ESS - Instrument Technical Interfaces

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2. ISSUING ORGANISATION

NSS

3. CONTEXT

Whole ESS vs. Instrument from design perspective

4. INTERFACE DESCRIPTIONS

4.1. Coordinate systems and breakdowns

Ref.: ESS-0035090

4.1.1. Main Coordinate System of the main ESS model (TCS)

The origin of the Target Coordinate System is positioned on the vertical monolith centerline.

X – axis axis pointing upstream the proton beam.
Y – axis is in accordance to the "right hand" rule
Z – axis is opposite to the gravity vector

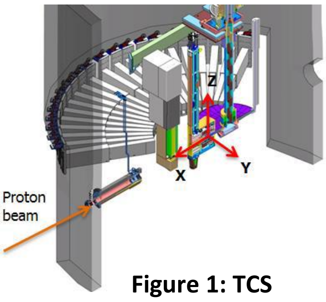


Figure 1: TCS

4.1.2. Instrument source coordinate system (ISCS)

The origin of the ISCS is the point considered as the neutron source for a given instrument. The ISCS is usually defined by the scientist responsible for each instrument.

X – axis axis pointing along the instrument the neutron beam.
Y – axis is in accordance to the "right hand" rule
Z – axis is opposite to the gravity vector

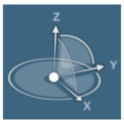


Figure 2

4.1.3. Standard NSS model breakdown for CHESS (PBS)

Ref.: ESS-0034841

4.1.4. Generic NSS model breakdown for models

Note: all the instrument models shall follow the high-level breakdown!

- In Bunker
- Outside Bunker
- End Station
- Utilities and Distribution
- Space claims and interface points

For low-level breakdown, please check Ref.: ESS-0748789 Instrument Skeleton [4]

4.2. Geometry interfaces (Models and drawings)

Note: Please use Explore layer in CATIA to open the models then select the model(s) and open only the necessary item(s).

4.2.1. Main models

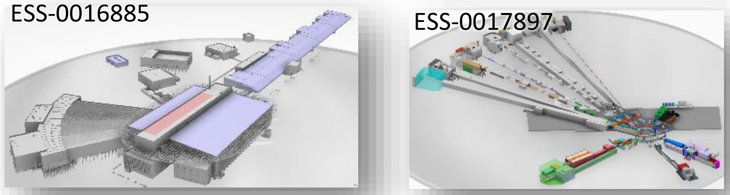


Figure 3: High level facility models

- ESS Plant Layout: ESS-0500000 (Official plant layout with Configuration management)
- ESS Conceptual Assembly: ESS-0016885 (Plant layout with no Configuration Management/Obsolete)
- Complete instrument suite: ESS-0017897 (No Configuration Management)

4.2.1.1. Instrument models

- NMX /W1/: ESS-0007146
- BEER /W2/: ESS-0083838
- CSPEC /W3/: ESS-0097525
- BIFROST /W4/: ESS-0065526
- MIRACLES /W5/: ESS-0115201
- MAGIC /W6/: ESS-0108796
- T-REX /W7/: -
- HEIMDAL /W8/: ESS-0099156
- ESS TBL /W11/: ESS-0131283
- LOKI /N7/: ESS-0066596
- FREIA /N5/: ESS-0089350
- ESTIA /E2/: ESS-0050413
- SKADI /E3/: ESS-0217889
- VESPA /E7/: ESS-0092139
- DREAM /S3/: ESS-0136449
- ODIN /S2/: ESS-0190750

4.2.2. Main Building (D01, D02, D03, E01, E02)

4.2.2.1. Building layout drawing

Overview for different levels of the building:
ESS-0475569

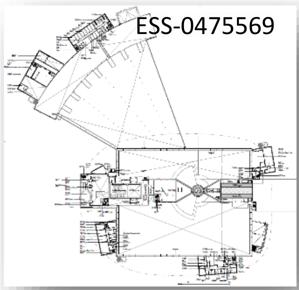


Figure 4: Building overview

4.2.2.2. Building models

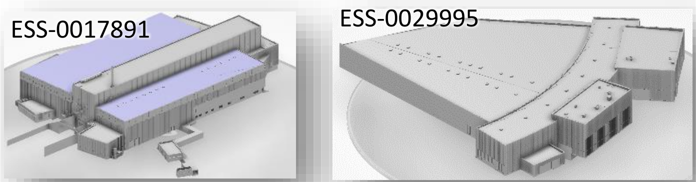


Figure 5: Building models

- D01, D02, D03 (Structural/Architectural/Infrastructure): ESS-0017891 /ESS-0016705 /ESS-0030008
- E01, E02: (Structural / Architectural /Infrastructure): ESS-0029995 / ESS-0029974/ ESS-0029996

