



PROJECT CAREMAG

Phase EDD

MTK045-MODELE



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Phase EDD

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1. INTRODUCTION

1.1. PROJECT PRESENTATION

The CAREMAG project involves industrializing a process for treating and recycling magnets from end-of-life equipment, and building a "demonstrator" unit capable of recycling 2,000 t/year of rare-earth magnets and/or magnet production residues (swarfs, scraps). This grass-root demonstrator unit will be the first in Europe to use a long-loop recycling process, i.e. producing pure, separated rare-earth oxides.

The aim of such a project is to :

- Secure access to rare earths outside China and increase France's and Europe's independence,
- Reduce the risks associated with the volatility of rare earth prices,
- Accompanying the ecological transition without consuming natural resources, but by enhancing the value of the "urban mine".

The unit will process a nominal 2000 t/year of a mix of :

- Around 1000 t/year of NdFeB magnets end-of-life equipment (electric motors from automotive applications, electric bikes and scooters, wind turbines and electrical or electronic equipment).
- Around 1000 t/year of manufacturing scraps (swarfs, scraps, etc.).

The CAREMAG process can be summarized in 3 main stages:

- Mechanical upstream (from magnets to demagnetized powder) using heat treatment technologies (demagnetization above Curie temperature, around 350°C), crushing.
- Chemical upstream (from demagnetized powder to concentrated rare-earth nitrate solution) using heat treatment (controlled oxidation), acid etching (or selective dissolution) and liquid-solid separation technologies
- Separation and purification of rare earths and boron (from concentrated nitrate solutions to pure oxides) using liquid-liquid extraction, filtration precipitation and drying/calcination technologies.

In addition to these sections, the industrial unit will also include:

- Storage of raw materials,
- Storage of rare-earth nitrates (),
- Product storage (Nd, Dd, Dy, Tb oxides),
- Storage of co-products (Na borate, ammonium nitrate solution),
- Waste storage (FeOOH, xH₂O, LaCeExo)
- Production and/or distribution of utilities (demineralized water, steam, natural gas, electricity, chilled water, compressed air, nitrogen, etc.).

The project also includes buildings, roads and networks, site preparation and general infrastructure.

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The project is divided into 3 phases:

- Phase 1: upstream wet treatment (010), which transforms demagnetized magnet powder or chips into a solution of rare-earth nitrates and boron.
- Phase 2: Separation and purification of rare earths and boron using the 4 SX0, SX1, SX2 and SX3 batteries to extract some of the light rare earths in oxide or carbonate form. The heavy rare earths are sent for storage.
- Phase 3 installation of SX4 to SX7 batteries and associated finishing (250) to treat the heavy soils stored in phase 2.

1.2. PURPOSE OF THE DOCUMENT

This document describes the criteria used for the engineering, supply, manufacture and installation required to supply power to the unit.

1.3. DEFINITIONS, ABBREVIATIONS

SUPPLIER: Refers to manufacturers or sellers of equipment.

SOBEGI: Société BEarnaise de Gestion Industrielle

A: Ampère

ANSI: American National Standards Institute

ATEX:

ATmosphère

Explosive **LV:**

Low Voltage U

< 1kV **AC:**

Alternating

Current

DC: Direct Current

Cu: Copper

DGPT2: Gas, Pressure, Temperature release with two thresholds (transformer protection),

ESD: Emergency Shut Down

HTA: High Voltage 1kV < U < 50kV

HVAC: Heating Ventilation Air Conditioning (Air Conditionné)

Hz: Hertz

ICSS: Integrated Control and Safety System

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IEC: Electrotechnical Commission

I/O : Inputs / outputs

Ik: Permanent short-circuit current

IK: Impact Protection Index

IP: Protection class

ISO: International Organization for Standardization

LED: Light Emitting Diode

LEP: Liaison EquiPotentielle

MALT: Mise A La Terre

NC: Normally Closed

NO: Normally Open

ONAN: Oil/natural; Air/natural (cooling mode for immersed transformers),

PAGA: Public Address and General Alarm

Rms: Root mean square

UPS: Un-interruptible Power Supply

V: Volt

G/J: Green/Yellow

VFD: Variable frequency drive

ANSI 27 : Minimum voltage

ANSI 64 : Insulation fault protection

1.4. CAREMAG UNIT POWER SUPPLY

The CAREMAG unit is located within the INDUSLACQ complex, and the LACQ site is supplied by two 63kV RTE lines. A 63kV substation (owned by SOBEGI) transforms an HV distribution (63kV) into an HTA distribution (5.5kV) "Customers. The CAREMAG unit is connected to the "Normal 5.5kV" network (uninterruptible power supply).

