplemented by Customer's access regulations for line corridors is judged to fulfil the requirements for 'Instructed'.

> Arrival at and departure from an operations area, line corridor, cable tunnel or cable culvert must always be notified to the eldriftledare.

13.1.3 Procedure for supplementary information to Instructed Person

The instruction must include the following elements:

> General safety provisions – see document ESA Access agreement

> Local access regulations – the Customer's specific regulations applicable to the station or line in question

> Local risks or restrictions in the work site
(e.g. known local risks, relevant minimum heights in relation to tools, vehicles or equipment, adjacent or crossing electrical installations belonging to another elanläggningsansvarig etc.)

> Any safety measures taken by a skilled person in the work site (e.g. barriers, shielding etc.)

> Any supplementary requirements for safety measures to be carried out by Elsäkerhetsledare before work begins (e.g. mechanical or electronic height restrictions to machines, crane areas, potential equalisation of tools),

> Review of relevant contact routes in accordance with ESA Access agreement

> Verification that all participants have up-to-date valid ESA certificates

> Signing of ESA Access agreement form

13.1.4 Procedure for handling ESA Access agreement

Copies of ESA Access agreement form must be saved:

> one by the elsäkerhetsledare at the work site and

> one by elanläggningsansvarig's representative

Special applications

14 Special applications for Svenska kraftnät plants

14.1 Electrical safety borders

The Customer employs the following policies for determining the limit of liability in electrical operations and switching:

- The border between proprietor's liability and plant responsibility coincides in the main with ownership. Border should be specified in the operating schedule.
- Border for switching responsibility shall be set so that it suits the two adjacent companies' Elanläggningsansvarig (Operation). Border for the switching responsibility must be clear and easy to observe. When determining the border, a switching device in the vicinity of the border between the electrical safety responsibilities should preferably be chosen, which in practice often means disconnector to the busbar. Nonconformities may occur with regard to design of the electrical plant or for organisational reasons. Border should be specified in the operating schedule.

The Eldriftledare who represents the owner of an equipment, e.g. transformer, is the only one authorised to operate the border unit. A departure from this rule may be
found in individual cases and should be agreed upon in writing between the relevant Elanläggningsansvarig (Operation). Operation of a border unit, as well as the cabinet switches, shall be made after consultation between the two neighbouring Elanläggningsansvarig (Operation).

14.1.1 Foreign links

When working on the submarine cable between countries, applicable principles are as follows;

- Swedish law applies within Swedish territorial water borders. Similarly, other country's law applies within its territorial water borders.
  In cases where the cable runs over international territory, the middle-principle applies unless otherwise specified, i.e. Swedish rules apply from the Swedish side to a contractually defined centre point on the cable.
- For overhead lines a contractually defined overhead line-post at the border applies as delimitation for the application of national laws or regulations.

For further detailed information concerning border delimitation, see the Customer's operating instruction D135.

For neighbouring countries communication in the English language is allowed by maintenance measures and communications assurance.

Due to our neighbouring countries ' regulations in some cases nonconforming from the Swedish regulatory framework, the earth connector on a border wire may need to be blocked in the disconnected position before Dead working – AUS.

14.2 Switching responsibility for certain types of facilities

For some types of power plants the supplier, with whom the Customer has signed an operation and maintenance contract for station facilities, has an automatic switching responsibility (without communications assurance) when he is called out for work and/or switching.

The supplier must himself ensure that a written directive is established. Before work or connections commence, the Purchaser's electrical operations officer shall be contacted
to authorise the work. Following completed work/connections, a report must be submitted to the Customer's
electrical operations officer. Any changes in the system or deficiencies detected will be reported as soon as possible to the Elanläggningsansvarig Maintenance according to established procedures.

The plants in question are:

- Auxiliary power plants (VS and LS-system) in grid stations where the Customer is the principal. Switching responsibility includes local transformer's low-voltage side (alt. transformer's auxiliary low voltage winding) and the other auxiliary power plant's low-voltage parts.
- Control plants, automation systems, as well as measuring systems belonging to the grid installations in grid stations, including secondary circuits on current and voltage transformers.

