

## Operation- and maintenance manual

# Lahmeyer Compactstation®

## Type LCS-E.7

Doc.-No.: T152A19.1



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## 1 Safety instructions

Please read these instructions before using the device and store them.

Installation, initial start-up and operation of the substation have to be done by qualified personnel, trained in use of MV-switchgears, transformers, LV-panels, and in accordance with the appropriate regulations and standards.



Following safety rules acc. to DIN VDE 0105 shall be observed:

- 1) Disconnect mains!
- 2) Prevent reconnection!
- 3) Test for absence of harmful voltages!
- 4) Ground and short circuit!
- 5) Cover or close off nearby live parts!

## 2 Use and technical instructions

The compactsubstation **type LCS-E.7** is used as network and customer substation and is IAC-qualified with certain MV-switchgears **IAC-AB 20kA, 1s**.

Requirements for proper and safe application:

- adequate transport and properly loading and unloading, as well as storage
- professional installation and initial start-up
- carefully operation and service by qualified personnel
- take notice of this manual
- compliance of safety- and operation instructions on site, regulations and standards of the utility or grid operator, as well as national standards



Please note, according to EN 62271-202, that in case of installation inside a substation the transformer must not be steady operated with nominal power. The transformer has to be operated with reduced power depending on ambient conditions and the housing class of the substation.

Equally, the LV-switchgears are subject to a reduction of the nominal current depending on ambient conditions.

### Torque precepts for screw connections

The given values apply all connections of housing and other parts, as far as no other precepts of the manufacturer are specified.

|           | Steel screw, zined   | Stainless steel screw A2-70   |
|-----------|--|---|
|           | setscrew<br>metric coarse pitch DIN 13, part 13<br>strength class: 8.8 | setscrew<br>metric coarse pitch DIN 13, part 13<br>strength class: 70 |
| Dimension | Torque $M_A$ in Nm   | Torque $M_A$ in Nm  |
| M5        | 5,9  | 4,2   |
| M6        | 10,0   | 7,3   |
| M8        | 25,0   | 17,5  |
| M10       | 49,0   | 35,0  |
| M12       | 85,0   | 60,0  |
| M14       | 135,0  | 94,0  |
| M16       | 210,0  | 144,0   |

### Torque precepts for cooper busbar- and cable lug connections

The given values apply all connections of copper busbars and cable lugs, as far as no other precepts of the manufacturer are specified.

|           | Steel screw, zined   |
|-----------|--|
|           | setscrew<br>metric coarse pitch DIN 13, part 13<br>acc. to SGB FV 8001 |
| Dimension | Torque $M_A$ in Nm   |
| M8        | 25,0   |
| M10       | 40,0   |
| M12       | 60,0   |
| M16       | 80,0   |

The substation follows the technical rules mentioned below:

|                                      |  |
|--------------------------------------|--|
| DIN VDE 1000                         | General guiding principles responsible to security of technical products   |
| DIN VDE 0101                         | Heavy current gears with rated voltages over 1 kV  |
| DIN VDE 0105-100                     | Operation of heavy current plants  |
| EN 60071-1<br>(VDE 0111 part 1)      | Insulation co-ordination - Part 1: Definitions, principles and rules   |
| EN 60071-2<br>(VDE 0111 part 2)      | Insulation co-ordination - Part 2: Application guide   |
| EN 60445<br>(VDE 0197)               | Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals and conductor terminations |
| DIN EN 60947-1<br>(VDE 0660-100)     | Low-voltage switchgear and controlgear<br>Part 1: General rules  |
| CENELEC HD 603 S1/A3                 | Heavy current cables; part 603: Distribution cables of rated voltage U0/U 0,6/1 kV   |
| CENELEC HD 620 S1/A3                 | Heavy current cables; part 620: Distribution cables with extruded insulation for rated voltages from 3,6/6 (7,2) kV to 20,8/36 (42) kV               |
| DIN EN 61442<br>(VDE 0278-442)       | Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7,2 kV) up to 36 kV (Um = 42 kV)                                   |
| EN 60529<br>(VDE 0470 part 1)        | Degrees of protection provided by enclosures (IP code)   |
| EN 60076-10<br>(VDE 0532 part 76-10) | Power-transformers; part 10: determination of sound levels   |
| DIN VDE 0660 part 514                | low voltage-switch device combinations; protection against electric shock; protection against direct accidental touch of dangerous active parts      |
| DIN EN 62271 part 1<br>(VDE 0671-1)  | High-voltage switchgear and controlgear<br>Part 1: Common specifications   |
| EN 62271 part 202                    | High-voltage switchgear and controlgear - Part 202: High voltage/low voltage prefabricated substation  |
| EN 61230<br>(VDE 0683 part 100)      | Live working - Portable equipment for earthing or earthing and short-circuiting  |
| DIN EN ISO 12944                     | Paints and varnishes - Corrosion protection of steel structures by protective paint systems  |
| DIN 4102                             | Fire behaviour of building materials and building parts  |
| DIN EN 14598                         | Reinforced thermosetting moulding compounds - Specification for Sheet Moulding Compound (SMC) and Bulk Moulding Compound (BMC)                       |
| VDE 0100                             | standards for low voltage installations  |
| DGUV order 3                         | Accident prevention regulation: electric installations and means of production   |