Between the 5.5kV substation and the CAREMAG unit area, SOBEGI is responsible for supplying and laying the HV power cables and auxiliary cables.

The HV cables will be connected to the 5.5kV switchboard input cell in the CAREMAG unit's electrical equipment room. This connection constitutes the CAREMAG / SOBEGI interface point.

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1.5. REFERENCE DOCUMENTS

- [1] ~~Electrical single-line diagram~~: NA
- [2] ~~List of consumers and power balance~~: NA
- [3] ~~Load flow study~~: NA
- [4] ~~5.5kV Switchboard data sheet~~ : NA
- [5] ~~5.5kV/0.4kV Transformers data sheet~~ : NA
- [6] ~~5.5kV/xx Transformers for rotary kiln data sheet~~ : NA
- [7] ~~400V Switchboard data sheet~~ : NA
- [8] ~~UPS Data sheet~~ : NA
- [9] ~~LV Motors and VFD Data Sheet~~ : NA
- [10] ~~230V Switchboards data sheet~~ : NA
- [11] ~~Electrical room layout plan~~: NA
- [12] ~~Grounding standards~~: NA
- [13] ~~Equipment specification (painting, electrical tracing, insulation)~~ : NA
- [14] ~~Safety concept~~: NA
- [15] ~~Site~~ : NA

1.6. STANDARDS AND REGULATIONS

As a minimum, the design of the electrical installation and the specification of the electrical equipment comply with national standards and directives, including addenda, annexes and revisions of these documents,

1.6.1. NFC STANDARDS

- NF C 13-200: High-voltage electrical installations,
- NF C 15-100: Low-voltage electrical installations.

1.6.2. OTHER STANDARDS AND DECREES

- Lightning reference system,
Standards NF EN 62305-1: Protection against lightning-Part 1: General principles
Standards NF EN 62305-2: Protection against lightning-Part 2: Risk assessment
Standards NF EN 62305-3: Protection against lightning-Part 3: Physical damage to structures and human risks
Standards NF EN 62305-4 : Lightning protection-Part 4: Power and communication networks in structures
- Guide UTE C 15-103: Determination of external influences
- IEC 60228 : Conductors of insulated cables
- IEEE C37.2: Standard Electrical Power System (ANSI protectives functions)
- ATEX Directive 2014/34/EU - (equipment conformity),
European Community ATEX Directive 99/92/EC - Equipment and protective systems for use in potentially explosive atmospheres

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2. ENVIRONMENTAL CONDITIONS

Please refer to the document Induslacq Site Data Version 2 dated 06/02/2017, with mainly :

- Average annual temperature: 12.5°C
- Absolute minimum temperature: -14°C
- Absolute maximum temperature: 40°C
- Minimum/medium/maximum relative humidity: 55 / 80 / > 95%

3. FREQUENCIES AND VOLTAGES

3.1. STANDARD FREQUENCY

The frequency is 50Hz.

3.2. STANDARD VOLTAGES

This chapter is applicable in conjunction with the following:

- The power to be supplied ≈ 3MW -see [2]
- Short-circuit current levels by voltage level:
 - Ik3 max 5.5kV ≤ 40kA at 5.5kV delivery substation (to be confirmed by SOBEGI)
 - Ik3 max 400V ≤ 50kA
 - Ik3 max 400V/230V ≤ 10kA.
- **High voltage**
 - Rated voltage: 5.5kV
 - Rated voltage (rms value): 7.2kV
 - Rated withstand voltage for 1 minute at industrial frequency (rms value): 20kV
 - Rated lightning withstand voltage (peak value): 60kV
 - Insulated neutral
- **Low voltage**
 - 400V, IT neutral regime, for main low-voltage distribution and large consumers. 400V is produced from 5.5kV.

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- 400V - 230V TT neutral system for lighting and small power distribution,
- 230V (UPS) IT neutral regime for PLCs, servers, PCs (personal computers), telephony equipment and PAGA.
- **DC systems**
 - 24Vdc for all electrical equipment command/control devices and all instruments (I/O, sensors, etc.), isolated network.

