Cable laying requirements

Ordering number: KRAV 05:17

September 2017

1. Foreword

The Electrical Safety Act 2016:732 and related ordinances and regulations came into force on 1 July 2017. The act contains requirements applicable to anyone carrying out electrical installations. The National Electrical Safety Board is the Swedish supervisory authority with regard to the obligations imposed on the various parties under the Electrical Safety Act and associated regulations.

The aim of the document is to account for the industry's competence requirements in the 'cable laying' activity type. In this document the term cable laying refers to the full scope of the 'cable laying' activity type according to the legal term defined by the National Electrical Safety Board.

The activity line pulling is often mentioned in the context of power cable laying, and that is why it is mentioned in this document. However, this should be regarded as being for information only and should not be regarded as constituting line pulling competence requirements.

September 2017

Energiföretagen Sverige – Swedenergy – AB

In all matters of interpretation, the equivalent Swedish publication will prevail

Contents

 | Ordering number: KRAV 05:17

2. Background

It is important for industry to have standardised rules governing the approach to underground cable laying.

The National Electrical Safety Board's amended regulation ELSÄK-FS 2017:3 shifts the responsibility in cable laying from the authorised tradesman to the installation company. The energy industry will therefore, through EBR, define requirements for cable laying work accordingly.

3. Legislation

The National Electrical Safety Board defines requirements for the 'cable laying' activity type primarily in the Electrical Safety Act 2016:732 and the Electrical Safety Ordinance (2017:218), supplemented by the associated regulation.

Scope of activity type

The following special activity types cover work on both low-voltage and high-voltage installations.

Electrical installation work in installations and sub-installations for the transmission of electricity via concessionary grids, limited to the following work:

- Laying underground cables.
- Installing cable boxes and posts.
- Installing earth terminals.
- Installing longitudinal earth wires.
- Line pulling and feeding of overhead cable.
- Simultaneously installing cables belonging to non-concessionary grids when carrying out installation work in accordance with the first paragraph.

The 'cable laying' activity type is exempt from the requirement to have a *compliance officer*. However, it is still subject to the other requirements relating to execution, the self-audit scheme and registration with the National Electrical Safety Board if the work takes place on an installation which is someone else's.

Self-audit scheme

All individuals and entities carrying out electrical installation work for business purposes are defined as electrical installation companies. The 'cable laying' activity type is exempt from the requirement in § 23 of the Electrical Safety Act to use an authorised electrical installation company, but the exemption does not extend to other requirements concerning execution, the self-audit scheme and registration with the National Electrical Safety Board. The self-audit scheme must include the organisation as well as the system, routines and other measures necessary in order to ensure that the company's electrical installation work is executed in accordance with the applicable rules. A self-audit scheme template is offered to Swedenergy's members. For other applicable rules and standards, see the section on regulations, standards and definitions in the most recent edition of the EBR publication entitled Cable laying up to 145 kV (KJ41) [*Kabelförläggning max 145 kV (KJ41)*].

In addition to the requirements set out in this document, work environment legislation and other legislation must be observed.

Figure 1. Legislation.

 | Ordering number: KRAV 05:17

4. EBR's competence requirements

General information

In its self-audit scheme, the company carrying out the cable laying work must be able to show that all personnel involved in work relating to cable laying have undergone appropriate training before being allowed to accept work orders from a grid operator. For example excavator operators, construction workers and truck drivers who handle cables.

Personnel carrying out work relating to cable laying must have undergone training and acquired the knowledge specified in the relevant document 'Cable laying requirements' [*Krav vid kabelförläggning*]. This knowledge must be attested by an EBR training certificate from the 'EBR Cable laying' [*EBR Kabelförläggning*] training course.

Figure 2. Example of a training certificate.
This certificate is only provided in Swedish.

Tasks, environments and situations in which tradesmen[1] work may be subject to additional training requirements from public authorities or recommendations from trade associations, for example Trafikverket's general rules [*Arbete på väg*]. The training course certificate is valid only for five years. After five years the training course should be retaken and the participant is given a new certificate.

1 Here, the term tradesmen does not just mean electricians but tradesmen in all trades.

General requirements for personnel who plan and manage the work

Personnel who manage the work in or close to a workplace in which cable laying is taking place must have undergone training and must have adequate knowledge, as attested by a training certificate from the relevant EBR training.