The regulations of the water regime law (WHG = „Wasserhaushaltsgesetz“) of the Federal Republic of Germany and the regulation concerning electromagnetic fields; 26. BimSchG (federal immission law) are fulfilled.

### 3 Substation-housing

Temperature class (with 630kVA) = 15 K

The Compactsubstation **type LCS-E.7** is, as all Lahmeyer Compactstations®, a prefabricated and single-tested unit. It contains Medium-voltage-, transformer- and Low-voltage-compartment. Normally the Compactsubstation is ready-to-connect when delivered, meaning that MV- and LV-grid-cable connection works, in some circumstances the insertion of fuses and other on-site-works (e.g. protection device tests), have to be done for operation-readiness.

**3.1** The substation housing of type LCS-E.7 is made from bended steel sheet construction and consists of:

- base pan with integrated oil collecting pan, welded oil tight, subsequently hot-dip-galvanised and powder-coated; skirting panels are the border to the ground
- two cross beams from bended steel sheet for carrying MV- and LV-equipment, mounted on base pan
- easy detachable roof (only one screw in LV-compartment)
- lockable push plug(s) (access to transformer compartment)
- housing, incl. doors and cover panels for MV- and LV-compartment, fully mounted detachable from base pan.

**3.2** Material and surface treatment

Exterior (in ground): Oil collecting pan: Steel sheet 4 mm, hot-dip galvanised (>750g/m<sup>2</sup>) and powder-coated (Zinc 70µm, coating >70µm)

skirting panels: Steel sheet, 2 mm, coil galvanised (>225g/m<sup>2</sup>)  
100 % porefree double powder-coating  
(Zinc 70µm, coating >140µm)

Exterior (above ground): Steel sheet, 2 mm, coil galvanised (>225g/m<sup>2</sup>) and powder-coated >70µm

Interior (above ground): Steel sheet, 2 mm, coil galvanised (>225g/m<sup>2</sup>)

Surface treatment: Computer-driven powder-coating-system and 5-Zone-pretreatment result in coatings >70 µm. The used powder-paints are free from heavy metal and non-toxic.  
Zinc and powder paint = highest corrosion-protection

Standard colour: Olive green (RAL 6003 - structured)

Notice:

The coating can be lacquered by the user in other colours, using special liquid lacquer.

The given corrosion-protection is not affected then.

**3.3** All connection elements of the housing are corrosion-resistant.

**3.4** The transformer compartment is accessible by push-plug. Doors to other rooms are mounted with three hinges each (adjustment see chapter 9.3).

The doors and push-plugs are electrical connected with the housing and part of the earthing concept. They have metal swivelling levers, designated for built-in of profile cylinders. They are protected by rain lids. The cylinders are not part of delivery (unless otherwise stipulated).

The doors can be installed left- and right-handed. This can be changed on site.

Lockable opening angles are 90° and 135°.

**3.5** Degree of protection (IP-Code)

closed compartments IP 54  
around louvers IP 23D  
LV-panel IP XXA or higher

- 3.6** The Compactsubstation type LCS-E.7 can be lifted and transported completely equipped. Lifting lugs are at the base pan. (see lifting and transport drawings)
- 3.7** All installed metallic parts are connected to the earthing. Main earthing point is the base pan. At LV-side is a PE-busbar in TN-S-system.
- 3.8** The MV- and LV-compartment can be equipped with lighting, switched by door contact (optional).