4.2.2.3. Expansion (/dilatation) Joints

Ref.: **ESS-0462002**, ESS-0409664**,** ESS-0260358

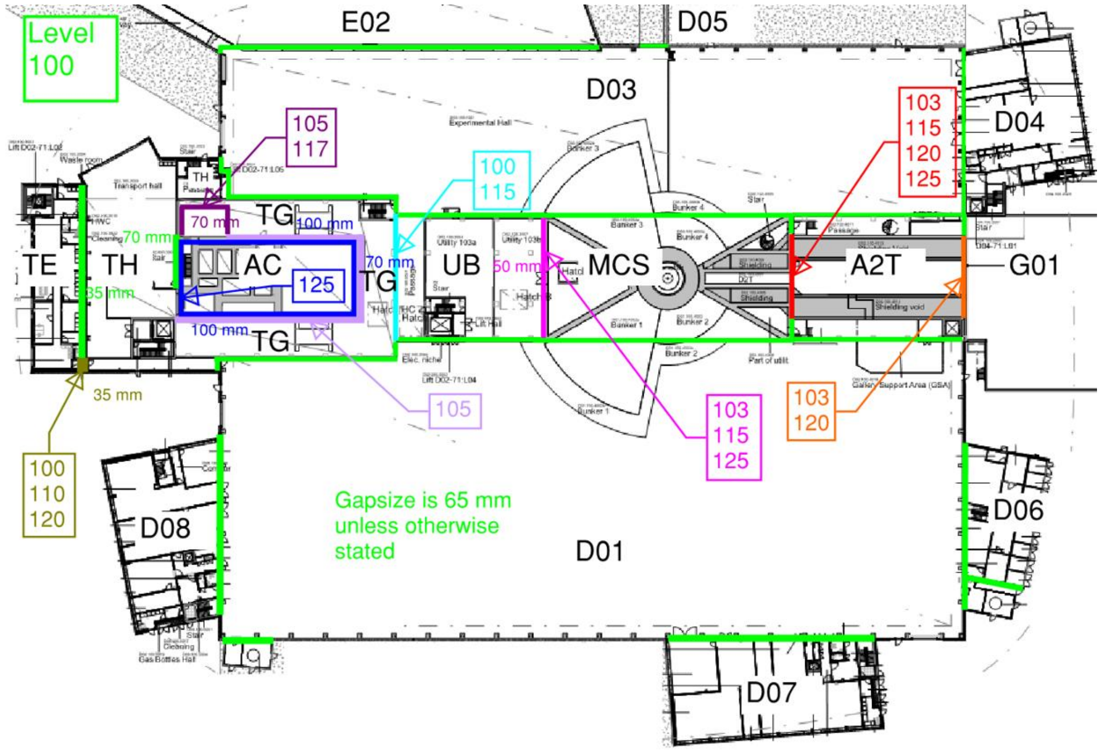


Figure 6: Expansion joints and gap sizes. The coloured lines mark the joints and the numbers refer to the levels

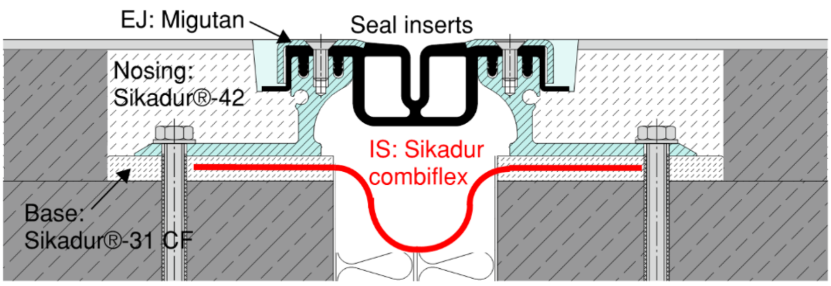


Figure 7: Expansion joint

There is no Expansion Joint between E02 and E01. We have expansion joints within E02, but since the piles are independent it shall not affect the instruments.

4.2.2.4. Non-Magnetic floor

Check drawing in document ESS-0121896 for detail of non-magnetic floor in hall D03. link: https://chess.esss.lu.se/enovia/link/ESS-0121896/21308.51166.4096.9748/valid
Check procedure ESS-0036612 for details of the 'ESS procedure for material choice in vicinity of Neutron Spin-Echo (NSE) instruments'.

