Gæðaskjal GSK-1061
Date of issue: 26.3.2014 Revision no.: 1.0
Responsible: Einar Friðgeir Björnsson
Editor: Örvar Ármannsson

NA-06-STS002

SPECIFICATIONS FOR LOTOV OF ELECTRICAL EQUPMENT

Doc. no. NA-06-STS002

This Standard Technical Specification is subject to change without prior notice. The most current issue will at all times be located on the Norðurál web site, www.nordural.is.

Contents

1 Responsibility

This Standard Technical Specification (STS) is of responsibility of the owner. The revision and date of issue are on the front page.

All deviations from the specifications must be approved in writing by the Owner.

2 Scope and Field of Application

2.1 Scope Definition

This Standard details the minimum technical requirements including but not limited to, the design, material quality and workmanship, installation, testing, inspection and identification for safety isolation switches for electrical equipment.

2.2 Document Conflicts

Any conflicts between the referenced documents shall be identified to the Owner in writing for resolution.

3 References and Definitions

3.1 References

All equipment, materials, workmanship, design calculation and tests shall be performed in compliance and read in conjunction with the NA-00-STS001 General Technical Standard and other relevant standards.

The relevance order of standards shall be according to NA-00-STS001.

All materials intended for use at Norðurál shall be approved by the Owner.

The following referenced documents should be considered for the application of this document. For dated references, only the edition cited applies. For all references, dated and undated, the latest edition of the referenced document (including any amendments) applies.

Standard nr.	Subject/name
ÍST EN ISO 1037:1995	Safety of machinery – Prevention of unexpected start-up
ÍST EN ISO 12100:2010	Safety of machinery – General principles for design, risk assessment and risk reduction
ÍST EN ISO 13849-2:2008	Safety of machinery – Safety-related parts of control systems – Part 2: Validation
ÍST EN 60204-1:2006	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
ÍST EN 60947-3:2009	Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units

Table 1 – References/Standards

3.2 Abbreviations

- AKS Aluminum Kennzeichen System
- CAT Risk evaluation category of safety isolation switch control
- EN European Norm (CEN)
- HMI Human Machine Interface
- IEC International Electrotechnical Commission (CENELEC)
- ÍST Prefix for Icelandic Standards
- LOTOV Lock Out, Tag Out and Verify
- PLC Programmable Logic Controller
- SCADA Supervisory Control And Data Acquisition

4 Prevention of Unexpected Startup

To ensure that an energy source has been safely isolated from equipment, the safety process of Lock Out, Tag Out and Verify is used. This safety process is abbreviated as LOTOV at Norðurál, and will be referred to as so in this technical specification.

Before any maintenance can be performed on equipment, it must be isolated from all energy sources as well as the energy source of incoming and connected equipment and the potential hazard neutralized. This is to prevent any hazardous situation during maintenance. These energy sources include e.g.

- Electrical energy
- Mechanical power
- Hydraulic power
- Pneumatic power
- Thermal energy
- Pressure vessels
- Gravity
- Potential energy

This is in accordance with Norðurál LOTOV procedures as well as Icelandic regulations and European standards. Further definitions are according to *ÍST EN ISO 1037:1995 Safety of machinery – Prevention of unexpected start-up*.

4.1 Electrical Equipment

This technical specification only applies for electrical equipment, e.g. motors, heaters etc. Circuit breakers in electrical panels are excluded and shall be according to NA-06-STS001 Low Voltage Standard Technical Specification. All high voltage equipment is also excluded and not included in this standard technical specification.

In order to perform maintenance safely, all electrical equipment shall include lockable safety isolation switches that allow for isolating the equipment from the incoming electrical supply. The design shall be based on risk assessment and this technical specification.

This technical specification includes information on owner approved safety isolation switches, standard installation and safety documentation to be provided with the equipment.

Furthermore, disconnecting device shall be provided as required by *ÍST EN 60204-1:2006 Safety of Machinery – Electrical Equipment of Machines – Part 1: General Requirements*. The supply disconnecting device shall be in accordance with recommendations of *ÍST EN 60947, Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*.

4.2 Risk Assessment

A formal risk assessment shall be carried out by the work provider. The risk assessment for the safety isolation switches only covers the risk that is relating specifically to this standard technical specification. All electrical equipment must be analyzed and evaluated in order to assess the risk associated with performing inspections and maintenance on it.

Other risks shall be assessed as well according to *ÍST EN ISO 12100:2010 Safety of machinery – General principles for design, risk assessment and risk reduction*.

Safety isolation switches may not be needed in the following situations:

- Where there is insignificant or no risk caused by electrical supply, according to the risk assessment.
- Where equipment can be disconnected safely by unplugging the electrical cord (e.g. smaller equipment and mobile/handheld equipment).

5 Owner approved Safety Isolation Switches

All safety isolation switches shall be front operated and lockable by a padlock in the OFF-position. Standard sizes shall be used for safety isolation switches, depending on if they are plastic enclosed or aluminum enclosed.

Plastic enclosed safety isolation switches shall be one of the following sizes:

- 25 A
- 75 A
- 160 A
- 250 A

Aluminum enclosed safety isolation switches shall be one of the following sizes:

- 45 A
- 90 A
- 160 A
- 250 A.

Aluminum enclosed switches shall be used outside and in adverse conditions.

Other safety isolation switches shall not be used, unless accepted by Owner.

6 Installation and connection

6.1 Standard Installation

Installation shall be carried out according to the approved risk assessment. All safety isolation switches shall be installed in a standard way in order to assist the users intuitively identifying and accessing them, e.g. by the power cable being visible the whole way from the switch to the equipment connection point.

- The safety isolation switches shall be placed next to the respective electrical equipment.
- They shall at all times be accessible by anyone needing to isolate the equipment.
- They shall be placed at a standard working height, preferably 1,4 m from floor level.
- No safety isolation switch shall face upwards or downwards. The safety isolation switch shall always face towards the access point.
- The safety isolation switch shall be easily seen and not obstructed.

According to *ÍST EN 60204-1:2006 Safety of Machinery – Electrical Equipment of Machines – Part 1: General Requirements*; “The operating means (for example, a handle) of the supply disconnecting device shall be easily accessible and located between 0,6 m and 1,9 m above the servicing level. An upper limit of 1,7 m is recommended.”

Each safety isolation switch shall be mounted on a standard sized bracket. The bracket is designed to be mounted on the front of a 200 mm cable tray and fastened securely.

- The bracket shall be made of 3 mm thick hot dip galvanized steel.
- Height of the bracket shall be 500 mm.
- Width between sides shall be 200 mm, so it is fixed to the outer sides of the cable tray.
- The depth shall be 100 mm, allowing other cables to pass behind it.