## 4 MV-switchgear

The LCS-E.7 is suitable for use of SF6-gas-insulated switchgears or air-insulated HV-fuse-compartment (make SBG).

| switchgear-type              | max. configuration | make               | nom. voltage | insulation |
|------------------------------|--------------------|--------------------|--------------|------------|
| HV-fuse-compartment          | for 2 cables       | SBG                | 12 / 24 kV   | Air        |
| 8DJH                         | 2 C + 1 T          | Siemens            | 12 / 24 kV   | SF6        |
| FBX                          | 2 C + 1 T          | Schneider Electric | 12 / 24 kV   | SF6        |
| MINEX®-C with Driescher-ABS® | 3 C + 1 T          | Driescher Wegberg  | 12 / 24 kV   | SF6        |

abbreviations: C - cable feeder  
T - transformer feeder, with HV-fuses



Depending on condition of the grid, the MV-switchgear can be live, when doors of the MV-compartment of the substation are opened.

**Working on live, hazardous contactable parts** of the installation are allowed only  
- after establishing a voltage free condition (5 safety rules, see chapter 1)  
- if made by persons, trained for live works.

Gas-insulated MV-switchgears can be tested for absence of hazardous voltages by integrated voltage detection systems.

For air-insulated HV-fuse-compartments the use of hand-held voltage detectors is necessary. Please take notice of voltage-range-qualification!



## 5 Transformer

Hermetic-sealed oil-filled transformers  $\leq 630\text{kVA}$   
Dry-type transformers  $\leq 250\text{kVA}$   
maximum dimensions L x W x H = 1250 x 900 x 1650 mm (incl. protective range)

Transformers stand in the base pan on slip-resistant pads and are fixed without screwing. The transformers will be fastened additionally with belts.



### Transport restraints:

The transformers are fixed with belts. These can be removed, but have to be refixed if the substation is lifted or transported again.

Prefabricated and tested MV-cables made of N2XS(Y) 35mm<sup>2</sup> CU RM / 16mm<sup>2</sup> CU RM, 12/24kV, connect transformer and MV-switchgear.

The LV-connection is made by high-flexible, 3kV-isolated cables, type NSGAFÖU, subject to rated power.

### Installation or replacement of a transformer

When installing or replacing a transformer, be careful that MV- and LV-side are disconnected, voltage-free and earthed! The transformer has to be lifted out of the substation.



### Procedure and advises:

- Unscrew the red marked roof-fixing screw in the top door frame, push the roof ca. 100 mm to LV-side and detach the roof.
- Demount the IP-protection-wire frame from above transformer compartment.
- Open push-plugs longside of the substation.
- Lift out the transformer, if present.
- Insert slip-resistant pads, if not present (it can be necessary to use bearings extensions for small transformers).
- Bring in transformer (without rolls), make connections and earthings, affix transport restraints.  
Notice equipment-specific regulations!
- Connect and adjust any protective devices, respectively establish function readiness.
- Test torques of connections and terminals.
- Mount the IP-protection-wire frame.
- Attach and lock in place the roof, fix the screw.
- Close push-plugs longside of the substation.

The upper housing can be removed completely after detaching the roof, if necessary.



## 6 Low-voltage-distribution panel (LVP)

The low-voltage-distribution panels of our Lahmeyer Compactstations® can be individualised to customer requirements within the technical possibilities and limits.

In common, the LVPs are built safe for back-of-hand (IPXXA, acc. to VDE 0660-514). Therefore, service and operation of the LVP may be done by electrically qualified persons with personal protection equipment and electrical qualified tools only.



Depending on condition of the grid, the LV-panel can be live, when doors of the LV-compartment of the substation are opened.

**Working on live, hazardous contactable parts** of the installation are allowed only

- after establishing a voltage free condition (5 safety rules, see chapter 1)
- if made by persons, trained for live works.

Indicating instruments, fuses and terminals are installed at a separate panel in the LV-room mostly. Other devices can be wall- or top-hat-rail mounted.

The N/PEN- and PE-busbars, respectively the main earthing bar, for connection of all earth conductors inside the substation and the outer earth conductor, are placed in the bottom area of the LV-compartment.

The cable holders for fixation of the power cables are placed at the cable compartment below.



**Notes to main devices (depending on technical specification):**

### **Circuit breaker (ACB, MCCB)**

Tripping units have to be adjusted to estimated nominal and short-circuit tripping times and values, before startup operations!

### **LV-fuse-switch-disconnector / LV-strip-type fuse-switch-disconnector**

have to be equipped with appropriate LV-fuses before startup operations. Mind the selectivity!