This means that basic knowledge has been acquired in the following areas:

- General understanding of the grid structure.
- EBR
  - Working methods as set out in the EBR publication entitled Cable laying up to 145 kV (KJ41) [*Kabelförläggning max 145 kV (KJ41)*].
  - Rules for cable laying as set out in the EBR publication entitled Cable laying up to 145 kV (KJ41) [*Kabelförläggning max 145 kV (KJ41)*].
  - Earthing as set out in Earthing structures for distribution grids and substations 0.4-24 kV (K25) [*Jordningskonstruktioner för distributionsnät och nätstationer 0,4-24 kV (K25)*].
  - Erection of power line poles.

If the work takes place close to an existing distribution grid, the person must have undergone the relevant electrical safety instruction (ESA in Swedish) training. This must be attested by a training certificate.

Specific requirements for machine operators

All machine operators involved in mechanised construction and maintenance of overhead lines must have undergone EBR machine operator training [*EBR Maskinförarintyg*].

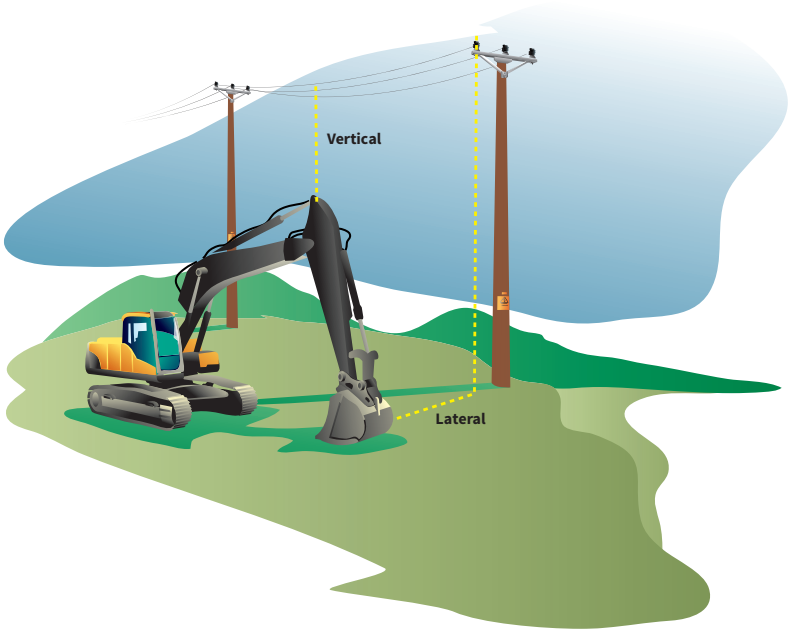

Figure 3.

 | Ordering number: KRAV 05:17

5. Work environment risks in cable laying and line pulling

Cable laying and line pulling work is often done at work places with other hazards and risks, for example close to roads, working at height and in urban environments. The work must be planned to eliminate or mitigate risks to a manageable risk level, and work environment management must follow the rules of the Work Environment Authority.

Electrical hazards

Electricity is dangerous because it cannot be seen, heard or smelled. In the event of an accident, the consequences can be serious or fatal, potentially also with loss, damage or injury to both property and persons.

Electrical accidents consist either of the passage of current (shock) or electrical arcs.

Causes of electrical hazards include crossing cables, crossing overhead lines, or electrostatic charge in the underground cable.

Passage of current

The person carrying out the cable laying/line pulling must have basic knowledge of the consequences of the passage of current and must be trained in first aid for electrical injuries.

Electrical arcs

The person carrying out the cable laying/line pulling must have basic knowledge of work activities involving an increased risk of electrical arcs, for example:

- Short-circuits in the installation.
- Short-circuits caused by tools and equipment.

In the event an electrical arc, mechanical forces may cause lines to oscillate, potentially injuring people and damaging machinery in their path.

Figure 4.

Electrical arcs may cause the release of highly toxic and hot metal vapours into the air, and the site must therefore be cleared.

Persons exposed to electrical arcs may suffer burns of varying degrees, with the temperature potentially reaching several thousand degrees. To limit the impact, personnel must wear full body clothing while working, made of flame retardant and electrical arc-tested material.

A short-circuit may also cause strong mechanical oscillations in lines etc. potentially injuring people in their path.