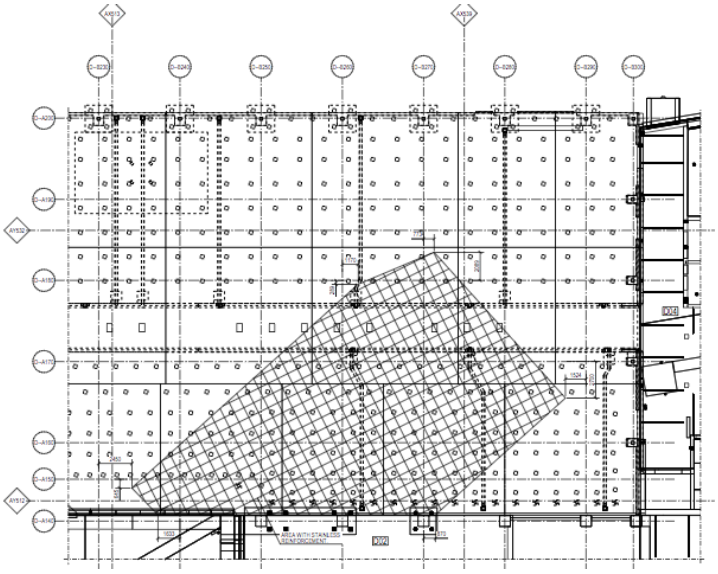


Figure 8. Non-magnetic floor in D03

4.2.2.5. E02 Piles

- Original *model*: ESS-0401829
- As built layout *drawing*: K04-20---V-E--------beamline_piles_actual.dwg
- Pile interface:

  Model and Drawing: ESS-1104269

  Compatible I-beams:

  - IPE 140 (140mmx73mm) or
  - HEB 140 (140x140) cross-beams

  Height tolerance of the interface plates: +/-2mm
  Stability: 3mm over 50years (With 1ton preload)
  Nominal Load capacity: 75ton/pile [25]

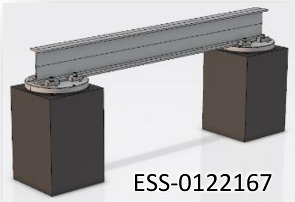


Figure 9: E02 pile interface

4.2.3. Monolith inserts (Target components)

Top Monolith Assembly *model*: ESS-0017679

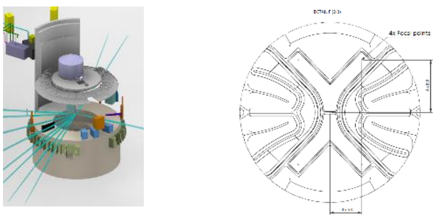


Figure 10: Top monolith assembly and moderator

Interface *drawings*:

- ESS-0032315.3 – ICD Moderator – NSS
- ESS-0054363.3 – Space for neutron guide in the monolith insert
- ESS-0068438.2 – Generic schematics of the Monolith Insert with the guide interfaces.
- ESS-0376748 – Dimensioned in monolith Geometry schematics for instrument optics

Models for all the beam-ports: ESS-0052572

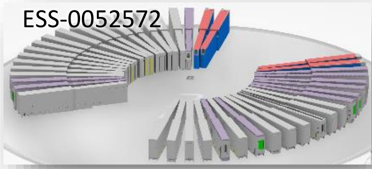


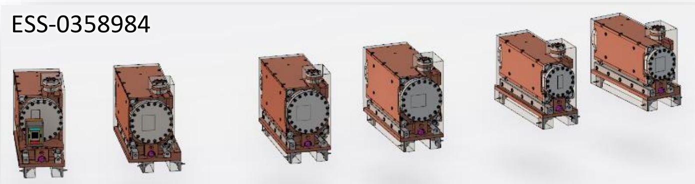
Figure 11: Beam-port inserts

4.2.4. Monolith Optics /NBOA/

- NMX /W1/: ESS-xx
- BEER /W2/: ESS-xx
- CSPEC /W3/: ESS-xx
- BIFROST /W4/: ESS-xx
- MIRACLES /W5/: ESS-xx
- MAGIC /W6/: ESS-xx
- T-REX /W7/: -
- HEIMDAL /W8/: ESS-xx
- ESS TBL /W11/: ESS-xx
- LOKI /N7/: ESS-xx
- FREIA /N5/: ESS-xx
- ESTIA /E2/: ESS-xx
- SKADI /E3/: ESS-xx
- VESPA /E7/: ESS-xx
- DREAM /S3/: ESS-xx
- ODIN /S2/: ESS-xx

4.2.5. Light shutter and Bridge Beam Guide assembly models

- Layout Schematics: ESS-0376748
- Light shutter *models*: ESS-0053469
- Layout schematics:
- Bridge Beam Guide Optical Assembly *models* for all instruments, including interface envelope for target: ESS-0358984