Risk of burns! Fuses reach very high temperatures during operations!

### **Outgoings** (standard width 50/100mm)

have to be equipped with appropriate LV-fuses before startup operations. Mind the selectivity!

The insertion and extraction of LV-fuses into/out of NH strip-fuseways may be done in a voltage free condition only! The use of strip covers is recommended.

We recommend the use of LV-strip-type fuse-switch-disconnectors because of their higher user protection. These can be switched under load, which is live working!

When Installation and replacement of outgoing takes place, please pay attention to tightening torques as specified by the manufacturer.

### **Synchronization sockets**

to synchronize emergency standby power systems for short-time-operations with supply network.

### **Auxiliary-power-inlets**

to bring in connection cables from any auxiliary power unit

### **Socket(s)**

for service

**Residual current device (RCD) / fuses / miniature circuit breaker (MCB) / motor circuit breaker**  
to protect devices and circuits; partly sealable

**Uninterruptible power supply (UPS)**

supply devices, e.g. for protection purposes, with auxiliary power in case of loss of the mains voltage.  
UPS-installations can be live and supply other devices long time after loss of the mains voltage!  
Therefore, they have to be disabled before working in the substation takes place!

**Protection- / detection-devices**

have to be parametrized, adjusted and tested before startup operations!  
In some cases they have to be externally supplied (per UPS or auxiliary power unit), e.g. if under voltage circuits exist!

**Meter boxes**

for installation of tariff meters, different data modems; sealable

**Multifunction-devices**

for display/signalling/storage/logging of type-dependent data (U, I, P, Q etc.).

**Voltmeter**

for momentary value display of voltage.

**Analogue ampere meter**

for display of momentary/maximum current values. Scales can be changed, depending on type.

**Plug-in current transformer (CT)**

meters the electric current for displaying-/tariff metering-/ protection-purposes and can be selectable (type-dependent).

Quantity of plug-in-CT's (default opening 50x10mm) in standard LVP's with incoming LV-strip-type fuse-switch-disconnector:

L1 and L3: max. 1 piece each

L2: max. 2 pieces

When equipped with a LV-tariff metering only one more CT is mountable.

Mounting is possible on backside of the main/incoming strip-type fuse-switch-disconnector (see right photo). The access is possible from the transformer compartment.

Quantity of plug-in-CT's in LVP's with LV-fuse-switch-disconnector or circuit breaker:

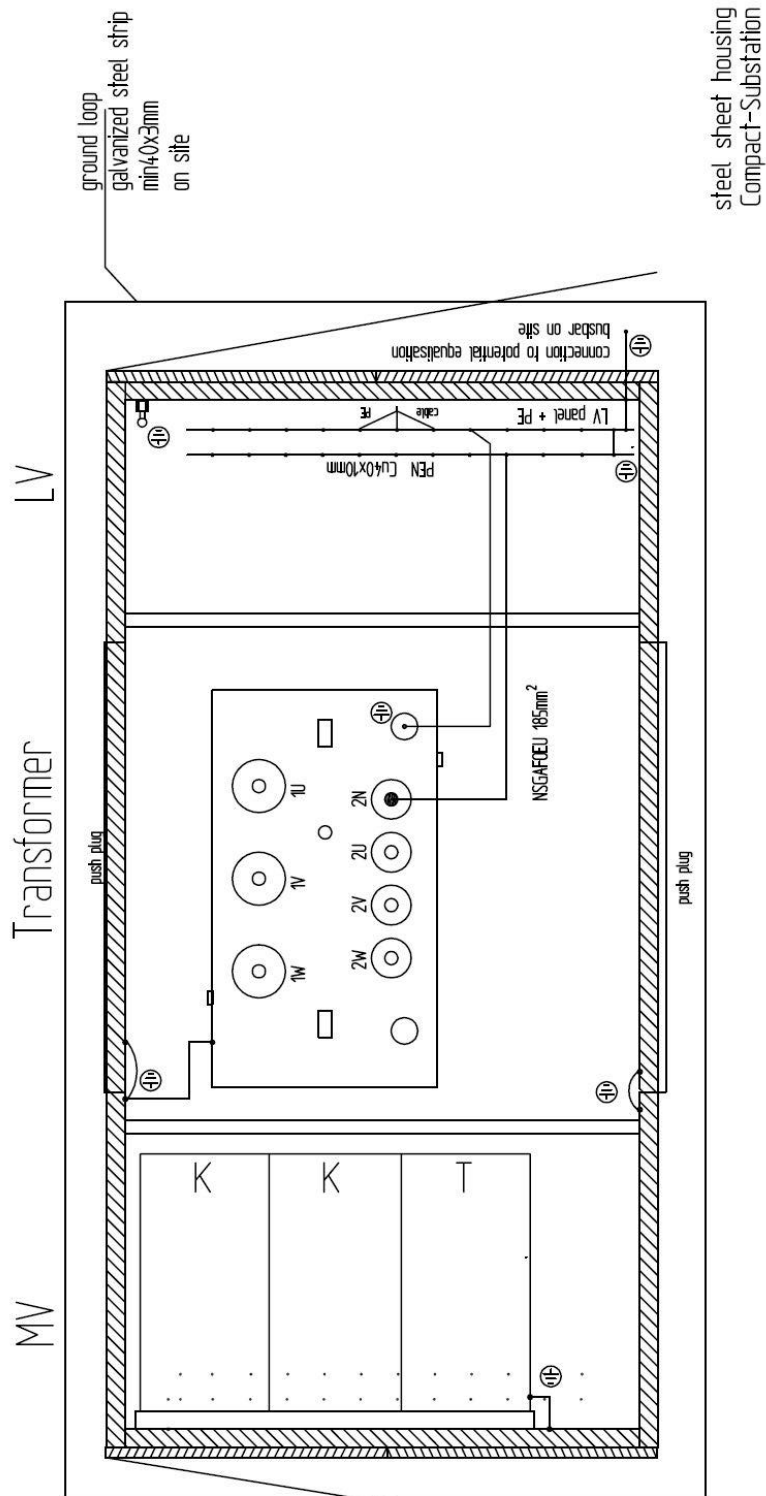
L1, L2 and L3: up to 2 pieces, depending on specification of the substation