3.3. VOLTAGE AND FREQUENCY VARIATIONS

Voltage variations for 5.5kV and 400V networks are $U_n \pm 10\%$ in normal operation.

3.4. VOLTAGE DROPS IN THE SYSTEM

The permissible voltage drop for MV installations, in absence of specific regulations, is: 5%

(NFC 13-200 § 525). Permissible voltage drop for LV :

The permissible voltage drop for the entire length of the line, from the source to the equipment, under normal operating conditions, will be at most :

Power supply type	Lighting	Other use
Installations supplied by a delivery substation or by a transformer station from a high-voltage installation and installations identical to those in the frame above whose point is located in the LV switchboard of a public distribution substation.	6%	8%

Apart from any numerical value conforming to the standard, voltage drops must never exceed a limit that is incompatible with the correct operation, during start-up and normal service, of the application supplied by the line concerned.

The voltage drop at start-up must be taken into account for motor operation.

3.5. HARMONIC DISTORTIONS

The total harmonic voltage distortion of the CAREMAG unit will be less than 5% at the SOBEGI delivery point.

The constraints imposed by the load, which generates harmonic currents and voltages, must be taken into account when sizing electrical equipment.

3.6. ELECTROMAGNETIC COMPATIBILITY (ECM)

In order to comply with the EMC requirements of IEC 61000, all electrical systems and equipment must meet the current applicable "emission" and "immunity" levels.

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4. ELECTRICAL INSTALLATION DESIGN

4.1. GENERAL

The electrical design will be carried out for :

- Installation and operation with a focus on personal safety,
- Maintenance without production downtime.

To this end, the main electrical distribution equipment (transformers, UPSs, switchboards) will be redundant.

4.2. PROTECTION RATINGS

Protection ratings must comply with standards NFC 15 100 and UTE C 15 103, i.e. :

- Equipment installed outdoors: IP55,
- Weatherproof equipment installed outdoors: IP54,
- Equipment installed a technical room: IP31,
- Equipment installed indoors (non-wet locations, offices): IP20.

Shock protection :

- IK08 for all equipment inside premises,
- IK10 for all small outdoor equipment (sockets/junction boxes/lighting devices).

4.3. DISTRIBUTION NETWORK CONFIGURATION

4.3.1. PANEL HT 5.5KV

- HTA operating voltage 5.5kV, nominal voltage 7.2kV (SF6 or vacuum technology),
- Two power sources,
- Two half-sets of copper bars,
- Busbar 400A (minimum value), Ith 40kA (rms) - 1s,
- Protection class: IP3X, IK: 08,
- Configuration with withdrawable circuit-breakers,
- Internal arc resistance to IEC 62271-200,
- Interlocking/tripping coils (opening/closing shunt coil, ESD shunt coil) on inlets and outlets,
- An automatic switchover device a voltage failure,
- Electrical equipment status transmitted to ICSS for processing (for each switching device): one electrical fault and one open/closed position status on dry contact, 2x(NC+NO) minimum on terminal block, one general electrical fault on switchboard,

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- The protection relays are designed for communication with the ICSS using the IEC61850 protocol,
- All 5.5kV disconnectors will be fitted with an earthing switch and mechanical key locking,
- Next design [4].
- Inter trips:
 - Upstream: 5.5kV
SOBEGI substation
 - Downstream:
CAREMAG unit
 - 1- Opening the upstream circuit-breaker trips the downstream circuit-breaker,
 - 2- Tripping the downstream circuit-breaker on an electrical fault triggers the upstream circuit-breaker,
 - 3- Closing the upstream circuit-breaker (except case '2') enables manual closing of the downstream circuit-breaker,
 - 4- On fire detection in the CAREMAG electrical room, the two upstream circuit breakers trip.
- Key interlocks will be installed between:
 - 1- The 5.5kV upstream feeder and 5.5kV downstream feeder,
 - 2- Each 5.5kV feeder from the CAREMAG unit, the 5.5kV/400V transformer and the 400V feeder to the transformer's secondary,
- 5.5kV network configuration
 In normal configuration, the two 5.5kV SOBEGI power supplies are each connected to half a set of 5.5kV busbars.
 An undervoltage relay (ANSI 27 protection function) will be connected to each half-busbar.
 The loss of an upstream supply automatically opens the downstream 5.5kV feeder circuit-breaker and closes the coupling circuit-breaker. The two transformers 5.5kV/400V are maintained, in which case (exceptionally) the site's entire power consumption is supplied by a 5.5kV SOBEGI power supply.

