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|  DM--SD-TBSIDDH09-System Description H09 Electrical.docx |
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Table of content

Table of content 2

1. Introduction 3

1.1. Purpose of the document 3

1.2. Definitions, acronyms and abbreviations 3

2. References 3

3. System Purpose 5

4. Concept of operations 5

4.1. System Stakeholders 5

4.2. Context & interfacing systems 6

4.2.1. Applicable standards 7

4.2.2. Environmental, Health, Safety and Security 7

4.2.3. Radiological safety important system parts 7

5. System characteristics 7

5.1. System functionality overview 7

5.2. Conceptual solution of the system 8

5.2.1. Low Voltage 8

5.2.1.1. Low Voltage Power 8

5.2.1.2. Lighting 9

5.2.1.3. Ducting systems 10

5.2.1.4. Grounding 10

5.2.2. Extra Low Voltage 11

5.2.2.1. Fire Alarm System 11

5.2.2.2. Integrated Security System 11

5.2.2.3. CCTV System 12

5.2.2.4. Communication Systems 12

5.2.2.5. Other ELV 12

5.2.2.6. Supervisory Security System 12

5.3. Constraints to the system 13

Document Revision history 13

# Introduction

## Purpose of the document

This document describes the system (H09 Electrical) functionality and serves as a basis for further design. This is a sub document to System Description H09 Waste building [1] and is a delivery within the Preliminary Design of the H09. Requirements on electric systems are listed in the requirement document [2] and Requirements in general are listed in the requirement document [3]

## Definitions, acronyms and abbreviations

|  |  |
| --- | --- |
| Abbreviation | Explanation of abbreviation |
|  |  |
| H09 | Waste building |
| ICS | Integrated Control System Division |
| ES&H | Environment Safety and Health Division |
| HV | High Voltage |
| LV | Low Voltage |
| ELV | Extra Low Voltage |
| SI | Site Infrastructure, a system within ESS |
| AHU | Air Handling Unit |
| C&M | Control and Monitoring |
| HVAC | Heating, Ventilation and Air Conditioning |
| SRS | System Requirement Specification |
| FBP | Fire Brigade Panel |

# References

|  |  |
| --- | --- |
| [1]  | ESS-0047239, DM--SD-TBSIDDH09-System Description H09 Waste Building..  |
| [2]  | ESS-0082464, DM--SR-TBSIDDH09-System Requirements H09 Electrical.xlsx.  |
| [3]  | DM--SR-TBSIDDH09-System Requirements H09 Waste Building, ESS-0183700.  |
| [4]  | Conventional\_Facilities\_Design\_-Manual\_Technical\_Systems, DM--AA-DEPGGDA---, ESS-0007857.  |
| [5]  | ESS-0027502, E01-DT-DEPGDDA--- INVESTIGATION AND STRATEGY REGARDING INDUSTRIAL LIGHTING.docx.  |
| [6]  | ESS-0018074, General grounding system description.  |
| [7]  | ESS-0002381, Fire Safety Strategy Report by B Yndemark.  |
| [8]  | Single line diagram power H09, ESS-0147168.  |
| [9]  | ESS-0068779, DM--SD-TBSIDD----SI Low Voltage.  |
| [10]  | DM--ID-DEPDDDH09-Common Systems ICD, ESS-0145269.  |
| [11]  | ESS-0206993, DM--DT-DEPDDDH09-ELECTRICAL DUCTING GROUND.pdf.  |
| [12]  | ESS-0206995, DM--DT-DEPDDDH09-ELECTRICAL DUCTING PLAN.pdf.  |
| [13]  | ESS-0045014 DM--SD-TBSIDD----SI ELV.  |
| [14]  | SI Fire Alarm System, DM--SD-TBSIDD----, ESS-0045013.  |
| [15]  | SI Integrated Security System, DM--SD-TBSIDD----, ESS-0045012.  |
| [16]  | Card reader drawing H09, ESS-0173270.  |
| [17]  | SI CCTV System, DM--SD-TBSIDD----, ESS-0045016.  |
| [18]  | SI Communication System, DM--SD-TBSIDD----, ESS-0045017.  |
| [19]  | ESS-0120478, DM--DT-TBSIDDA---Fiber Cable routing and dimensions.  |
| [20]  | ESS-0117912, DM--DT-TBSIDDA---SI SingleLine Communication systems.  |
| [21]  | SI Other ELV, DM--SD-TBSIDD----, ESS-0045015.  |
| [22]  | SI Supervisory Security System, ESS-0045018.  |