Mounting is possible on busbars above or underneath main switch.



## 7 Earthing

The main earthing busbar can be found in the LV-room. The outer earth conductors have to be connected here (outer earth distance to substation approx. 0,5m - 1,0m). Thereby, all housing parts and the base pan are connected with the main earthing.



PE-connections:  
H07V-K 70mm<sup>2</sup>

## 8 Transport, deployment and installation

The LCS-E.7 is fabricated ready-to-connect and single-tested, if not negotiated otherwise. Transport, foundation, positioning and installation have to be done on the basis of technical documents as dimension sheet, lifting plan, foundation plan and transport plan.

**8.1** Positioning on site:  
see documentation "set-up conditions"

**8.2** Definition of the excavation depth has to be done under consideration of terrain height and condition, as well as surface water.

**8.3** The excavation may have a sustainable ground. Surface irregularities have to be levelled by a planar sand bed. In case of difficult ground conditions, a foundation made from lean concrete is recommended.

Under some circumstances, it may be necessary to adjust the doors. A tutorial is given in chapter 9.3.

**8.4** The lifting of the substation into the excavation may be done by use of proper lifting equipment. The LCS-E.7 can be lifted fully equipped. Please mind our information in "set-up conditions".

**8.5**  **Please attend for cable connection:**

- Aluminium-conductor-LV-cables may be mounted by cable lug onto bolts only; mounting with steel-frame clamps is not permissible!
- Steel-frame clamps may not be used for more than one conductor!
- Pay attention to the tightening torques!

**8.6** Cable connection MV-side:

- Dismount front panel of the base pan
- Detach cable compartment covers of MV-switchgear according to manufacturer's advices
- If necessary, dismount bottom door frame (unscrew sideways)
- Loosen front bottom plate (with prepared cutouts)
- Connect cables and fasten them by use of cable clamps, connect screen wire where required

**8.7** Cable connection LV-side:

- Dismount front panel of the base pan
- If necessary, dismount bottom door frame (unscrew sideways)
- (If provided) loosen front bottom plate
- Connect cables and fasten them by use of cable clamps, connect screen wire where required

**8.8** Transport restraint:

Transformers are fastened with transport belts additionally. These can be removed, but have to be reassembled in case of anew lifting or transport of the substation.

## 9 Maintenance and care

### 9.1 Cleaning and care

The materials of the substation are high-resistant and weatherproof. Powder-coated surfaces have to be handled carefully and cleaned gently. Do not use cleaner with abrasive additives. Use water and detergent.