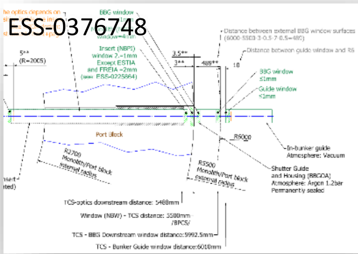


Figure 12: Light shutters

4.2.6. Bunker

- Bunker cross-section drawing: ESS-0047079.5
- Main bunker assembly model: ESS-2118168
- Bunker wall assembly model: ESS-2118409
- *Generic Interface drawing: ESS-0238152.2*
- Bunker roof assembly model: ESS-2118416
- Bunker frame model: ESS-2118395
- *Bunker pillars drawing: ESS-0051975.1*

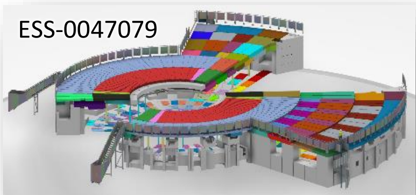


Figure 13: Bunker top assembly

4.2.6.1. Bunker Instrument Base-plates

- Bunker instrument base-plate model: ESS-0191187
  Interface drawings: ESS-0191210.2, ESS-0190902.2, ESS-0190978.2

  Baseplates will be procured by ESS up to 11.5m with the exception of the dilatation joints. Baseplate models are available for the complete bunker.

  There will be customized base-plates for the dilatation joints, if necessary.

4.2.6.2. Bunker Wall Feed Through and Inserts

The Feed Trough penetrations will be prepared based on the envelopes of the instrument inserts.

The planned gap is 5mm sideways and 10 mm vertically. The 60% of the gaps will be filled with steel plates and borated PE on the top of the insert.

Summarized absolute position tolerance of the internal envelope (void) of the embedded case: ±1mm

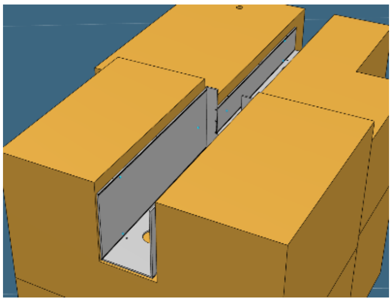


Figure 14: Feed-trough case

4.3. Parameters, rules and requirements

4.3.1. Spatial Tolerances with regards to the nominal position, relative to TCS

- Absolute dimensional tolerance for the building: ±10mm [39]
- Height tolerance of the E02 pile interface plates: ±2mm [30]
- Absolute dimensional and positional tolerance for the Bunker Instrument Baseplates: ±1mm (±0.5mm for the fiducial sockets)
- Alignment accuracy of the BBGOA: ±0.11mm (X,Y,Z) [29]
- Repeatability of the BBGOA better than [29]:
  - Lateral is better than:
    - ±0.05mm for FREIA
    - ±0.2mm for the other instruments in case of the first 15
    - ±0.15mm for the later instruments
  - Vertical is better than ±0.2mm
  - Longitudinal: ±1mm
- Floor properties: see 4.3.2
- E02 Piles: see 4.2.2.1

4.3.2. Floor properties

4.3.2.1. Nominal Load capacity

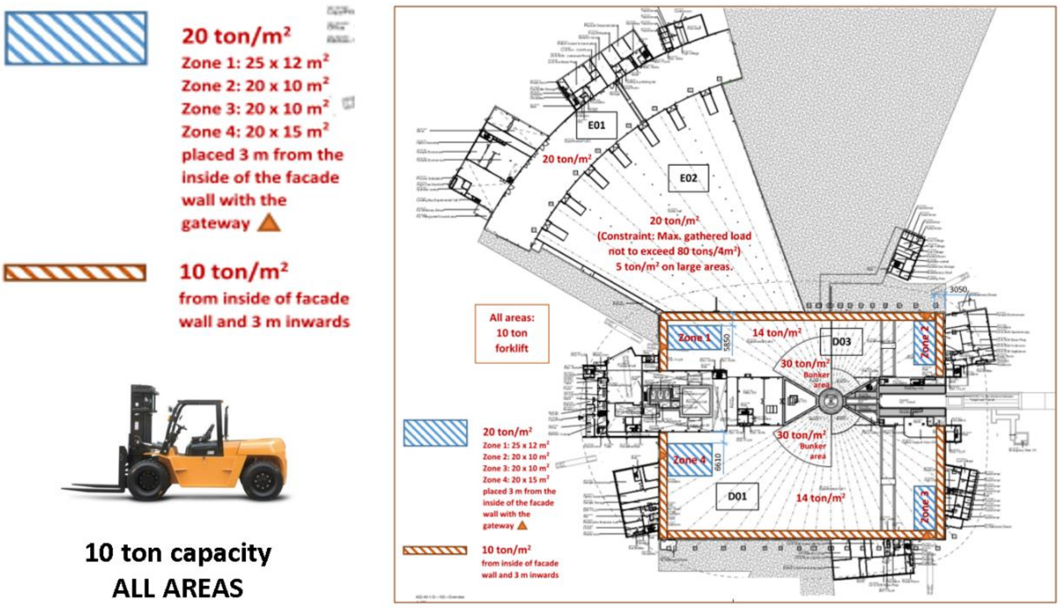


Figure 15: Nominal floor load

4.3.2.2. Floor load calculation for shielding

See ESS-3139153[49] for more details!