Induction and influence

Personnel carrying out cable laying/line pulling must have basic knowledge of induction and influence risks and how to protect against them.

Induction

A physical phenomenon that can occur between two parallel electric lines, in which one of the lines (the emitting line) is energised and transfers electrical energy. The other de-energised line (the receiving line) is affected by the energised line (the transmitting line), causing an induced voltage. The magnitude of the induced voltage depends on three factors: the length of parallel lines, the distance between the lines, and the current in the transmitting line. The amplitude of the induced voltage is harmful and could present a direct danger of death on contact.

When cables are laid, there is a risk that induction could create a voltage difference in the metallic parts of the cable (conductor, sheath) large enough to present a risk for personal safety. To avoid the risks, potential equalisation is necessary for all conductive parts.

Influence

A physical phenomenon causing steel structures and utilities to become charged through the influence of energised cables or natural phenomena.

The charging could be so significant that any contact with the charged steel structure, cable or other utility presents a hazard for people or can damage machinery.

Mechanical risks

Large mechanical forces can occur during line pulling and cable running work. It is important for these risks to be considered and assessed in order to avoid personal injury and material damage.

 | Ordering number: KRAV 05:17

Working at height

Personnel working at height must have the fundamental competence and relevant training for such work. Personnel working at height must have training in lowering casualties to the ground.

Risk management

Personnel involved in cable laying must understand all work environment risks associated with the work, and how to take a structured approach to eliminating the risk or minimising the impact. Risk management must be an integral part of day-to-day work. Risk management must address all possible hazards and must be described and documented in the work environment plan and the inspection plan.

Figure 4.

Third party hazards

The work must be carried out in a way that offers adequate protection against personal injury or material damage. This can be achieved with security measures and by closing off the working area.

6. Environment

Everyone involved in the cable laying activity must know how to handle situations in which environmentally hazardous waste is encountered.

Excavation work might uncover various items which affect the work, for example archaeological finds or old burial sites, or environmentally hazardous waste dumped at some time in the past and covered over, and potentially presenting a hazard to the people on site. It is not uncommon for old cables to be oil-filled, and cables can sometimes leak oil and contaminate the surrounding land. To determine whether cables contain hazardous materials such as PCB, oil samples may have to be sent to a suitable testing institute.

There are a number of EBR publications setting out in detail how to handle waste in the workplace:

- HMS 7:11 Material and waste handling in grid projects [*Material- och avfallshantering för projekt i elnätsbranschen*].
- HMS 3:08 Handling of oil-contaminated land [*Hantering av oljeförorenad mark*].
- HMS 4:09 Handling of cables at end of life [*Hantering av uttjänt kabel*].

The law (the Environmental Code [*miljöbalken*]) lays down how to handle and transport environmentally hazardous waste. Hazardous waste contains or consists of substances with hazardous properties. Some electrical cable types contain oil classed as environmentally hazardous waste. It is important for the waste to be handled correctly so it does not spread and potentially cause harm to people, animals or plants.

The Swedish Environmental Protection Agency web site has comprehensive information about hazardous substances and contaminated land. There is also a handbook entitled Hazardous waste, Handbook in accordance with the Ordinance on Waste [*Farligt avfall, Handbok enligt avfallsförordningen (SFS 2001:1063)*] with guidance on different types of hazardous materials andhow to handle them.

If bone remains are encountered, they could be from an old anthrax burial site. It used to be commonplace to bury animals infected with diseases, and the bacteria causing anthrax form resilient spores when they come into contact with air. The bacteria survive for a very long time in the ground, and cases have been documented in which the infection reactivates after 75 years of dormancy. Grazing ruminant animals that come into contact with the spores are at the greatest risk of infection. Terminate all work activities and contact the Environmental Protection Agency.

If buried containers are encountered, they may contain chemicals or similar substances from industry that have been dumped in the environment. Terminate all work activities and contact the emergency services and the environmental administration of the local authority [*Kommunens miljökontor*].

Methods and considerations must be described in and documented in the work environment plan and the contractor's inspection plan.

! **Cables which have been damaged or uncovered must always be handled with great care and, without exception, reported to the utility owner.**

 | Ordering number: KRAV 05:17

7. Cable laying

The necessary expertise is essential so that everyone involved can plan and carry out correct work activities in the 'cable laying' activity type.