# System Purpose

The H09 Electrical system supply equipment and installations in H09 Waste Building with Low Voltage power. All power supply for H09 emanates from electrical substations in D05, which are fed with High Voltage from H06 Distribution Substation.

The central units for all Extra Low Voltage in H09 are located within racks in the COM room.

The H09 Electrical Low Voltage systems includes ducting system, power system, lighting system and grounding systems. The H09 Electrical Extra Low Voltage systems include Fire Alarm System, Integrated Security System, Communication Systems and Mobil-/radio communication.

# Concept of operations

## System Stakeholders

* ES&H
	+ ES&H representatives for safety and security.
* Other CF disciplines
	+ Other CF disciplines are sprinkler, HVAC, Transport and Control & Monitoring
	+ Other CF disciplines that will be connected are Cranes, Waste water treatment eq. and ELV systems.

## Context & interfacing systems

Figure 1: Context diagram of H09 Electrical (with subsystems). Blue systems are fed by the H09 Electrical. Green systems are feeding the systems

H09 Electrical has interfaces to other systems as defined in Figure 1 and in the text below.

H09 Electrical:

* ***H09 Electrical / Low Voltage*** receive Low Voltage from D05 substation.

H09Building:

* ***H09 Electrical / Low Voltage / Ducting*** provide conduits that are cast in the foundation with interface at the outer surface of the conduit.
* ***H09 Electrical / Low Voltage / Ducting*** provide Ducting using cable trays, duct or wall channel supported from ceiling of Building with interface at the surface of the ceiling/wall for CF equipment only.
* ***H09 Electrical / Extra Low Voltage / Safety System*** provide I/O signal to the fire hatches and some doors and doors in fire compartment zone.
* ***H09 Electrical / Extra Low Voltage / Security System*** provide I/O signal to some doors.

H09C&M:

* ***H09 Electrical / Low Voltage*** provide Low Voltage at distribution boards where H09 Control & Monitoring connect control cabinets.
* ***H09 Electrical / Extra Low Voltage / Communication system*** provide connection to Communication through data outlets in the generic cable system. Equipment such as routers, switches etc. are not included in electrical Scope.

H09 HVAC:

* ***H09 Electrical / Low Voltage / Grounding*** provide Grounding connecting at the bonding rails placed at control cabinets and around the building.

H09 Process:

* ***H09 Electrical/Low Voltage/Low Voltage Power*** provide low voltage to control cabinets.
* ***H09 Electrical / Low Voltage /*** Grounding provide Grounding connecting at the bonding rails placed at control cabinets and around the building***.***

H09 Transport:

* ***H09 Electrical/Low Voltage/Low Voltage Power*** provide low voltage at the transport control cabinets
* ***H09 Electrical/Extra Low Voltage/Communication*** provide communication systemswith the generic cable system delivering data at the transport control cabinets.

### Applicable standards

See CF Design manual Technical systems [3]

### Environmental, Health, Safety and Security

Lighting: ESS-0027502, Investigation and strategy regarding industrial lighting [4]

Grounding: ESS-0018074, General grounding system description [5].

Fire alarm: ESS-0002381, Fire safety strategy report [6]

Sustainability is defined in DM--SD-TBSIDDH09-System Description H09 Waste Building [1].

### Ra**d**iological safety important system parts

At this moment the electrical system for H09 has no RSF.