The safety isolation switch shall be placed on the middle of the bracket and space allowed for a marking label, see section *7.1 LOTOV Instructions*. The standard installation of a safety isolation switch on a bracket can be seen in *Figure 1,* as a principle drawing for 200 mm wide cable trays.

All exceptions from these specifications shall be approved by Owner.

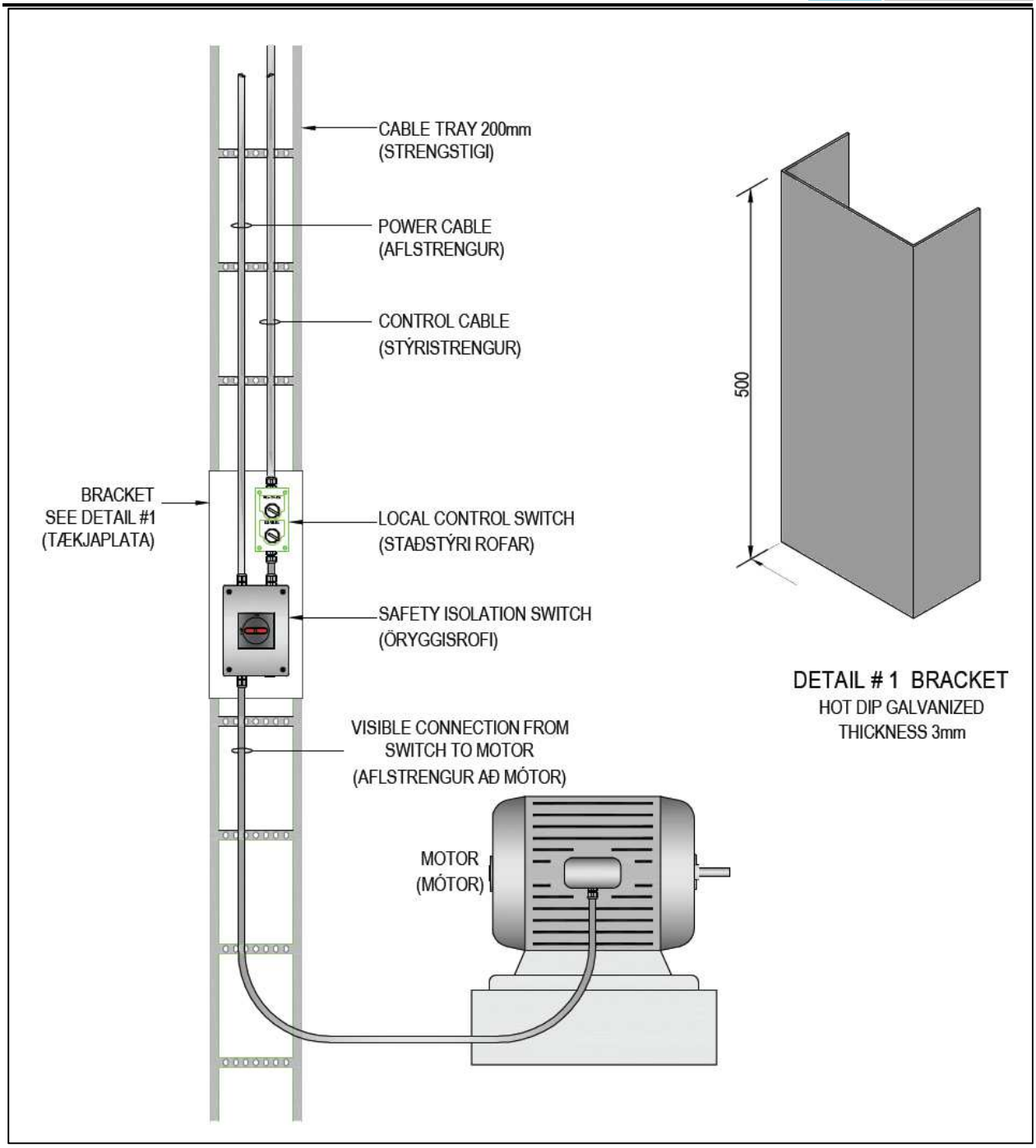


Figure 1: The safety isolation switch is installed on a standard size bracket next to the equipment, e.g. according to this typical arrangement figure.

The safety isolation switch power and control cables shall be connected according to Norðurál Technical Specification NA-06-STS001 Low Voltage Standard Technical Specification.

6.2 Connection

The safety isolation switches shall be connected according to respective CAT category and according to appended standard drawings.

- CAT B, 1 and 2 shall be connected according to section *8 Appendix 1 – CAT 2*.
- CAT 3 and 4 shall be connected according to section *9 Appendix 2 – CAT 4*.

Programming into PLC shall be according to Norðurál Standard Technical Specification NA-07-STS009 PLC programming

The state of the safety isolation switch shall be displayed according to Norðurál Standard Technical Specification NA-07-STS011 SCADA programming.

7 Handover

Before equipment can be handed over to Owner for operation the following documentation and commissioning shall be completed, at minimum.

7.1 LOTOV Instructions

The LOTOV instructions are to be used as a check list to ensure that all power sources, to specific equipment have been made safe prior to maintenance or inspection. This applies to all energy sources listed in section *4 Prevention of Unexpected Startup* and shall consider all equipment affected by or affecting the equipment. Overview drawings for main areas will be supplied by the owner. All equipment (motors, conveyors etc.) shall be marked and numbered on the overview drawing for the respective area. The numbers on the overview drawing reference a set of equipment that corresponds to the respective instruction sheet in the LOTOV instructions (see *Figure 2*).