  Note 1. If an auxiliary power system, control system, automation system, etc. is affected by disturbance in the high or low-voltage network,
  the called supplier is responsible for promptly ensuring the station's protection functions (including special power supply
  to rectifiers and relay protection).

14.3 Blasting work next to electrical installation

14.3.1 Planning of blasting

By blasting next to a Customer's deployed electrical installation, risk management shall be made taking into account both blasting technical risks and risks associated with the installation's potential impact on charges and igniters. Given the importance of the electrical installation for society and the installation's electrical risks if damaged by blasting', this should also be taken into account when blasting next to an electrical installation.

Blasting shall be planned in accordance with current regulations from the Swedish work environment authority, good engineering practice in blasting-safety matters, and also in accordance with EBR IN068:16. Personnel who carry out blasting must have at least ESA Instructed Person skills certificate Alternatively, they must work under the guidance of an ESA Skilled person. An Instructed or Skilled elsäkerhetsledare must be available at the workplace.

When blasting within 100 meters from the Customer's switchgear, or overhead line (for underground power cable 20 meters), the blasting boss shall submit the blasting plan to the Customer's maintenance engineer at least three weeks before the blasting. Since blasting may pose a serious risk to electrical installations' construction and operation safety, the Customer may require a blasting technical review as well as equipment for vibration measurement.

Within a distance of 50 metres from the Customer's switchgear, overhead line or underground power cable, electrical ignition wires and detonator wires may not come in contact with the soil, as there may be risk of accidental ignition due to ground potential from the power line. Within this area, non-electric ignition system must be used as they are not initiated by electric fields.

When the plan for the proposed blasting has been submitted by the blasting boss to the Customer, the following measures shall be taken prior to the blasting:

- The acquisition of vibration measurement equipment if the Customer so requires.
- If the blast is expected to require interruption of the electrical installation or other electrical safety measures due to high risk factors, the blasting boss should submit request for permit-to-work (including risk management) to the Customer's unit for operations planning. The request should be in the hands of the Customer no later than ten (10) working days before the scheduled blasting.
- The Customer's unit for operations planning then informs involved staff, such as Eldriftledare, maintenance engineer, project manager, maintenance supplier

and supplier's blasting boss, with an operations notice about the blasting. The operations notice shall contain information on:

- Facility and location
- Time
- Contact details for blasting boss and Eldriftledare
- Management of reclosing automation
- If risk assessment indicates a risk of damage to installations, the blasting shall be carried out with interruption of the electrical plant; this should appear in the request for permit-to-work
- If risk assessment indicates the need for interruption of the electrical installation, the Customer's unit for operation planning issues an operating order for the disconnection of the plant part affected. The plant part does not need to be disconnected and earthed for work if the disconnection is only for operational safety reasons.

14.3.2 Conduct of blasting

Before blasting

- No later than two working days prior to blasting, the blasting boss requests a preliminary permit for blasting from the Customer's unit for operations planning
- The Eldriftledare takes automatic reclosing of the plant out of operation before blasting
- Blasting boss requests permission for blasting from Eldriftledare before charging
- Blasting boss informs Eldriftledare before blasting occurs.

After blasting

- Blasting boss reports to Eldriftledare about completion of blasting and about further work.
- The Customer checks measurement data from any vibration measurement

14.4 Flushing of switchgear

Flushing can be done using fixed flushing equipment or manually.

Flushing of switchgear can be implemented as Live working, Special live working (sAMS). Work may only be carried out by qualified skilled person who is trained in the current method for flushing of the switchgear. Whether the work is done with fixed flushing equipment or manual flushing, the following measures shall be taken;

- Employer plans the work, conducts Risk-Pl and appoints Elsäkerhetsledare. Elsäkerhetsledare shall be fully familiar with the work, the workplace and the equipment, as well as the applicable regulations, standards and guidelines
- Prerequisite for all works is that personal protective equipment is used, as well as that insulated tools and equipment for Live working can be used
- A request for permit-to-work should be made in writing to Eldriftledare
- When working on energised plant with automatic reclosing (såi, fåi or duba), the automation should always be shut off.
- To warn that Live working is in progress and to prevent connection of switched-off circuit breakers, indications should be placed in Eldriftledare's monitoring systems in the points where connection can be made.
- Permit-to-work is issued by the Eldriftledare to Elsäkerhetsledaren
- Risk management at performance (Risk-Pe) is made and documented before commencing work
- After finishing work Certificate of commissioning is issued.