# System characteristics

## System functionality overview

* Low Voltage
	+ Low Voltage Power
	+ Lighting
	+ Ducting systems
	+ Grounding
	+ Lightning protection
* Extra Low Voltage
	+ Fire alarm system
	+ Integrated Security System
	+ Communications Systems
	+ Mobil- and radio communication
	+ Other ELV

## Conceptual solution of the system

### Low Voltage

#### Low Voltage Power

The Low Voltage system is generally described in the Design Manual, see DM--AA-DEPGGDA---Conventional\_Facilities\_Design\_-Manual\_Technical\_Systems, ESS-0007857 [3].

***Power supply***

There are four separate power supplies, three from grid power (“normal power”) and one from back-up power (“fed from diesel generator”) in switchgear in substations in D05.

The three feeds from grid power will be connected to three different distribution boards.
- One for large Process loads
- One for small Process loads
- One for building (outlets, lighting, electrical radiators, ELV-system, transport system and C&M)

The feed from back-up power will be connected to a distribution board. A redundant feed will be connected from the distribution board for Facility loads.

The main distribution boards will feed locally placed distribution boards, electrical cabinets for C&M, process and transport system.

Numbers and location of distribution boards and cabinets are defined in Single line diagram, ESS-0147168 [7]. Definite location will be decided in Detail Design. Location should be close to actual loads.

Note: Solution above could be subject for change when further information is available. Possible changes could be to merge two of the normal feeds to one or maybe three feeds to one.



Figure 1 Conceptual solution flow chart for the LV system

***Outlets etc.***

Scope of outlets and connection boxes according to The Low Voltage system is generally described in the System Description Site Infrastructure Electrical [8] and DM--ID-DEPDDDH09-Common Systems ICD, ESS-0145269 [9].

Charging stations for electric vehicle shall of 3-phase typ2 with fixed charging cables.

#### Lighting

The Lighting system is generally described in E01-DT-DEPGDDA--- INVESTIGATION AND STRATEGY REGARDING INDUSTRIAL LIGHTING, ESS-0027502 [4].

Lighting systems provide lighting for all areas and outside exit doors and gates.

Emergency lighting system will be designed according to the Fire safety strategy report [6] and fed from back-up power. Emergency lighting will be switched on automatically at power failure when the generators have started. The emergency lighting system is supplied from the back-up power system.

There shall be lighting for fenced in area for containers.

Emergency exit signs will be designed according to the Fire safety strategy report [6]. The signs will always be switched on and provided with internal battery back-up.

#### Ducting systems

The Ducting system is generally described in the System Description Site Infrastructure Electrical [8].

Ducting systems are performed with cable trays and conduits. The purpose is to support all kind of cable routing in CF scope.

Preliminary design of ducting according to DM--DT-DEPDDDH09-ELECTRICAL DUCTING GROUND [10] and DM--DT-DEPDDDH09-ELECTRICAL DUCTING PLAN [11]

#### Grounding

The Grounding system is generally described in the General Grounding System Description [5].

Grounding system is to provide protective grounding and lightning protection. The base of the system is the foundation grounding using the concrete reinforcement bars in the base slab. The functional grounding system is made accessible by ground bars in electrical substations and in all electrical niches that are connected to the foundation grounding.

The ground in foundation is connected to the main ground ring every 10 meter. The main ring ground conductor in stainless steel goes outside of the building where it is not in direct connection to other buildings, approximately 0,75m below finished ground level and 1m from the foundation.

The lightning protection system installed to protect from lightning surges in accordance with Lightning protection risk Analysis. On the roof there is a grid system of conductors to cover the complete roof with a lightning protection system of class LPL2. At some places there are also antennas connected to the grid system to protect other installations like ventilation hoods or communication antennas on the roof.
The grid system is connected to the main ground ring in around the foundation via down conductors along the façade.

The internal lightning protection of the waste treatment function i.e. surge protection and induced protection, provides SPD protection according to level LPL1. Residual voltage of 1,5kV.

### Extra Low Voltage

General system description, see DM--SD-TBSIDD---- SI ELV, ESS-0045014 [12].

The building is connected to the Site Infrastructure ELV ducting system through separate ducts.

