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# Scope

This Leading Practice document describes the general design of new Electrical Rooms. This document is based on the CoE document E-DS-002 Electrical Rooms.

The scope of this document is to specify general requirements for engineering, design and construction of new Electrical Rooms, either in new plants or in major expansions of existing facilities.

For existing Electrical Rooms, the requirements in this Leading Practice are recommended.

The scope of this Leading Practice is limited to Electrical Rooms (HV rooms, LV rooms, MCC rooms, transformer rooms, etc.); it is not dealing with control-, IT rooms and outdoor/field installations.

Required LP documents to be followed:

* LP50420-05 – Engineering Specification (this doc)
* LP50420-10 – Electrical Room Specification
* LP50420-11 – Electrical Room – Doors Specification
* LP50420-12 – Electrical Room – Raid Access Floor Specification
* LP50420-21 – Electrical Room – Doors Datasheet
* LP50420-22 – Electrical Room – Raid Access Floor Datasheet
* BU EHS requirements
* GRC recommendations (document 203J) [link](https://sites.cargill.com/sites/Finance/CFOLinks/insurance/Pages/EngineeringandInspectionsGuidelinesbyCategory.aspx)

# Definitions

An Electrical Room for this document is defined as closed electrical operating area enclosed with four walls, a floor and a ceiling.

Electrical power distribution and control equipment for this document contains, but is not limited to, transformers, HV panels, MCC panels, VSD, Soft Starters, lighting cabinets, UPS, auxiliary power cabinets, central I/O cabinets, DCS/PLC cabinets, etc.

Packet Units: are e.g. compressors, chillers, packaging and bottling equipment, silo unloaders, etc

# Electrical room

## General

All electrical power distribution and control equipment should be installed in Electrical Rooms.

Exceptions are local starters for packet units. This equipment can be installed out of an Electrical Room close to the machine, in ambient conditions specified by manufacturers with right ingress protection. But whenever possible it is recommended to install these cabinets also in Electrical Rooms and leave locally a control display (HMI) only.

This does not include oil filled power distribution transformers which are usually installed outdoors, including the primary disconnect switch.

As a general principle, different types of rooms should not be mixed in order to reduce the risk of electrical shock and arc flashes to a minimum. This allows the restriction of the room access according policies, local practices, and regulations to a minimum. The following type of rooms should be taken into account for the separation of rooms:

* HV (IS, MDS, SDS, etc.)
* LV rooms (MDP, MCC etc.)
* Instrumentation/automation rooms (central I/O, CPU, PC, etc.)
* Transformer rooms (dry transformers)
* Lead acid batteries

The room has to be constructed to withstand the pressure rise in case of an arc flash event. The installation of a pressure relief might be necessary.

## Room access and egress

Preventing access of unauthorized people to electrical room will increase the safety of personnel but also increase the reliability of the electrical distribution system. The following requirements apply:

* Electrical Rooms do contain potential hazard for people (e.g. electrical shock, arc flash, etc.). The access to Electrical Rooms shall be restricted. Doors to Electrical Rooms shall be closed and locked at all times to prevent unauthorized/unnecessary access.
* All doors to the electrical room shall be self-closing.
* It is preferred that doors to Electric rooms do not open to process areas; Electric rooms shall not be used as shortcut to process areas and only be entered for works or operations required inside the room.
* The locking of the door must never prevent the exit of the room (e.g. installation of crash bars or panic locks on all doors).
* The general design of the room and the location has to be done to allow for a safe egress (exit) of the room at any time, especially considering an incident or rather emergency situation.
* Locations and numbers of the doors shall facilitate the requirements of the emergency exit as defined by local code. Some local codes have specified a maximum length and width of the emergency exit way out of a room.
* It has to be ensured that an escape route is existing that is not passing or crossing any area with an arc flash energy CHRC 2 or greater. Exceptions apply for installations that are usually not accessed while being energized and exposed.

## Location of Electrical Rooms

The correct location of an electrical room is substantial for the reliability and safety of the room. The following requirements apply:

* Short distances to consumers/suppliers should be considered to achieve less cable lengths and electrical losses. Electrical equipment should be installed close to the functional areas they serve. MCC’s and transformer rooms should be adjacent to each other and also close to the load center of the serviced process area.
* Process areas should not be above Electrical Rooms.
* Preferred location of Electrical rooms is a separate building, outside the process area with separate foundations and an air gap to the next process building.
* MCC room and I/O room floor elevations should be located above any 500-year Flood Zone. It is important the equipment and the cable ends are above the flood zone.