4.3.2. BT 400V PANEL

- Operating voltage: 400V,
- IT neutral system,
- Two power sources,
- Two half-sets of copper bars,

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- Insulation voltage: 1000V (power/control/command/measurement),
- Rated current (In): as per [7],
- Rated short-time current (Icw): as per [7],
- Horizontal and vertical copper busbars,
- Motorized inlet circuit breaker,
- Plug-in panel: WWW,
- Shape: 4b,
- Service index: 333,
- Protection class: IP 31,
- Internal arc resistance,
The switchboard must have been evaluated by type testing, under arc due to an internal fault developing in air, in accordance with the procedure described in IEC TR 61641. The value of arc current must be equal to the short-time rated current declared for the switchboard, in terms of duration.

Individual protection of assembly is achieved when criteria 1 to 7 are met.

- Front panel: pull-out drawers for starters and door for auxiliary compartments,
- Rear cladding: removable panel,
- Connection: Avant - will be confirmed following the study of the electrical room - ref.[11].
- Cable entry: from below - to be confirmed following the study of the external routing and the study of the electrical room - ref.[11],
- Interlocking/tripping coils for main inlets and outlets (opening/closing shunt coil, ESD shunt coil),
- Permanent insulation monitor ANSI [64] and undervoltage relay ANSI [27] on each half-busbar with a fault reporting contact available on the terminal block,
- An automatic switchover device a voltage failure,
- Key-operated interlock in the disconnected position (key free if circuit-breaker open and disconnected),
- Electrical equipment status transmitted to ICSS for processing: a general electrical fault in dry contact 2x(NC+NO) on terminal block,
- The protection relays on the main circuit breakers are designed to communicate with the ICSS using the IEC61850 protocol,
- 400V feeders, main feeders, will be equipped with electrical locking and key locking as follows:

1- Electrical interlocks in accordance with chapter 4.3.1

2- Key locks in accordance with chapter 4.3.1

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- Equipped reserve departures as follows [7],
- Reserves of available space (10%),
- Next design [7].
- 400V power supply configuration
In normal configuration, the two 5.5kV/0.4kV transformers are each connected to half a 400V busbar.
A fault in one of the two transformers opens the relevant 5.5kV and 400V incoming circuit-breaker and closes the coupling circuit-breaker. A single 5.5kV/0.4V transformer is maintained, in which case (exceptionally) the site's entire low-voltage 400V power consumption is supplied by a single 5.5kV/0.4kV transformer.

4.3.3. HT/BT TRANSFORMERS

The HV/LV transformers will be hermetically sealed, full oil filling, Ecodesign 2021.

They will be installed in boxes adjoining the electrical equipment room.

In the particular case of rotary kiln packages, HV/LV transformers dedicated to this equipment should preferably be installed close to the workshop, to reduce the length of the low-voltage link.

- Power: xx kVA according to [1],
- Primary voltage: 5.5kV,
- Secondary voltage: 420V - In the specific case of Rotary Kiln Packages the Package power supply voltage is to be confirmed by the Supplier,
- Dyn11 coupling,
- Frequency: 50Hz,
- Insulation level: 40kV,
- Ucc: xx% according to [1],
- Cooling mode: ONAN,
- Multifunctional protection device type DGPT2,
- HV plug-in connections, fixed and moving parts (straight or angled),
- IP55 cover for LV connections,
- Accessories: Pressure relief valve, drain and filler valves, oil thermometer, swivel rollers, grounding lugs, nameplate, lifting and draining rings,
- Locking device,

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- Fire- resistant drip tray, design as per [5] [6].

4.3.4. BT/BT TRANSFORMERS

- Transformer: dry type, air-cooled AN type,
- Primary: three-phase 400 V - 3Ph,
- Secondary: 400V/400V-230 V - 3Ph+ N,
- Rated power: xx kVA according to [1],
- Frequency: 50Hz,
- Winding: copper,
- Electrostatic screen,
- Thermal insulation class: H,
- Coupling: Dyn 11,
- Protection rating: IP21,
- Voltage setting $\pm 5\%$,
- Accessories: lifting rings and earthing terminals,
- Nameplate: IEC.