### 9.2 Maintenance

Maintenance of the installation with her specific kind regarding safety rules, scope and dates of inspections and maintenance work to be performed is subject to local law and local (especially environmental) conditions.

Further manufacturer recommendations for routine inspections and maintenance:



**Always follow the applicable safety rules!**

- Periodic visual control, to spot potential damages on or in the substation
- Check if ventilation openings are free from dust and dirt, to assure air
- Clean dirty surfaces with thermal emission
- Check alignment and correct closing of the doors
- Check sealings for fitting and damages
- Periodic check of electrical connections and earthing connections

If there are no regulations, e.g. by law, operator or utility company, then we recommend a period for inspection and revision not longer than once per year, at least for visual check and cleaning.

For maintenance purpose of single components please see the relevant manuals!

### 9.3 Adjustment of doors

Safe closing of the doors is given, when the doors alignment is parallel to bottom edge of the roof. If this is not the case, little adjustment of the doors can be made.

The doors have three hinges each. The middle hinge is mounted in a round hole. The top and bottom hinges are screwed in horizontal elongated holes.

Cutouts in the sideways door frame allow loosening of the screw-nuts for the top and bottom hinge with an open-end wrench, to adjust the door.



## Confirmation

according to §5 par.4 of the accident prevention regulation „Elektrische Anlagen und Betriebsmittel“ (DGUV Vorschrift 3) (electrical installations and equipment)

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FROM :

**Sächsisch – Bayerische Starkstrom-Gerätebau GmbH**

**Ohmstraße 1**

**08496 Neumark**

**Germany**

It is confirmed that the electrical installation / the electrical equipment of production

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**Lahmeyer Compactstation® type LCS-E.7**

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corresponds to the requirements of the accident prevention regulation „Elektrische Anlagen und Betriebsmittel“ (DGUV Vorschrift 3) (electrical installations and equipment).

This confirmation does not dispense the operator of the installation or equipment from testing it before startup operations or in determined periods from begin of service, e.g. regarding easing of screw connections and the like by transport (according to §5 par.4 of DGUV Vorschrift 3).

# Risk assessment

## Product: Lahmeyer Compactstation®

| No. | Risk              | Danger spot                            | Description of danger   | Risk before  | Description of measure  | Risk after  |
|-----|-------------------|--|---|--|---|---|
| 1   | Direct touching   | Electrical equipment of the substation | When touching live parts, this person's life and health are acute endangered.                                 | <ul style="list-style-type: none"> <li>- Risk: high</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul>    | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- identification</li> <li>- professional design and constructing, assembly and testing</li> <li>- protection by housing</li> <li>- protection by insulation of live parts</li> <li>- routinely maintenance and recurrence inspection</li> </ul>  | <ul style="list-style-type: none"> <li>- Risk: middle</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul> |
| 2   | Indirect touching | Electrical equipment of the substation | When touching parts, that are live by occurring failures, this person's life and health are acute endangered. | <ul style="list-style-type: none"> <li>- Risk: high</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: high</li> </ul>     | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- identification</li> <li>- professional design and constructing, assembly and testing</li> <li>- testing before startup</li> <li>- protection by housing</li> <li>- protection by insulation of live parts</li> <li>- routinely maintenance and recurrence inspection</li> <li>- transport instructions, installation and maintenance manual</li> <li>- protection against indirect touching</li> </ul>                 | <ul style="list-style-type: none"> <li>- Risk: middle</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul> |
| 3   | High voltage      | Electrical equipment of the substation | When approaching live parts under high voltage, this person's life and health are acute endangered.           | <ul style="list-style-type: none"> <li>- Risk: increased</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: often</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: high</li> </ul> | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- identification</li> <li>- professional design and constructing, assembly and testing</li> <li>- testing before startup</li> <li>- protection by housing</li> <li>- protection by insulation of live parts</li> <li>- routinely maintenance and recurrence inspection</li> <li>- transport instructions, installation and maintenance manual</li> <li>- proper disconnection of the substation from supplies</li> </ul> | <ul style="list-style-type: none"> <li>- Risk: middle</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul> |