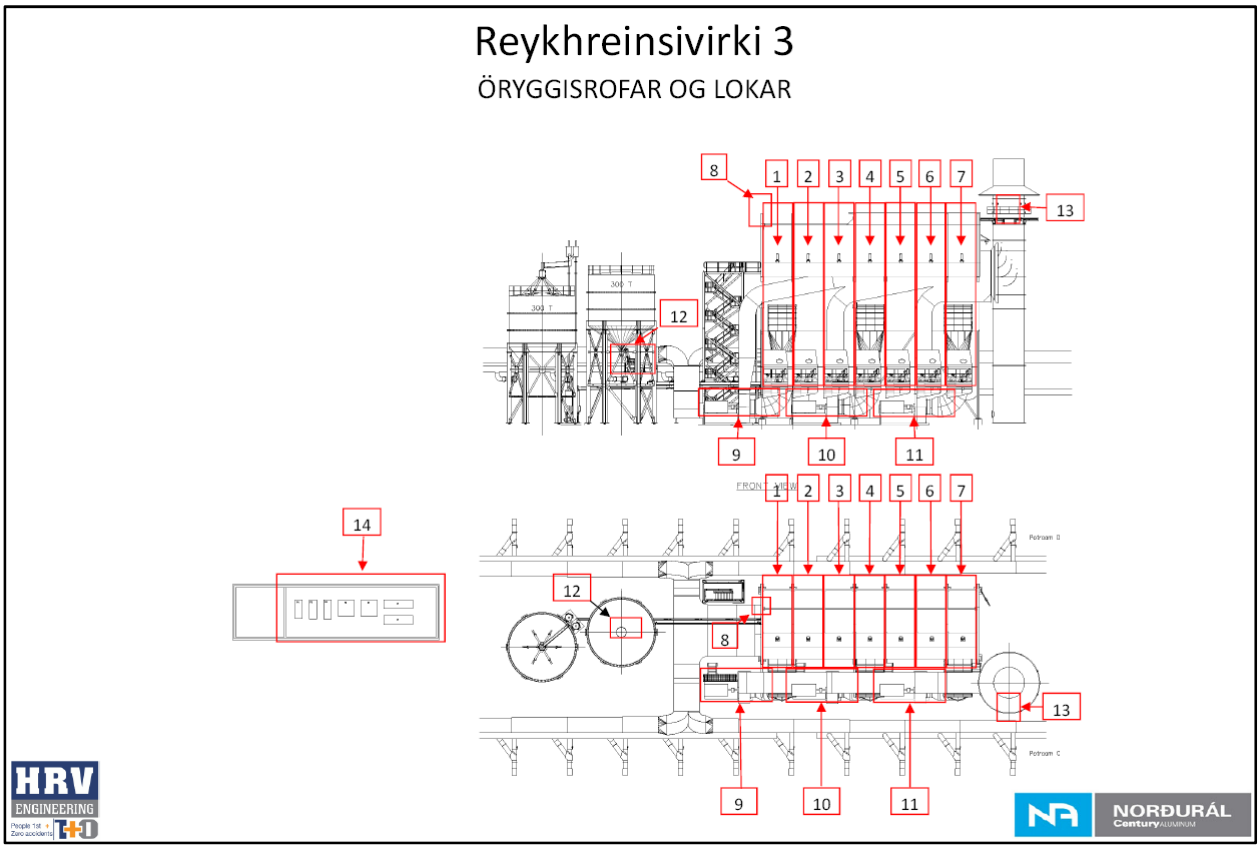


Figure 2: Example of an overview drawing showing equipment location

The overview drawing shall demonstrate the position and size of the relevant equipment in the working area. All text in the LOTOV instructions shall be in Icelandic. The font of the LOTOV instruction sheet shall be according to the following:

- The font type shall be Calibri and the font size varies from 8 to 28 pts.
- All headlines shall be size 28 pts., explanation below a headline shall be 18 pts.
- The numbers indicating the information location on the overview drawing shall be size 11 pts. as well as other text.

There shall be a LOTOV instruction sheet for each set of equipment, identified by the AKS code, in the overview drawing of the LOTOV instructions (see *Figure 3*). The LOTOV instruction

sheet shall include photos or drawings of the relevant equipment and position of all switches, valves etc. used to ensure safety during maintenance and inspection. Numbered arrows indicate the position of switches and valves. These numbers refer to a table in the upper left corner of the instruction sheet. This table shall include information that corresponds to the LOTOV labels on the equipment. The contents of each respective numbered column shall be:

1. The equipment AKS code, supplied by Owner.
2. The number identifying the location of the lockable safety device, which shall be unique for that equipment or area to avoid confusion.
3. The name or description of the equipment, which shall be in Icelandic.
4. The type of lockable safety device (safety switch, valve, etc.), in Icelandic.
5. The complete motor AKS number, correlating to the electrical drawings.

In the upper right corner a list of various safety advices regarding this specific equipment, highlighted in yellow, shall be filled out in cooperation with Norðurál. A template for the LOTOV instructions, both the overview drawing and LOTOV instruction sheet, can be provided upon request.