4.3.5. MOTORS

- Squirrel-cage induction asynchronous type, rated for S1 continuous duty,
- Degree of protection: IP55 / IK08,
- Thermal insulation class: F,
- Temperature rise class: B,
- Cooling: air/air,
- Efficiency will be IE3 according to IEC 60034-30, IE1 and below is not permitted,
- The noise level will be a maximum of 85 dBA at 1 m from the surface and at rated voltage,
- Motors with a power rating of less than 370W will be supplied at 230V,
- Motors between 370W and 360kW will be supplied with 400V-3Ph, with a requirement for all motors over 90kW to be driven by VFD's.

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- Motors associated with a VFD will be fitted with temperature sensors (PTC),
- Motor heater for $P > 22\text{kW}$,
- Paint category: C5-I,
- Mushroom-type Emergency-Stop pushbutton for each rotating machine, at except fan motors.

4.3.6. FREQUENCY INVERTER

AFE technology - 12 Front-End

pulses, Cooling: air/air,

VFDs will be located in technical rooms only,

VFDs will be supplied by the supplier of the driven equipment to ensure that the motor and VFD are matched.

Dimmer cabinets in the electrical equipment room will be connected from above (cable glands or equivalent system installed on the cabinet roof).

Cut-off switches installed on the front of the cabinets must be fitted with shunt trip coils and an auxiliary contact to perform inter-trip functions between the package cabinets and the supply circuit-breakers for these cabinets located upstream.

Differential devices (with adjustable detection ranges) must be installed on the power circuits upstream and downstream of each drive.

Operator safety : Cabinets and package equipment must be designed to minimize the effects of an internal arc fault. Key locking systems should be installed, where necessary, to guarantee operator safety against electrical hazards.

Next design [9].

4.3.7. DIMMER-CONTROLLED ELECTRIC REHEATING

Dimmers (thyristors) are integrated into the Rotary Furnace Packages. They will be wave-train or phase-angle technology.

In the case of phase angle control, anti-harmonic filters will be installed to minimize the impact.

Total harmonic voltage distortion must be less than 5%.

The control panel will be tested flash arc conditions. A standard test certificate will be supplied.

4.3.1. PACKAGE CABINETS

Package cabinets with multiple power supplies must be fitted an omnipolar disconnecting device (main disconnecting switch).

Isolating switches must be fitted with shunt trip coils and an auxiliary contact to perform inter-

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trip between package cabinets and upstream circuit breakers.

Operator safety : Cabinets and package equipment must be designed to minimize the effects of an internal arc fault. Key locking systems should be installed, where necessary, to guarantee operator safety against electrical hazards.

Connections :

Particular attention must be paid to the connection of power cables; motor terminal boxes, electrical distribution boards and boxes, and variable speed drives/dimmers (integrated into packages) must be dimensioned to allow easy connection of several cables with large cross-sections/phases. Control cables and auxiliary power supplies will be connected to terminal blocks.

Package cabinets located in the electrical equipment room will be connected via (cable glands or equivalent system located on the cabinet roof).

4.3.2. CAPACITIVE BENCHES

There are no plans to raise the power factor.

4.3.3. ECS - ELECTRICAL NETWORK CONTROL SYSTEM

There is no ECS, but each piece of electrical equipment must provide two dry contacts (NC+NO) on its terminal blocks, based on the electrical fault of the inlets and outlets, the fault of the internal equipment (such as the AC/DC converter), the open state of the auxiliary switching devices (e.g. open auxiliary circuit breakers), and the state of the ANSI protection relays [27] and [64] for communication to the ICSS.

The protection relays on the main circuit breakers are designed to communicate with the ICSS using the IEC61850 protocol.

4.3.4. ELECTRICAL DISCONNECTION, REQUIREMENTS

Voltage-lack coils will be dedicated to ESD and installed on:

- 5.5kV HV switchboard inlets and outlets
- 400V main LV board inlets and outlets
- 400V/230V cabinet inlets and outlets
- UPS battery circuit breaker
- 230Vac UPS distribution box inlets and outlets
- 24VDC distribution box inputs and outputs

4.3.5. UPS ALTERNATING CURRENT

General UPS features :

Redundant UPS: rectifier, batteries and UPS are redundant (2x100%), with the exception of the transformer bypass,

- Power supply: 400 V - 3Ph,

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- Output voltage: 230 V - 1Ph - 50Hz,
- Downstream IT distribution,
- Autonomy: 30 min at rated power, open lead batteries.