# Risk assessment

## Product: Lahmeyer Compactstation®

| No. | Risk                          | Danger spot                            | Description of danger  | Risk before   | Description of measure  | Risk after   |
|-----|-------------------------------|--|--|---|---|--|
| 4   | Thermal emission or particles | Electrical equipment of the substation | When approaching thermal emissions or proceedings, as projecting molten particles or chemical proceedings while short-circuits, overload etc., this person's life and health are acute endangered. | <ul style="list-style-type: none"> <li>- Risk: increased</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: often</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: high</li> </ul>              | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- identification</li> <li>- professional design and constructing, assembly and testing</li> <li>- testing before startup</li> <li>- protection by housing</li> <li>- overload protection</li> <li>- short circuit protection</li> <li>- electric arc protection</li> <li>- routinely maintenance and recurrence inspection</li> <li>- transport instructions, installation and maintenance manual</li> <li>- proper disconnection of the substation from supplies</li> </ul> | <ul style="list-style-type: none"> <li>- Risk: minor</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul>           |
| 5   | Emission: frequencies         | Electrical equipment of the substation | When approaching emissions with low frequency, radio frequency etc., this person's health is acute endangered.   | <ul style="list-style-type: none"> <li>- Risk: middle</li> <li>- Extent of damage: heavy injuries</li> <li>- Duration of stay in danger zone: often</li> <li>- Possibilities to recognize and avoid: rarely possible</li> <li>- Probability to occur: high</li> </ul> | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- professional design and constructing, assembly and testing</li> <li>- testing before startup</li> <li>- protection by housing</li> <li>- routinely maintenance and recurrence inspection</li> <li>- transport instructions, installation and maintenance manual</li> </ul>   | <ul style="list-style-type: none"> <li>- Risk: minor</li> <li>- Extent of damage: heavy injuries</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: middle</li> </ul> |
| 6   | Third persons                 | Electrical equipment of the substation | Danger to life and health and possible destruction of the substation by unauthorized startup and use.  | <ul style="list-style-type: none"> <li>- Risk: increased</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: often</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: high</li> </ul>              | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- identification</li> <li>- protection by housing</li> <li>- routinely maintenance and recurrence inspection</li> <li>- transport instructions, installation and maintenance manual</li> </ul>   | <ul style="list-style-type: none"> <li>- Risk: minor</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul>           |

# Risk assessment

## Product: Lahmeyer Compactstation®

| No.                           | Risk                                | Danger spot                 | Description of danger  | Risk before  | Description of measure   | Risk after  |  |
|-------------------------------|-------------------------------------|-----------------------------|--|--|--|---|--|
| 7                             | Strength of parts of the substation | Surrounds of the substation | Danger to life and health and possible destruction of the substation in case of inappropriate transport and lifting proceedings. | <ul style="list-style-type: none"> <li>- Risk: increased</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: often</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: high</li> </ul> | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- identification</li> <li>- professional design and constructing, assembly and testing</li> <li>- routinely maintenance and recurrence inspection</li> <li>- transport instructions, installation and maintenance manual</li> </ul> | <ul style="list-style-type: none"> <li>- Risk: middle</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul> |  |
| 8                             | Loading points                      | Surrounds of the substation | Danger to life and health and possible destruction of the substation in case of inappropriate transport and lifting proceedings. | <ul style="list-style-type: none"> <li>- Risk: increased</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: often</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: high</li> </ul> | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- identification</li> <li>- professional design and constructing, assembly and testing</li> <li>- routinely maintenance and recurrence inspection</li> <li>- transport instructions, installation and maintenance manual</li> </ul> | <ul style="list-style-type: none"> <li>- Risk: middle</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul> |  |
| 9                             | Lightning                           | Surrounds of the substation | Danger to life and health and possible destruction of the substation in case of lightning strike.                                | <ul style="list-style-type: none"> <li>- Risk: increased</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: often</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: high</li> </ul> | <ul style="list-style-type: none"> <li>- Installation, startup, operation and maintenance only by qualified personnel</li> <li>- professional installation</li> <li>- testing before startup</li> <li>- protection by housing</li> <li>- routinely maintenance and recurrence inspection</li> </ul>  | <ul style="list-style-type: none"> <li>- Risk: middle</li> <li>- Extent of damage: death</li> <li>- Duration of stay in danger zone: rarely</li> <li>- Possibilities to recognize and avoid: possible</li> <li>- Probability to occur: minor</li> </ul> |  |
|                               |                                     |                             |  |  |  |   |  |
|                               |                                     |                             |  |  |  |   |  |
|                               |                                     |                             |  |  |  |   |  |
|                               |                                     |                             |  |  |  |   |  |
| <b>Measures adequate: YES</b> |                                     |                             |  |  |  |   |  |