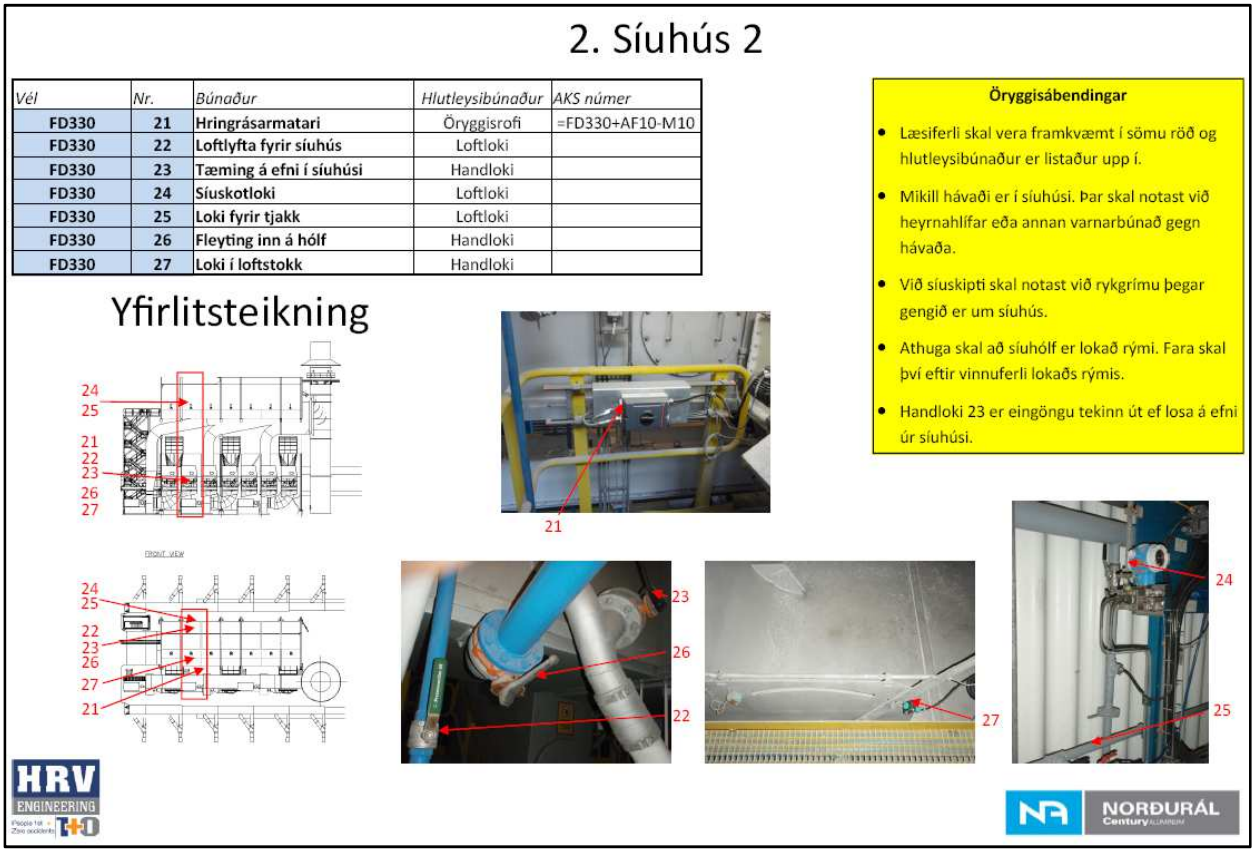


Figure 3: Example of LOTOV instruction sheet for equipment safety

Special considerations have to be made regarding all equipment adjacent to the locked out equipment, so it cannot cause any accidents while maintenance is being performed. The LOTOV instruction sheet shall include all relevant equipment that shall be locked out before maintenance is performed. If there are many LOTOV instructions, a table of contents shall be made and placed after the overview drawing.

Each safety isolation switch shall be labeled corresponding to the LOTOV instruction sheet. The label shall be placed on the safety isolation switch bracket, if possible, otherwise on the switch itself. The label shall be securely and permanently fastened to the surface and be clearly visible and readable from point of access. The label shall be a yellow plate, engraved with black letters and in Icelandic (see *Figure 4*).

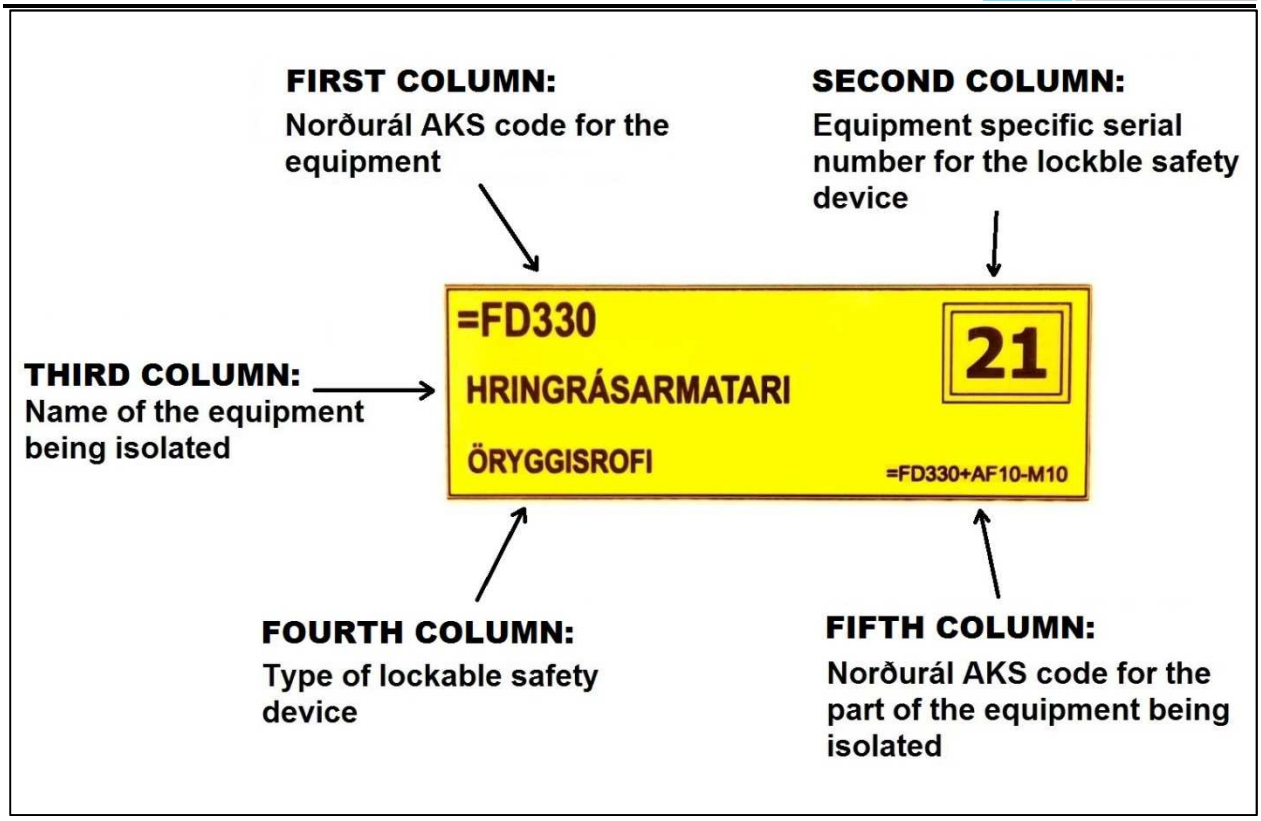


Figure 4: Example of a label plate and the correlation to the LOTOV instructions sheet table

The LOTOV label plate shall be made according to the dimensions and font information provided in *Figure 5*. Any alterations to the label design must be approved by Owner.

- The label plate color shall be RAL1023.
- The minimum plate thickness shall be 1,5 mm.
- The label plate shall be weather and fade resistant.