This type of battery must be installed on a chassis in a specific, ventilated room equipped gas detection.

- Static by-pass contactor,
- By-pass transformer,
- Maintenance bypass

4.3.6. DIRECT CURRENT

A DC UPS is not recommended; 24 VDC consumers will be supplied via AC/DC converters from the AC UPS.

4.3.7. 400V/230V DISTRIBUTION CABINET & 230VAC UPS DISTRIBUTION CABINET

- Rated insulation voltage (Ui): 1000 V,
- Rated operating voltage (Ue): 400/230 Vac, SLT: TN-S (IT for UPS cabinet),
- Rated frequency (F): 50 Hz,
- Rated voltage of auxiliary circuits: 24 Vdc (from 230Vac UPS via rectifier in cabinet),
- Rated current (In): xxA according to [1],
- Rated short-time current (Icw): 10kA (rms) - 1s,
- Protection class: IP 31,
- Shape: 2b,
- Service index: 222,
- Front cladding: solid door followed by interior faceplate,
- Connection: Front,
- Cable entry: from below,
- Socket outlets, tracing (to be confirmed), reheating, will be equipped with 30mA residual current protection, the other outlets will be equipped with 300mA residual current protection; for the 230Vac UPS cabinet, only the socket outlets will be equipped with residual current protection and 300mA sensitivity,
- Electrical protection required on the : [27].

4.4. CABLES

- HTA - Rated voltage: 3.6/6 (7.2) kV,

According to NF C 33 220 - Extruded solid dielectric insulated cables for rated

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voltages from 1.8/3 (3.6) kV to 18/30 (36) kV, screen, double steel strip armouring

- LV - Rated voltage 0.6/1kV, According to UTE / AFNOR standard
 - Type U1000 R2V - C2 flame-retardant and halogen-free, black sheath,
 - Type U1000 RVFV - C2 for cables running underground or in explosive areas.

Shielded cable for VFD control.

- Type HO7VR V/J for grounding. Copper cable core.

Cable cross-sections should be selected according to the IEC 60228 standard list.

Maximum cross-sections are as follows:

- BT= 3 x 240mm² (three-pole)
 - = 1 x 400mm² copper (single-pole)
 - = 1 x 630mm² aluminum (single-pole)
- HT= 3 x 240mm² (three-pole)
 - = 1 x 300mm² copper (single-pole)
 - = 1 x 630mm² aluminum (single-pole) Wired cable core (not solid) > 2.5 mm². Copper cable core.

Power cables can be laid in a maximum of two layers.

4.5. LIGHTING

entire lighting system will be powered from 230 V cabinets.

Lighting and sockets inside the buildings will be distributed from a 230V power supply located in each room, supplied from the 400V/230Vac distribution cabinet.

Outdoor lighting and sockets will be distributed from a dedicated box powered the 400V/230Vac distribution cabinet:

Normal lighting - Indoor installation:

- Waterproof industrial LED lighting 1x48W,
- Lighting fixtures must have a minimum fire resistance of 850°C (glow-wire test),
- Each room will have at least two lighting circuits.

Emergency evacuation lighting :

- Evacuation lighting will be provided by self-contained 45 lumen fluorescent units with 1 hour autonomy, equipped with a built-in Automatic Test System (SATI).

Outdoor installation :

- Post, tilting lighting , 10m high with 2 LED spotlights.

Average illuminance levels, measured 1 meter above ground level; for outdoor areas, the reference is ground level:

- 50 lux Handling and general outdoor areas

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- 100 lux General indoor areas
- 150 lux Process areas in general
- 300 lux Electrical and instrumentation rooms
- 300 lux Stores
- 500 lux Control room
- 500 lux Offices, meeting rooms
- 500 lux Laboratories

4.5.1. JUNCTION BOXES

The junction boxes will be made of GRP and fitted with cable glands.