1. The instrument shall provide a load map, with pressure values, to show the load on the surface of the floor.
2. If the load is less than the nominal load capacity (E01:20t, D01-3: 14t) then it is approved.
   The load shall be less than the nominal load capacity on the surface above the conduits (ref. models ESS-0346214 (D03), ESS-2721512 (D01))
3. If the load is less than the nominal load capacity (above) in the mid plane of the floor (25cm deep), considering 45% load spreading, then the load has to be reviewed by CF/COWI. For this the map of the environmental static and dynamic surface load has to be also provided (dwg). To speed up the process, it is advised to supply verification analysis results.
4. If the load is more than the nominal load capacity, considering load spreading, then the footprint has to be increased.

4.3.2.3. Point Loads

Part of the uniform area load (Figure 15)

- D01 and D03: 140 kN/m2 (14 ton/m2)
- E01 and E02: 200 kN/m2 (20 ton/m2)

can be “collected” to a point load. The point load shall be placed in the center of the collected area.

The largest area that is allowed to collect load from is 1,3 m x 1,3 m. The maximum surface load that can be collected is 100kN/m2(in E01), or 59 kN/m2 (in D01, D03).

The same uniform surface load that is collected shall be reduced inside the chosen area (since point loads placed in certain points on the slab will reduce the capacity). The maximum point load is then 100 kN (=59kN/m2x1.3x1.3), or 169 kN (=100kNx1.3x1.3). The area is always square. The uniform area load outside this area can still be 140 kN/m2 or 200kPa.

The local surface load under a point load shall never be larger than 10 000 kN/m2.

It is possible to collect lesser uniform area load than the chosen 100 kN/m2, or 59 kN/m2, but the reduction shall always be at least the same value as the collected uniformed surface load.

It is possible to collect loads from smaller area than 1,3x1,3 m2. It is possible to place areas close to each other. The point loads will always be placed a distance from each other since they are placed in the center of the collected area, see attached figure 1 below, for better understanding.