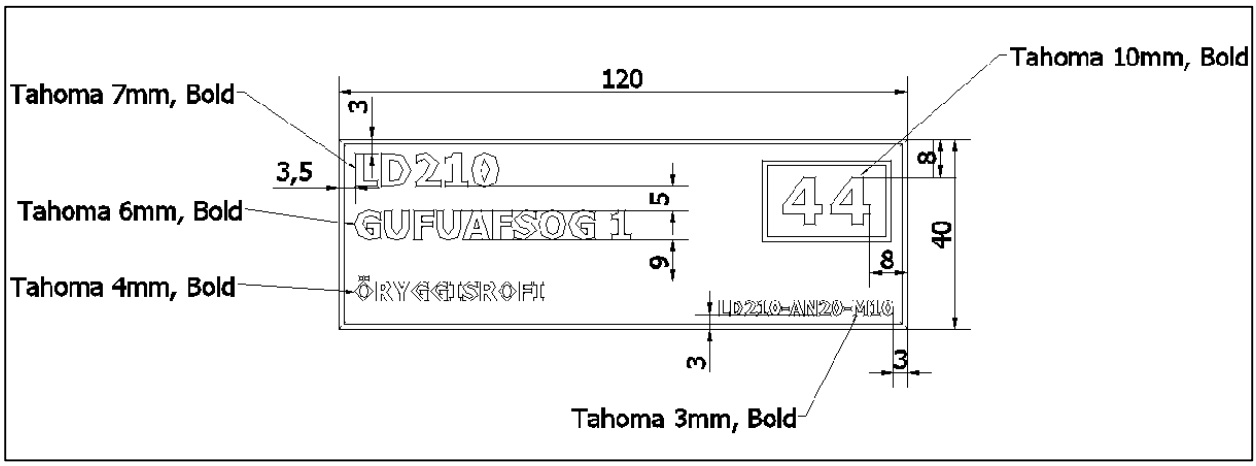
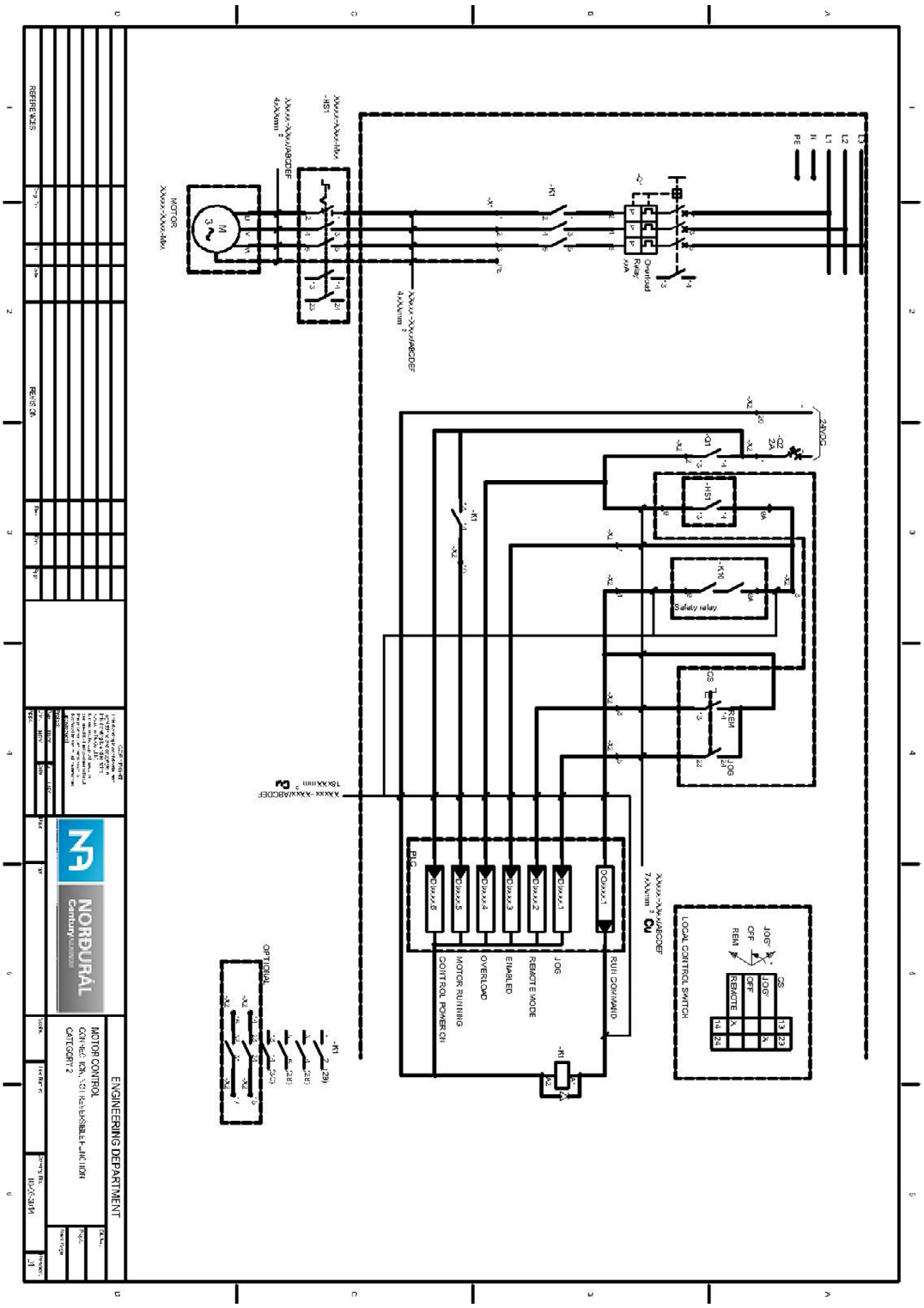
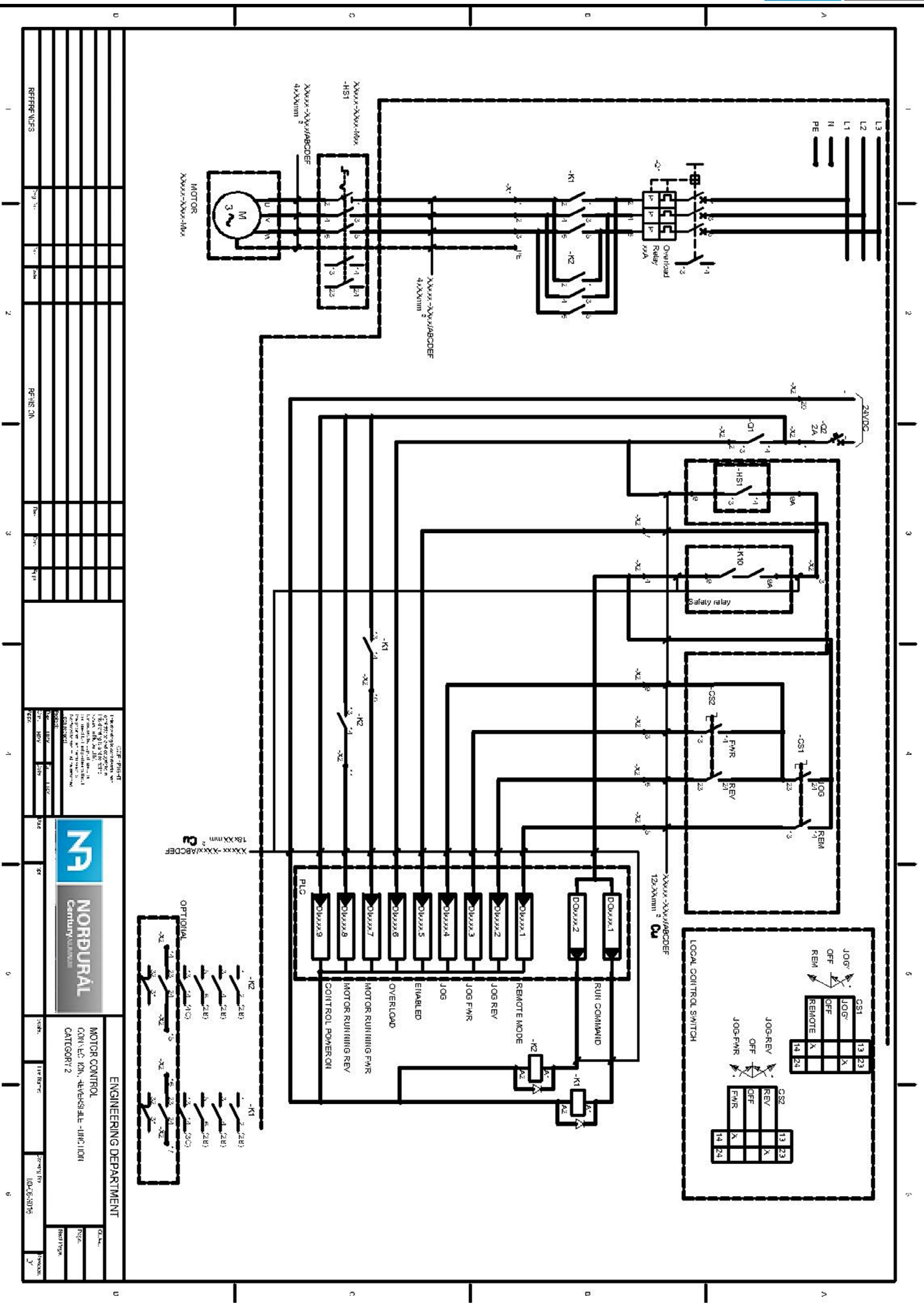