4.5.2. SOCKET OUTLET

230 V - 2P+T - 16A surface-mounted socket outlet,
 400 V - 3P+T - 16A and 32A surface-mounted socket-outlet,
 The 16A - 400V sockets will be supplied by the 400V/230V cabinet, the 32A - 400V sockets will be supplied by the 400V switchboard,
 Sockets will be protected by 30mA differential devices.

4.6. ELECTRIC TRACING

The special features will be as follows:

- Thermo-regulated, thermally insulated heating cable,
- Supply voltage 230VAC
- The tracing is laid and connected in accordance with the supplier's recommendations,
- Tracing circuits will be protected by a high-sensitivity 30mA differential device,
- Next design [13].

4.7. CABLE ROUTING

Outside production workshops, walkways will be either :

- Rack-mounted on enclosed cable trays,
- In gutters
- In-ground under jackets

Within the production unit, the routes will be :

- Overhead trays (cable trays, cable ladders)

Cable segregation :

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	Horizontal distance			Vertical distance		
	HT	BT	INS	HT	BT	INS
HT	50	300	1000	300	300	1000
BT	300	50	600	300	300	600

4.7.1. INDOOR / OUTDOOR CABLE TRAYS

Cable trays and their support systems must be :

- ✓ Path :
 - Indoor galvanized steel type,
 - Aluminum AG3 or stainless steel for outdoor use,
- ✓ Support: aluminum, stainless steel or painted iron.

Magnetic fields must be avoided in the case of closed brackets.

Cable trays should be of the safety folded edge (BS) type, with a 48mm flange height.

Simplified connection elements should be preferred to ensure a perfect finish.

Cable trays must be supported using support systems such as hanging profiles, brackets and hangers.

All brackets must be "clamped to the main and secondary structure; no brackets may be welded to the main structure; along facades, downspouts must be fixed to the cladding fastening rails.

4.7.2. TPC FOURREAUX

They must be made of extruded polyethylene, corrugated on the outside and smooth on the inside, in a standard color matching that of the warning mesh.

These sleeves allow a permissible bending radius corresponding to 20 times their diameter. They must be marked with the NF monogram.

All sheaths must be routed.

Joining sleeves: The junction between two sheaths must be sealed with a joining sleeve.

Alignment comb : The duct layers must be held together by alignment combs made of rot- proof materials, to ensure that the ducts remain perfectly stable when the trench is backfilled.

Warning wire mesh: cable sheaths must be marked with wire mesh conforming to the NF standard, in the same color as the cable sheaths. The mesh must be detectable with a metal detector.

4.7.3. DRAWING CHAMBERS

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Pulling chambers equipped with covering devices.

They must be of sufficient quantity and size to meet the needs of the electrical networks, to be defined by the ENTREPRENEUR in a detailed study.

Before the cables are laid, the bottom must be drilled to keep the chambers dry in the event of rainwater run-off.

4.8. PRESS-ETOUPE

Features must be as follows:

- Minimum IP65 protection.
- In case of a metal junction box, the cable gland must be made of bronze or 316L stainless steel.
- In the case of armored cable, the cable gland must be adapted,
- Threads must be ISO standard with tightening nut.

4.9. TECHNICAL PREMISES ELECTRICITY

4.9.1. GENERAL

Electrical equipment will be installed in a dedicated LV electrical room.

The associated HV/LV transformers will be installed in boxes adjacent to the room (special case of rotary kiln packages, see § 4.3.3).

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The 5.5kV switchboard will be installed in a dedicated HV room.

4.9.2. LOCATION

A 10% reservation fee will be charged.

For HV and LV switchboards, space for a spare cell will be provided on each side.

Connections to equipment in the LV electrical technical room will be made from above, with cable routing on a cable ladder inside the room; no false floor or technical void - will be confirmed following the study of external routing and the study of the electrical room - ref. [11].

4.9.3. CABLE PENETRATION

Cables will enter electrical equipment rooms using watertight systems to guarantee the building's fire resistance.

4.9.4. MINIMUM SPACING

Above equipment (ceiling or HVAC duct)	500mm (Note 1)
At the front of HT panels	1500mm
At front of LV switchboards	1200mm
At the end of a set of arrays	100mm

Note 1: Suppliers' recommendations concerning additional equipment for internal arc resistance may determine a greater distance.

4.9.5. SAFETY EQUIPMENT

Electrical rooms will be equipped a panel showing the safety equipment associated with the voltage level.

4.10. SITE INSTALLATION

Site electrical installation will comply with NF C15-100.