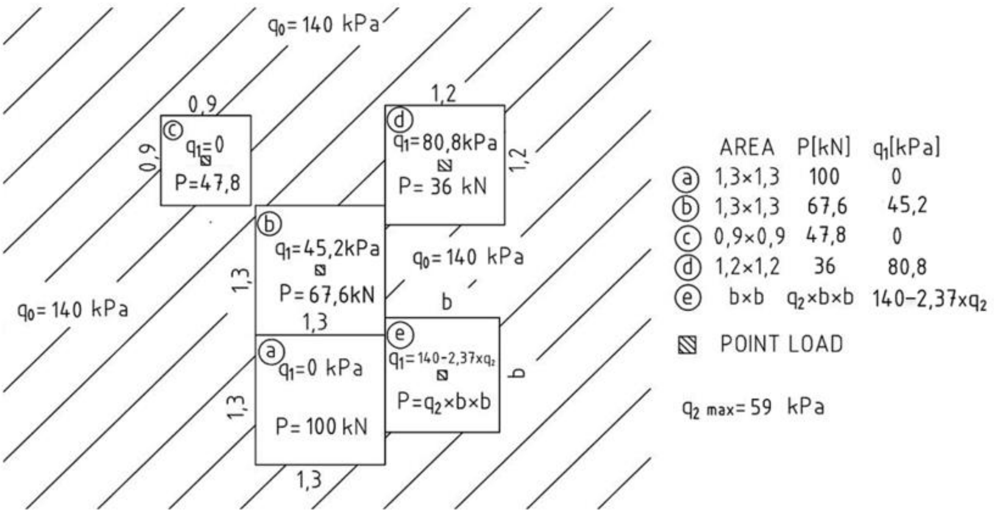


Figure 16.: Point load example for D01 & D03

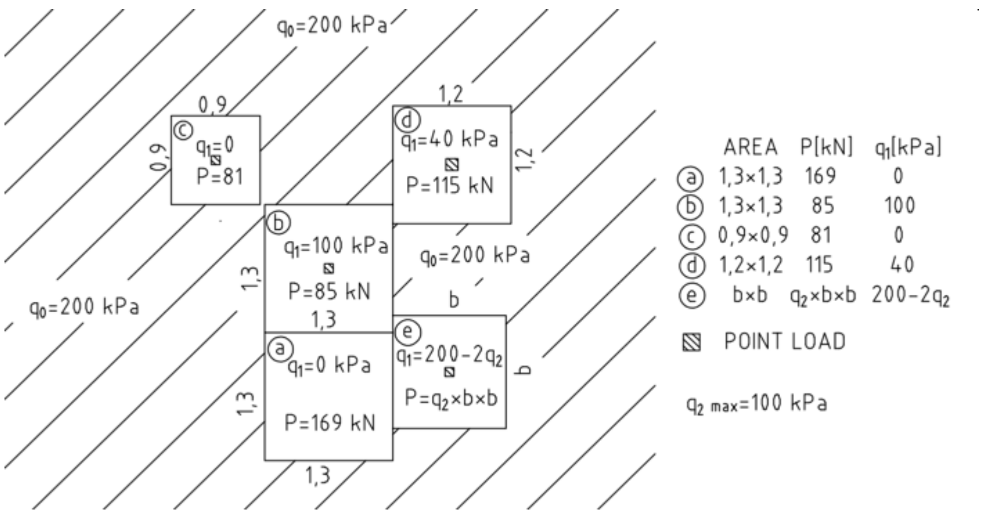


Figure 17.: Point load example for E01 & E02

4.3.2.4. Floor properties

Stability of D01-2-3 and E01 (sinking With respect to day1) [6] [49]:

- Due to dynamics loading have a stability for elastic movement: **3mm**
- Stability for creep/deformation over the lifespan of the facility: **3mm**
- Absolute level tolerance: ±6mm (in the TCS coordinate system)

Expected maximum horizontal movement of the floor at the dilatation joints (heat expansion + shrinkage): ±3mm

Flatness: 5mm per 2.0m; 2mm per 0,25m (AMA)

Surface treatment: dust bonded concrete (water glass)

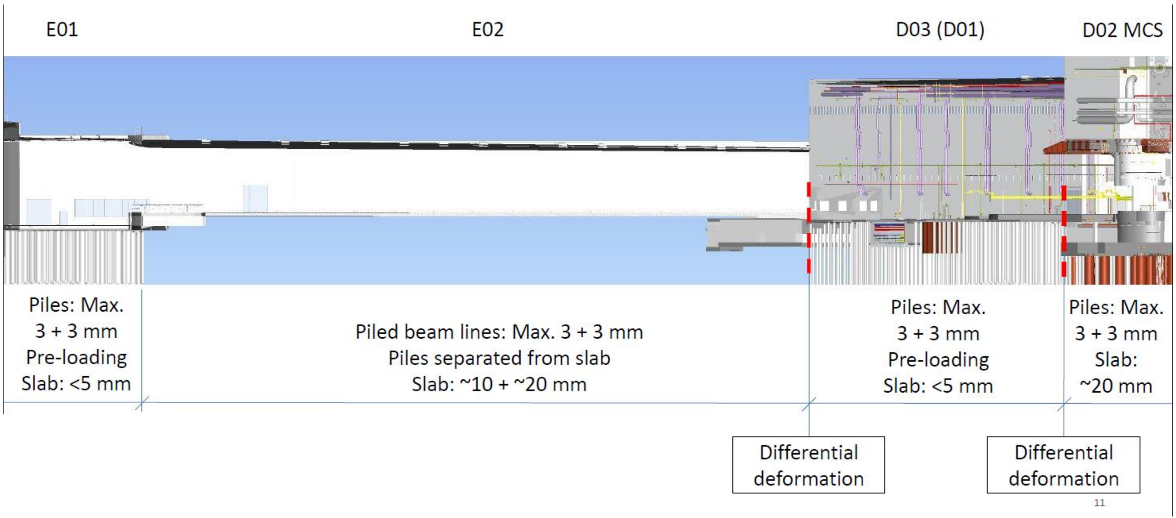


Figure 18.: Summary – Vertical deformations

4.3.2.5. Load Capacity of piles under the floor [25]

- ULS: 750 kN
- SLS: 550 kN

With relaxed settlement requirement:

- ULS: 1200 kN
- SLS: 850 kN

4.3.2.6. Drilling and mounting to floor

Thickness of the top concrete layer in the instrument halls (without reinforcement): 35mm±10mm. It is allowed to drill this layer.

Based on tests in the accelerator tunnel, the recommended maximum load for the top concrete layer with M16 chemical anchor (HILTI): 11.1 kN (Ultimate strength: 42kN)

If deeper anchors are needed then check the details in [37] for the E buildings and [38] for the D buildings. In this case it is possible to drill small pilot holes, or scan the area.