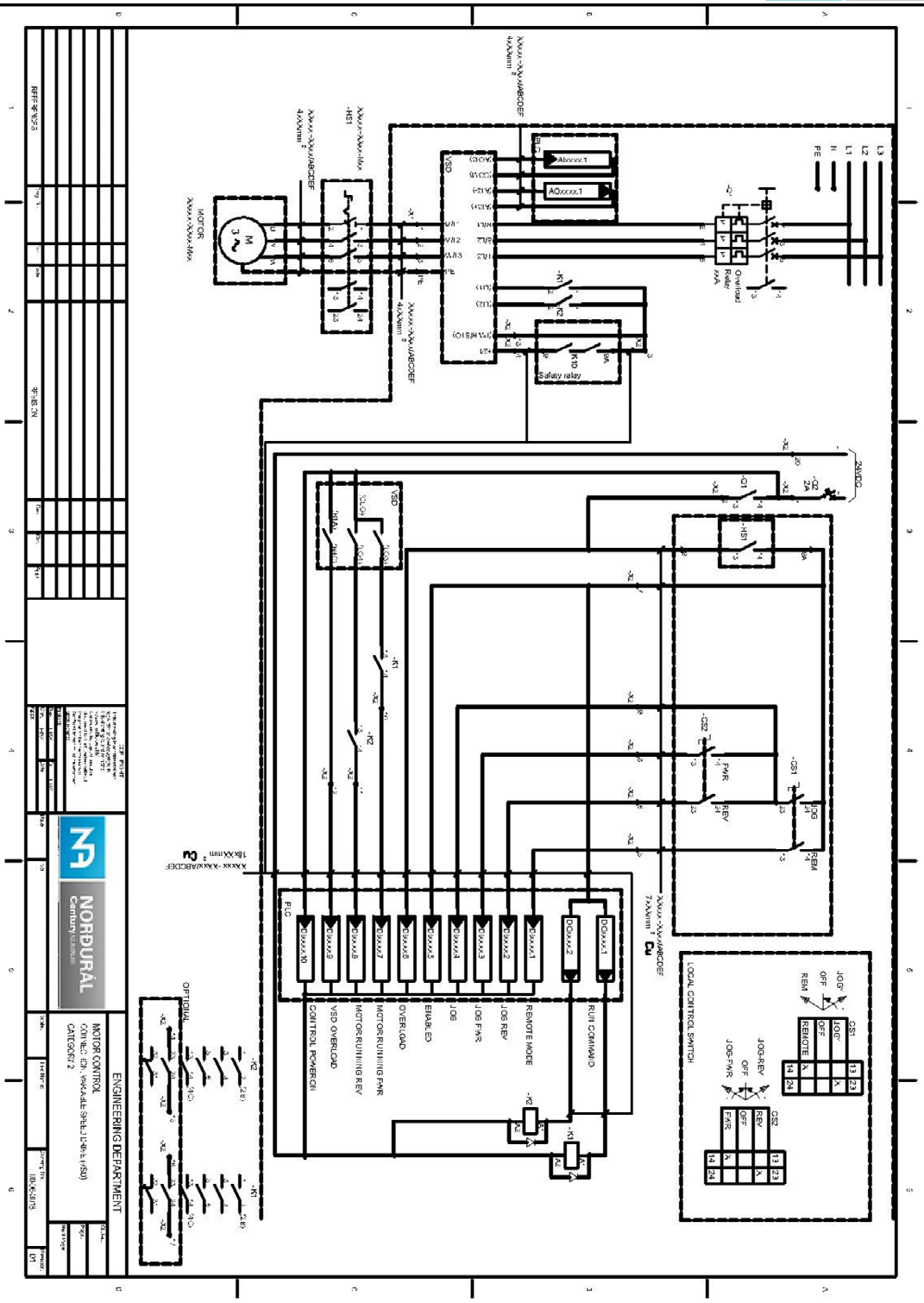
Figure 5: Label design – all lengths in mm

The LOTOV instructions and label information shall be approved by Owner before labeling the safety isolation switches.