The publication is a handbook for cable laying and covers structures for the laying of power cables and colocation of power cables, telecommunication cables and optical cables. The expertise must cover structures and must raise awareness of the forces and the hazards associated with the work.

Figure 6.

Cable laying personnel must take care with the equipment they are handling. Considerable assets are managed, and the finished installation is required to work reliably throughout its long service life, often more than 40 years.

It is important for personnel to be aware that they represent the grid operators, and to act in a responsible way. They must ensure that the working area is demarcated, and exclusion zones are created such that vehicles or pedestrians are not at any risk of falling into trenches or entering the danger zone close to moving parts of machinery.

Care must be taken not to damage or uncover cables or pipelines of other utility owners. A layout plan showing utilities of all types must be requested before work commences.

Care must be taken during excavation in the vicinity of utilities. If utilities of a third party are exposed, the owner must be contacted and appropriate steps considered.

If something unexpected happens, the utility owner must be contacted without delay and if someone is injured the emergency services must be called immediately.

8. Other

Underground utilities check

To reduce the number of cables damaged and uncovered, you are recommended to use the free underground utilities checking service [*Ledningskollen*]. It is designed for people planning digging and excavation work and is a quick and easy way to obtain correct information from all affected utility owners (www.ledningskollen.se).

 | Ordering number: KRAV 05:17

9. Appendices

Appendix 1: Example of wording in procurement

Appendix 2: Instructor requirements

Appendix 1. Example of wording in procurement

A new regulation on electrical safety came into force on 1 July 2017. From that date, the supplier carrying out electrical installation work must be registered with the National Electrical Safety Board. Also from this date, the supplier must operate a self-audit scheme for electrical installations containing the following information at least:

- Which electrical installation activities are performed by the company.
- Confirmation that there is adequate competence for each task.
- Confirmation that there is an electrical installation company with the correct authorisation (exceptions are possible).
- Who has/have been named compliance officer(s) for electrical installations.
- How prerequisites, system knowledge and the client's technical requirements are planned in electrical installation work.
- How inspections of the electrical installation work are planned.
- How inspections of the electrical installation work are performed.
- How the self-audit scheme is followed up and updated over time.

At the client's request, the supplier must be able to present relevant parts of the self-audit scheme for inspection.

 | Ordering number: KRAV 05:17

Appendix 2. Instructor requirements

General information

Purpose

The general purpose of the training is to create a sound basis upon which electrical systems can be installed in a safe and quality-conscious way.

Objective

After completing the course, the trainees will have acquired knowledge of the EBR's requirements applicable to cable laying.

Target group for the training

This training is relevant for all personnel involved in the laying of cables for general electricity distribution, but not employed in a company with its own authorised electrical contractor (for example excavator operators, construction workers and truck drivers, etc.). Note that this also includes supervisors and planning personnel.

Requirements from EBR

The training must be given by an instructor who has completed instructor training approved by Energiföretagen Sverige – Swedenergy – AB, and it results in a valid course certificate. Training can only be provided if knowledge and skills are maintained through practical experience and refresher training.

Refresher training for instructors must take place every three years.

Prior knowledge and maintaining competence

No prior knowledge required. However, there are refresher training requirements in accordance with the relevant documents, and competence requirements applicable to the instructor.

Training content

The time commitment for the training should be at least one working day (at least 8 hours).

The following items should be included in the training:

1. Relevant legislation

2. EBR's competence requirements

3. Work environment risks associated with cable laying

4. Environmental considerations relating to excavation and work on utilities

5. Cable laying as set out in the EBR publication entitled Cable laying up to 145 kV (KJ41) [*Kabelförläggning max 145 kV (KJ41)*]

6. Self-audit

7. Excavating close to existing cables

The emphasis should be on the main items (3 – 5), and the other items should be adjusted so they relate to the main items.

Depending on the role/experience of the participants, the training will emphasise different parts of each item.

Knowledge evaluation and certificate

A knowledge evaluation will be carried out. More details are available in the training materials provided by Energiföretagen Sverige – Swedenergy – AB.

Energiföretagen Sverige – Swedenergy – AB issues a certificate if the knowledge evaluation is passed.

Register

Energiföretagen Sverige – Swedenergy – AB keeps a register of successful trainees. This means that the course agreement must include consent for the storage of personal data.

 | Ordering number: KRAV 05:17

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EBR publications can be ordered at
www.svenskenergi.se/webbshop