For deep anchors, chemical anchors are recommended with plastic centralizer rings to avoid grounding problems. It is also recommended to consider alternative mounting solutions during the design to avoid hitting the reinforcement, i.e.: additional, or elongated holes, or clamps.

In case of hammer drilling the holes shall be at least 25cm from the edge of the floor slab. Main references: [37], [38]

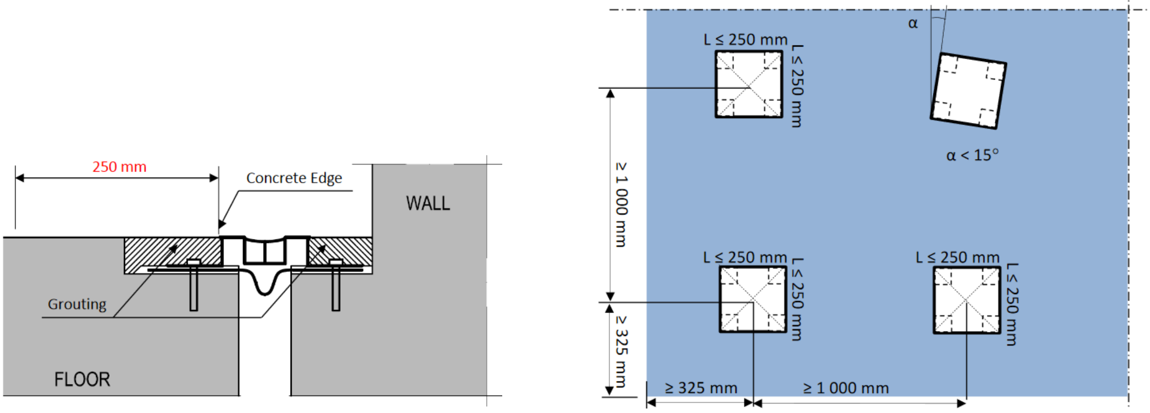


Figure 19: Minimum drilling distance from concrete edge for a) hammer drill and b) core drill with anchor plates

4.3.3. Logistics

4.3.3.1. Definition of ESS space claim envelope for transfer routes

Model: ESS-0207007

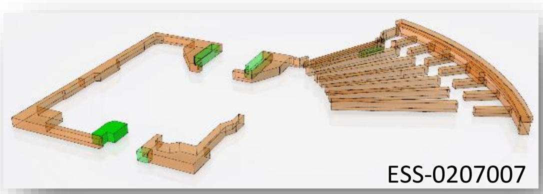


Figure 20: Space claim for transportation

Note.: This volume shall not be violated by the instruments without ESS approval.