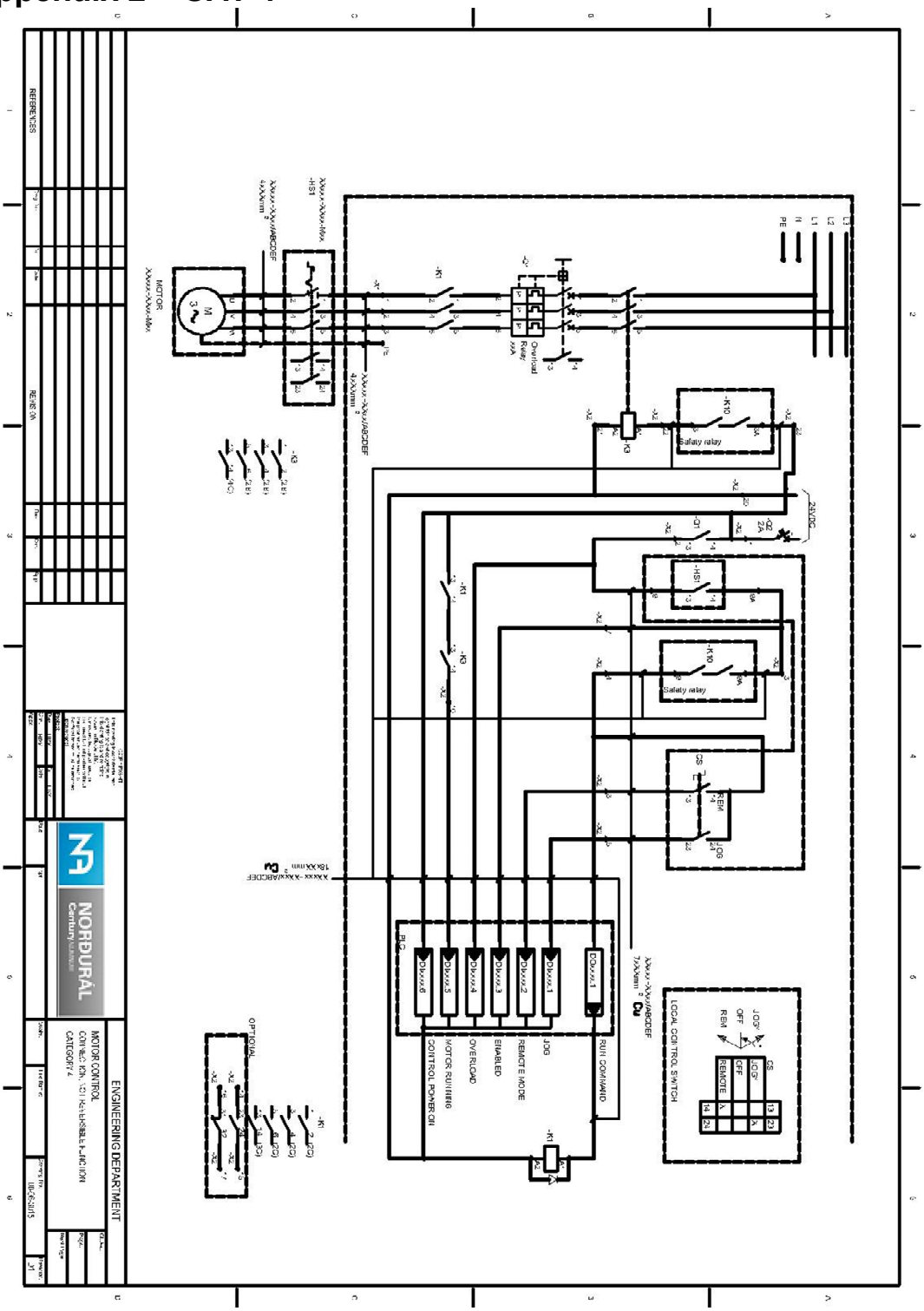
8 Appendix 1 – CAT 2

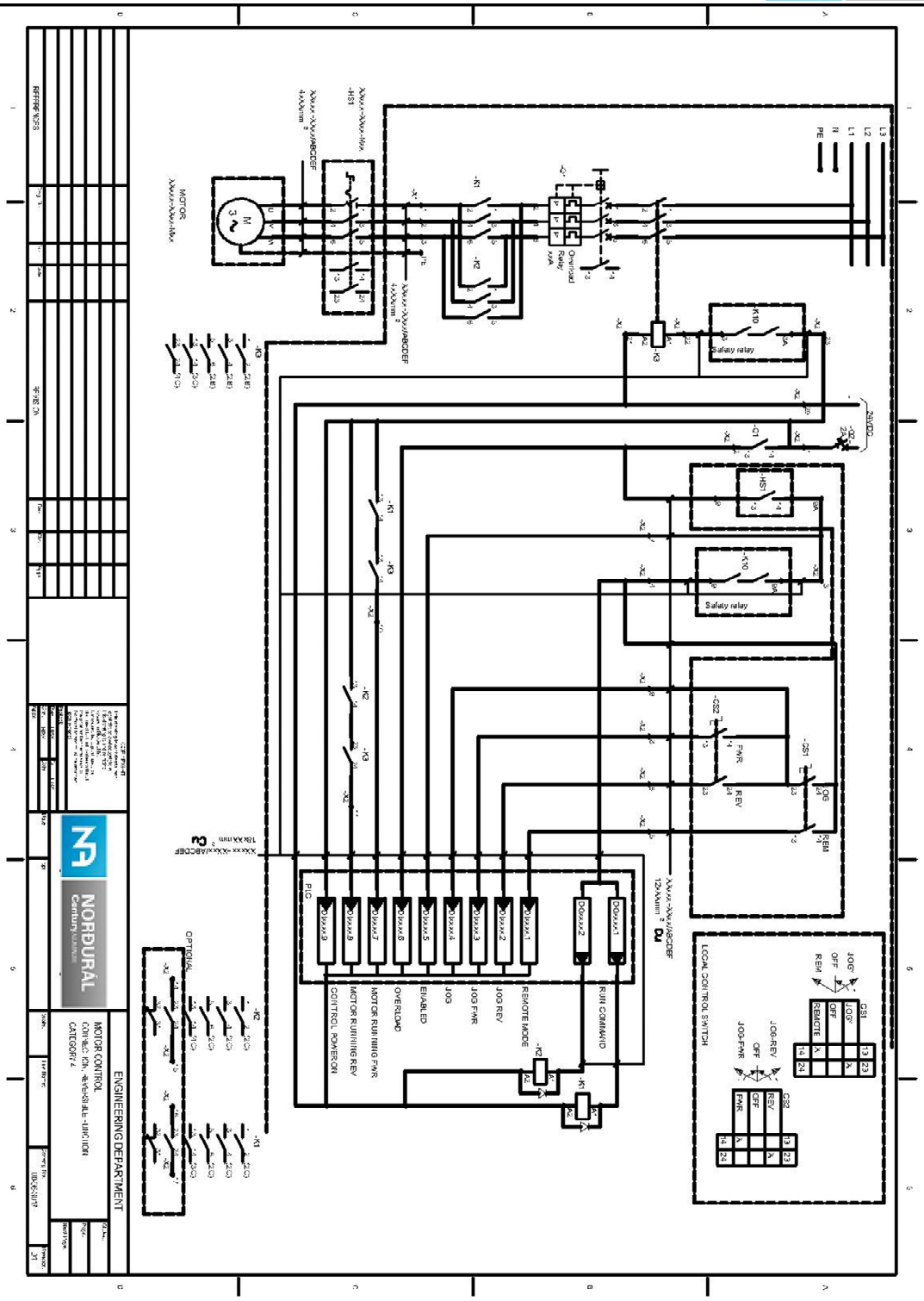


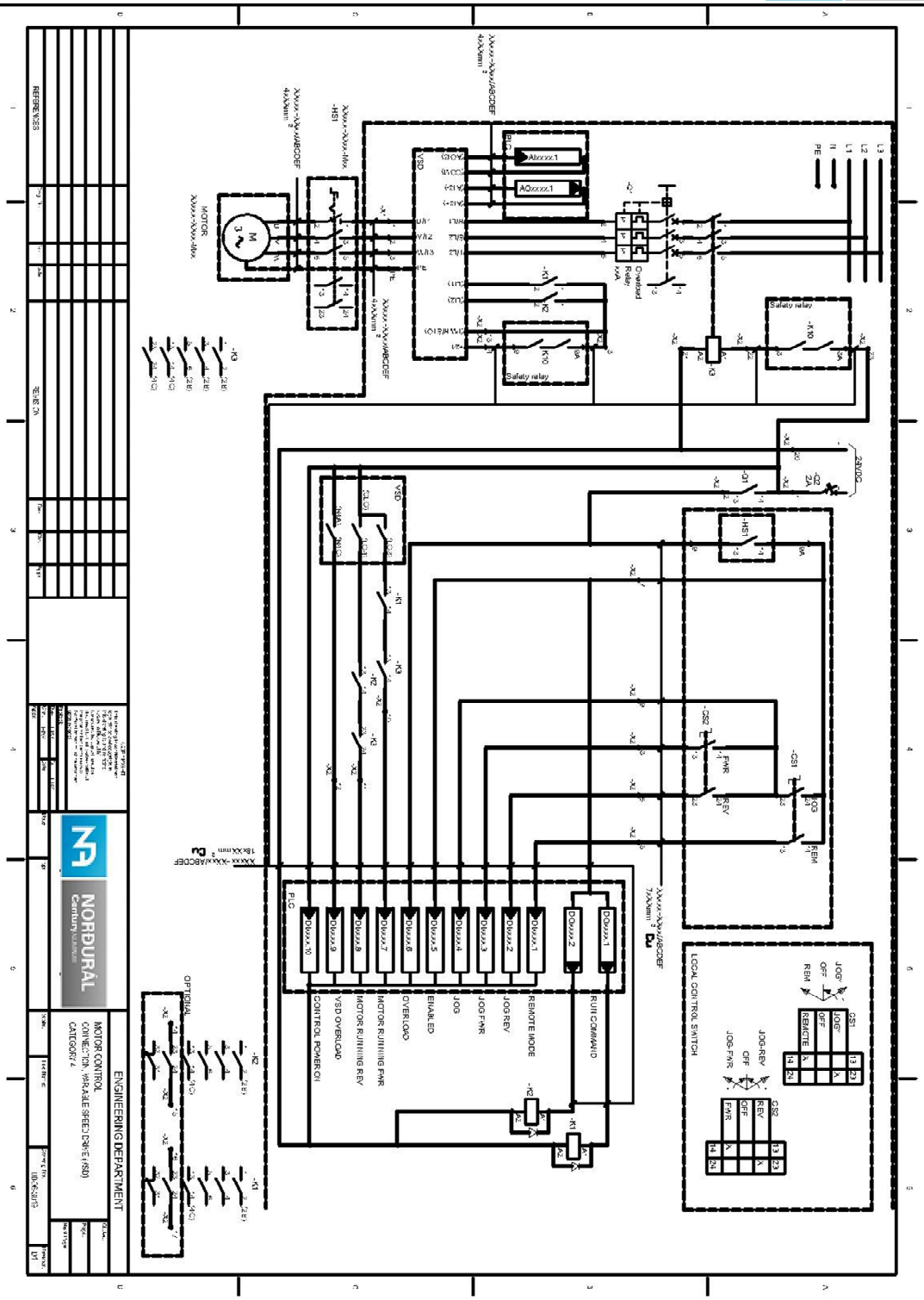

24VDC
Safety relay
LOCAL CONTROL SWITCH
PLC
RUN COMMAND
REMOTE MODE
JOG REV
JOG FWR
JOG
ENABLED
OVERLOAD
MOTOR RUNNING FWR
MOTOR RUNNING REV
CONTROL POWER ON
OPTIONAL
MOTOR
ENGINEERING DEPARTMENT
MOTOR CONTROL
NORÐURÁL


MOTOR CONTROL
ENGINEERING DEPARTMENT
NORÐURÁL
Century ALUMINUM
24VDC
VSD
PLC
Safety relay
Overload Relay
LOCAL CONTROL SWITCH
JOG
OFF
REM
REMOTE
FWR
REV
JOG-REV
JOG-FWR
OPTIONAL
CONTROL POWER ON
VSD OVERLOAD
MOTOR RUNNING REV
MOTOR RUNNING FWR
OVERLOAD
ENABLED
JOG
JOG FWR
JOG REV
REMOTE MODE
RUN COMMAND

9 Appendix 2 – CAT 4




ENGINEERING DEPARTMENT
MOTOR CONTROL
LOCAL CONTROL SWITCH
Safety relay
Overload Relay
PLC
REMOTE MODE
RUN COMMAND
JOG REV
JOG FWR
JOG
ENABLED
OVERLOAD
MOTOR RUNNING FWR
MOTOR RUNNING REV
CONTROL POWER ON
24VDC
OPTIONAL


ENGINEERING DEPARTMENT
MOTOR CONTROL
LOCAL CONTROL SWITCH
JOG
OFF
REM
REMOTE
JOG-REV
JOG-FWR
FWR
REV
Safety relay
Overload Relay
REMOTE MODE
RUN COMMAND
JOG REV
JOG FWR
JOG
ENABLED
OVERLOAD
MOTOR RUNNING FWR
MOTOR RUNNING REV
VSD OVERLOAD
CONTROL POWER ON
OPTIONAL
24VDC
MOTOR
VSD