## Environment of Electrical Rooms

The environmental conditions can have a major impact on the lifetime and reliability of the electrical systems and parts of systems. The wrong environment can cause and support the development of corrosion, which at the end could result in overheating of contacts, malfunction of protection circuits, short-circuits by whiskers (needle type corrosion caused by sulfuric acid that causes corrosion on silver plated equipment), etc. The key parameters are temperature, humidity, dust, and air quality. The following requirements apply

* If the room is subject for contamination with corrosive gases or dust exists, the room shall be pressurized. In this case the air shall be taken from a clean place.
* The air intake to the room shall be filtered, adequate for the environment from which the air is taken in. This might include a carbon filter for corrosive gasses and pre-filter depending on the dust particles (e.g. 3um / MERV 8).
* Doors to Electrical Rooms shall be self-closing to limit ingress of gasses, dust and rodents
* Doors to Electrical Rooms shall be equipped with door sweeps and shall have no gaps
* The entrance of rodents and other animals shall be prevented. Cable ducts should be sealed, and all openings shall include protection against rodents and birds.

## Construction of Electrical Rooms

There shall be no penetrations through the ceiling of an Electrical Room as this is a great potential source for water and dust ingress.

Acceptable construction material for electrical rooms are called out in document 203J.

## Electrical Room Dimensions

Additionally, to the size of the equipment to be installed, further aspects have to be considered to define the final dimensions of an Electrical Room:

* Operation and service possibilities: The aisles width shall be of 1,2 m minimum. Depending on the voltage level or regional code requirement higher space requirements might apply.
* Expansion possibilities: Consider the possibility to expand the equipment inside the room (e.g. additional bay for HV/LV switchgear, additional transformer box, spare MCC columns).
* Proper clearances should be provided around all equipment inside the room

## Heat and Ventilation

Adequate cooling, ventilation, heating and proper design of the building are the means for creating an indoor climate that prevents condensation and subsequent corrosion, reduction of creepage distance and reduction of lifetime of the installed equipment. Electrical rooms shall be maintained at a temperature to prevent equipment damage. The following requirements apply:

* The preferred system for HV/LV rooms and Instrumentation/automation rooms is an HVAC closed loop system. It should be considered to have a redundant or partly redundant unit.
* Sump cooling systems shall not be permitted
* The preferred system for a transformer room is forced ventilation using a clean air source that is not HVAC controlled.

## Fire Protection

Fire protection is a key element to ensure safety and reliability of our plants. Fire protection starts with the selection of the right building materials. In case of a fire, a key element to limit the damage is the earliest possible detection, a quick reaction and the possibility to de-energize the electrical room. The following section describes the requirements for fire protection of the electrical room:

* Fire protection shall follow the recommendations as laid down by the Cargill insurance company in document 203J and local code requirements for Electrical Rooms. This requires in particular to have a high sensitive fire/smoke detection system.
* A camera to allow a remote monitoring of the electrical room should be considered if the required emergency response time as laid down by document 203J cannot be met. This will provide secondary verification of a fire when the fire alarm system goes into alarm.
* It is recommended that the room be equipped with the possibility to de-energize the room either remotely (on site) or locally (outside of the room) for non-electricians. The de-energization does not need to be limited to the equipment inside the specific room (e.g. it is possible to de-energizes all transformers in a specific plant area instead). This will provide a method to turn off power before firefighting starts.
* The facility shall have a written response procedure on what to do in case of a fire alarm, which includes criteria when and how to turn off power to the room.

The following installations are generally not recommended and should only be allowed after separate, written approval:

* Installation of fire suppression system – this is because electrical arcing will continue until the power is turned off.  After power is turned off and the fire is detected in time, local portable fire extinguishers should be able to extinguish the fire quickly.
* Interlock of the fire detection system with the electrical feeder to the room – this is because Cargill has experienced multiple nuisance alarms of fire detection systems and the impact to the production could be very high.

## Room infrastructure

The infrastructure inside the electrical room shall be designed for temporary occupancy and shall follow safety, operational and reliability requirements. The electrical room shall be equipped with the following infrastructure:

* Normal lighting system to ensure sufficient lighting level as required by local code for operation and repair work.
* Emergency lighting system (battery powered or from an emergency generator) to facilitate safe egress in the event of power loss.
* GFCI/RCD protected socket outlets as per local code and standard to facilitate maintenance, repair and janitorial work
* MET (Main Earthing Terminals), to interconnect the PE cables/equipment grounding conductors of all switchgear/switchboards, all bonding cables and the conductors to the earthing rods.

# Executive Summary

The following section gives a brief summary of the major points from chapter 3

* All electrical power distribution and control equipment should be installed in Electrical Rooms.
* Different types of rooms should not be mixed.
* The access to Electrical Rooms shall be restricted.
* Electrical equipment should be installed close to the functional areas they serve.
* Process areas should not be above Electrical Rooms.
* If the room is subject for contamination with corrosive gases or dust exists, the room shall be pressurized.
* The entrance of rodents and other animals shall be prevented.
* There should be no openings in the ceiling of an Electrical Room.
* Electrical rooms should be sized to allow for safe and adequate maintenance/operation and for future expansion.
* Electrical Rooms should have adequate cooling and/or ventilation
* Design of room must take into account safe egress.
* Fire protection shall follow GRC recommendations and local code requirements for Electrical Rooms.
* Cargill’s minimum fire rating of the walls and doors is 1 hour. In some applications and geographies, the minimum requirement is 2 hours