When flushing with fixed flushing equipment the Eldriftledare shall ensure that automatic reclosing controls (såi, fåi or duba) are taken out of operation, both in the affected switchgear as well as in adjacent switchgear.

Manual flushing of switchgear should always be carried out by incoming wires being disconnected in the neighbouring stations. Earthing of switchgear or earthing for work is not required, however.

14.5 Splicing of earthing conductor or other earth connection

Earthing conductor damaged by digging or otherwise should be considered energised with potential. Splicing should be done by skilled staff and in accordance with ESA Work section Potential equalisation at a work location when cutting or splicing of wires.

14.6 Use of lift

For electric safety reasons lift for work in electrical switchgear and wiring must be selected on the basis of employer's planning and risk assessment when planning (Risk-Pl) for the current working location, its design and soil conditions, and other current working conditions.

Before starting work with lift, risk assessment (Risk-Pe) shall be carried out. When working with the method Live working – AMS, the lift must meet the requirements assumed by the work method.

Before movement of the lift, any roads shall be marked with safety barriers. The movement shall take place on the selected roads under surveillance, while keeping the selected safety distance.

By switchgear measures articulating boom lift, telescopic lift, or preferably scissor lift should be used. Lifts with boom giving a movement "behind" lift chassis/carriage should not be used due to electrical risks.

For line measures other lift equipment may be considered after planning and risk assessment.

- If telecom transmitters are present next to the work area, any operational problems with the lift caused by the transmitter's high-frequency electromagnetic fields must be included in the risk assessment and selection of lift. In work platform, which is electrically controlled remotely from the platform, control cable and control panel must be effectively shielded against electromagnetic fields.
- Lift shall be equipped with removal system suited to current soil conditions. Lift shall have good stability.
- When moving, the chassis shall either have earth braid to the ground for earthing of potential influence, or be earthed in the plant’s permanent earth connections.
- Chassis or load-bearing machine must be earthed in the plant’s permanent earth connections during manoeuvring or operation. Working basket should be connected to the load-bearing machine earth terminal. Intermediate booms should be potential equalised to carrying machine’s earth terminal.

14.7 The use of a crane or other bulky equipment

Crane or other bulky equipment for work in switchgear and on power line shall be selected on the basis of the employer's planning and risk management when planning (Risk-Pl) for the current working location, its design and soil conditions, and other current working conditions.

14.7.1 Movement

Before the movement starts or work is commenced next to a power plant, should;

- risk management at performance (Risk-Pe) be carried out.
- any roads be marked with safety barriers. Roads should be measured to prevent electrical risks before the relocation begins. The movement shall take place on the selected roads under surveillance. During movement the chassis should be earthed to the current plants fixed earth terminal.

14.7.2 Operation

Fixed or mobile cranes must not be positioned so that any part of the crane or its load can come within the safety clearance selected by the electrical safety leader. To prevent inadvertent movements the crane should be equipped with locking. If a crane without lock is used in places where faulty operation or failure can cause machine, cables, or load to come inside the safety distance, the work must be carried out in accordance with the selected ESA method.

- When manoeuvring, chassis or work object shall be grounded in the current plant's fixed earth terminal.
- Intermediate mast or booms should be potential equalised to carrying machine's earthing point. If telecom transmitters are present next to the work area, any operational problems with the lift caused by the transmitter's high-frequency electromagnetic fields must be included in the risk assessment and selection of lift.

14.7.3 Other bulky equipment

The above requirements also apply to the use of mobile concrete pumps, suction trucks, drilling rigs or other large machines in electrical environments where there is a possibility that the machine by its size may come within the safety distance.