5. GROUNDING AND LIGHTNING

5.1. EARTH NETWORK

5.1.1. GENERAL

The earthing system must take into account the provisions for earthing, protective conductors

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and equipotential bonding in order to meet the safety and functional requirements of the electrical installation as defined in standard NFC 15100.

As a general rule, earth cables buried in the ground should be Cu-Nu cables with a minimum cross-section of 50mm², buried at least 1m above the finished floor.

The lighting columns will be earthed using a Cu-Nu earth cable with a cross-section of 25mm², buried alongside the power supply cable.

Overhead grounding cables or LEPs must be V/J sheathed copper with a minimum cross-section of 35mm². In addition, the following indications must be considered,

5.1.2. OUTSIDE TECHNICAL PREMISES

A grounding network using V/J grounding cables with a minimum cross-section of 1x50mm² and splitters.

Civil engineering structures and metal structures must be connected via splitters to the general network at the bottom of the excavation using HO7VR grounding cables with green/yellow outer sheaths.

The equipment listed below must be interconnected to the nearest distribution frames by individual 1 x 35 mm² type HO7VR cable with green/yellow outer sheath via a stainless steel bracket (ASTM 316 L or 316 TI) size 40 x 20 x 5 mm with a $\varnothing$ 8 mm hole:

- ✓ Boxes, junction boxes and electric motors,
- ✓ The ends of all cable trays,
- ✓ The ends of all steel sheaths,
- ✓ All boilers,
- ✓ All skids, containers
- ✓ All access ladders, walkways and platforms not welded directly to the structure.

Lighting fixtures and control stations will be directly connected to the low-voltage panel by a third or fourth green/yellow protective conductor incorporated into the cable, with the same cross-section as the active conductors.

5.1.3. INSIDE TECHNICAL ROOMS

A grounding network for electrical grounds in equipment rooms.

All metallic and electrical grounds (transformers, switchboards, cabinets, cable trays, cabinet frames, false floor supports) must be connected to the electrical grounding network (TP), using 1 x 35 mm² or 1x $\geq$ 120mm² (depending on the case) HO7 VR type cable with green/yellow outer sheath.

5.2. LIGHTNING PROTECTION

A Lightning Risk Analysis (LRA) and a Lightning Technical Study (LTS) will be carried out by

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a QUALIFOUDRE company to issue a lightning protection rate to be applied on the site.

In accordance with the conclusions of the Lightning Risk Analysis and in compliance with the requirements of standard NF-EN-62305 for lightning protection, an exterior and interior lightning protection system will be installed.

Earthing and equipotential bonding must be applied to achieve lightning protection. Secondary structures will be welded to the main structures in various zones.

Surge arresters will be installed at all voltage levels.

6. EQUIPMENT IDENTIFICATION

6.1. EQUIPMENT IDENTIFICATION

All electrical equipment must be identified by nameplates,

- in dilophane with white background and black engraving inside,
- in 316L stainless steel on the outside, securely and permanently fastened with 316L stainless steel rivets or screws.

All electrical components (cables, fuses, terminals, contactors, push-buttons, relays, etc.) must be clearly identified physically, on drawings and diagrams.

Labels must not be attached to components that can be replaced or removed.

All special warnings, safety instructions and operating or maintenance should be inscribed on separate plates affixed directly to the equipment wherever possible.

6.2. CABLE NUMBERING

Each cable must be marked at each end with a "Plio Markers (PVC)" ring or similar, and the ring holder must be secured with a PVC collar.

The cable numbers break down as follows: Link type :

- ⇒ P : Power, , Tracing,
- ⇒ C : Control / Alarm / Signaling,
- ⇒ E : Lighting
- ⇒ M : Measurement.

Chrono : Chronological number of cables by link type

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7. TECHNICAL FILE

7.1. LANGUAGE

The operation and maintenance document must be in French.

All information, data, documentation, certificates, etc. from equipment SUPPLIERS and manufacturing CONTRACTORS must be in French.

All warnings, safety signs, inscriptions and labels must be in French.

7.2. CERTIFICATES

This CE certificate must be issued by a third party (automatic SUPPLIER certification is not accepted).

Assembly certification is not required if all assembly components are certified and designed to be installed together.

For all required type tests, SUPPLIERS must provide third-party validated test reports and certificates.