#### Fire Alarm System

General system description, see DM--SD-TBSIDD---- SI Fire Alarm System, ESS-0045013 [13].

Fire alarm is installed in purpose to detect a fire in all areas within the H09 as defined in the Fire Strategy Report [6].

The building H09 is connected to the fire alarm panel in D05, room D05.100.XXXX through a separate loop.

Alternative: Fire alarm in H09 is connected to separate fire alarm central unit. Central unit is connected to site wide system via fibre.

There will be a fire brigade panel in main entrance to H09.

The system shall be designed so installation of by-pass timer is possible. Placement and function of by-pass timer should be according to requirements in Fire Strategy Report [6].

Evacuation alarm is trigged by a detector, when alarm is activated it should be heard in the whole building according to ESS-0002381, Fire safety strategy report [6]. All alarming devices in the fire alarm system placed in H09 are presented in the Security Monitoring room with individual addresses. The indication consist of information in several levels; “dirty” detector, Pre-Alarm and alarm.

The fire alarm system distributes control signals to technical devices as the C&M and receives signal from the sprinkler system at the Sprinkler Monitoring Panel.

#### Integrated Security System

General system description, see DM--SD-TBSIDD---- SI Integrated Security System, ESS-0045012 [14].

The Integrated Security systems in H09 include intrusion alarm, access control and door control. Local power supply for the integrated security system are to be located in the building, communication to central units emanates from Security server room in H01 or in D02.

Card readers will be placed on door according to card reader drawing, ESS-0173270 [15]

In purpose to trigger an alarm in case of an unauthorized entrance to H09, there is an intrusion alarm with different sensors installed. The intrusion alarm system may comprise of main units, control panels, motion detectors, door sensors/contacts, sounder units, address units. In case of an alarm there is a signal sent to the supervisory security system from central unit, each alarm point is individually presented in the Supervisory Security System. The Supervisory Security System remotely open and locks doors, blocks doors and card readers.
The access control system is performed with proximity card reader at the entrance door, locks with handle control or push buttons to control the doors.

The Access Control system shall provide functions such as

* Normal passage
* Signal if a door is open to long
* Control intrusion alarm
* Alarm indication

#### CCTV System

General system description, see DM--SD-TBSIDD---- SI CCTV System, ESS-0045016 [16]. CCTV will be installed on the outside of the building according to above referred document.

#### Communication Systems

General system description see DM--SD-TBSIDD---- SI Communication System, ESS-0045017 [17].

Cabinets to support H09 is placed in the COM room.

There should be reserved space for 1 pcs ICS rack in the COM room.

Network communication outlets will be designed for technical equipment to C&M.

Outlets for technical equipment are provided to C&M, Transport and “Monitoring of ionising radiation”.

Scope of Network communication outlets is generally described in the Design Manual, see DM--AA-DEPGGDA---Conventional\_Facilities\_Design\_-Manual\_Technical\_Systems, ESS-0007857 [3], and DM--ID-DEPDDDH09-Common Systems ICD, ESS-0145269 [9].

Optofiber is provided to Security systems and Fire alarm system.

Structure of fiber network backbone cabling are described in the SI documents [18] and [19]

#### Other ELV

General system description see DM--SD-TBSIDD---- SI Other ELV, ESS-0045015 [20].

There are no identified requirements to install any other ELV-system in H09.

#### Supervisory Security System

General system description, see DM--SD-TBSIDD---- SI Supervisory Security System, ESS-0045018 [21].

A Supervisory Security system is to be installed in the security monitoring room, located in F04.

## Constraints to the system

|  |  |
| --- | --- |
| Material used in radiation environment | The equipment installed in red zones will be affected by the radiation environment. It is very difficult to clarify all materials used in all equipment and to predict what damage the radiation will cause. It is clear that the maintenance of electrical installation in red zones must be more periodically than normal. |

Document Revision history

| Version | Reason for revision | Date |
| --- | --- | --- |
| 1.0 | New document | 2017-02-28 |
| 2.0 | Revision PD | 2017-10-02 |
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