4.3.3.2. Logistics in the E buildings

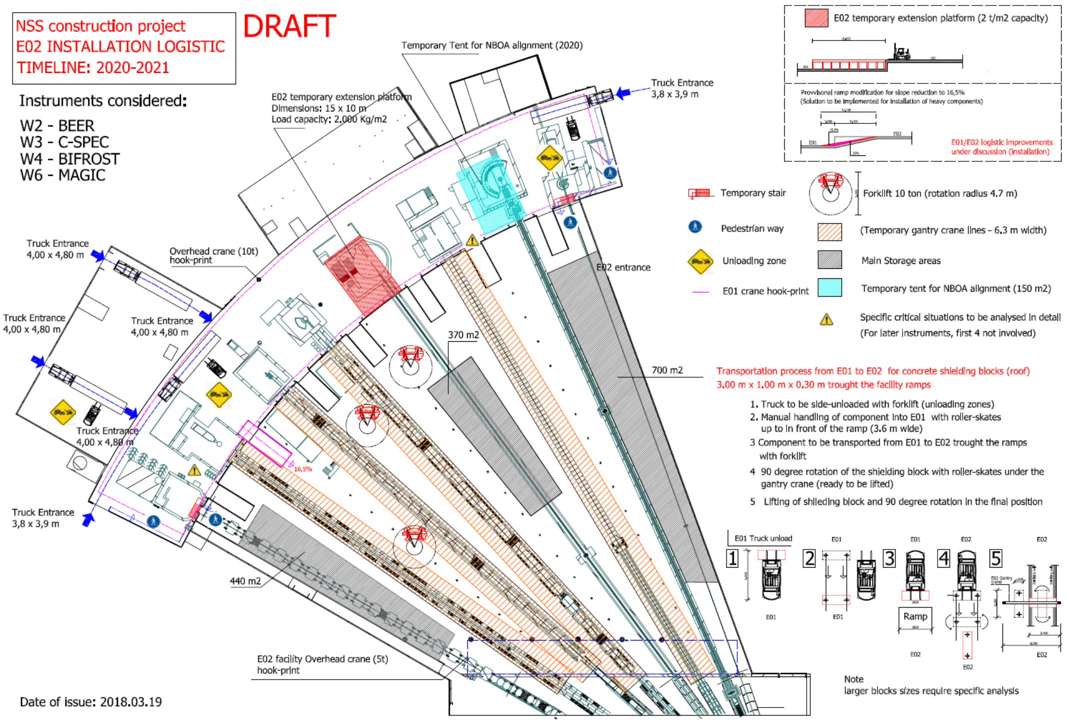


Figure 21: Logistics in E01 and E02

4.3.3.3. Doors

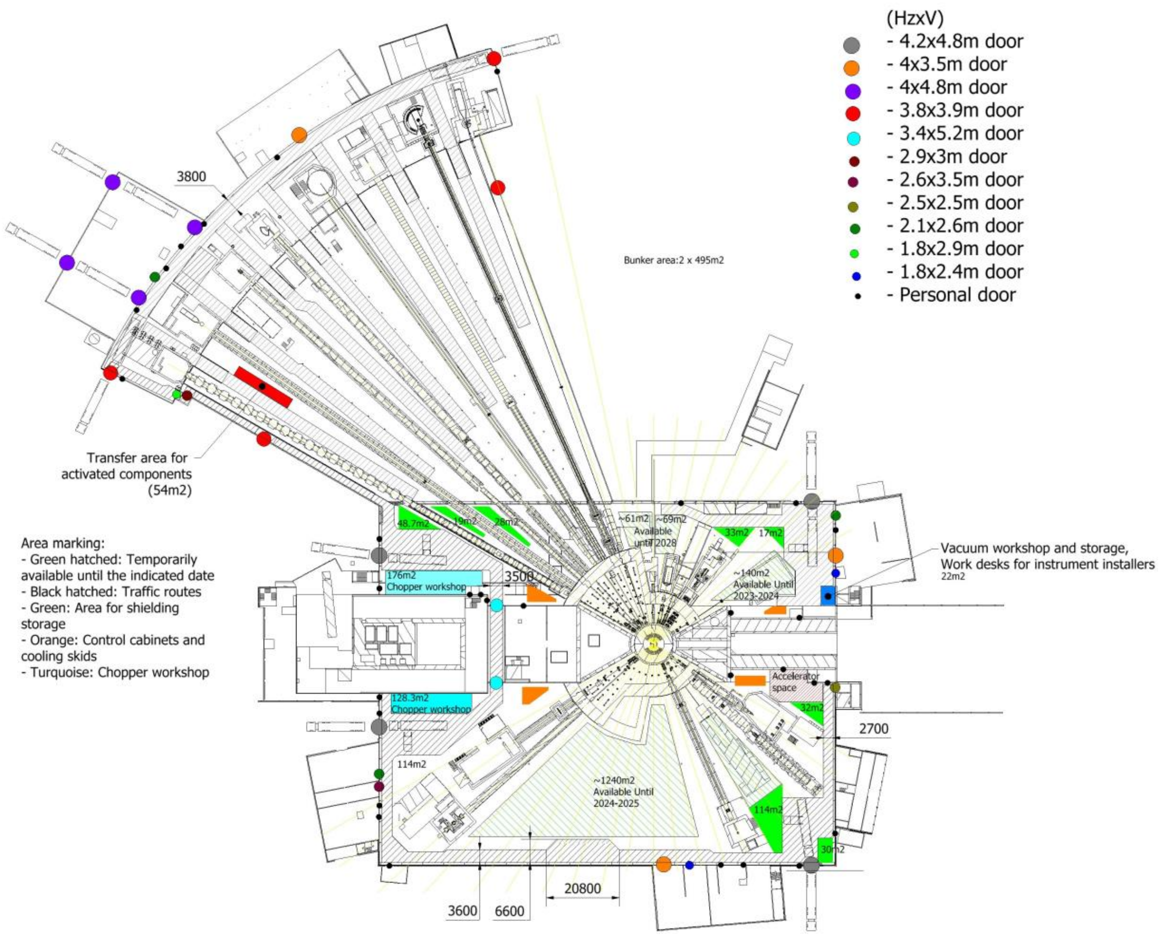


Figure 22: Door dimensions

4.3.4. Instrument Building (Cave, shielding, hutch) requirements

Please see [51] and [52] for details.

- Eurocode 0: Basis of structural design (EN 1990)
- *Eurocode 1: Actions on structures* (EN 1991)
- *Eurocode 2: Design of concrete structures* (EN 1992)
- *Eurocode 3: Design of steel structures* (EN 1993)
- EKS 11: Boverket mandatory provisions amending the board's mandatory provisions and general recommendations (2011:10) on the application of European design standards (Eurocodes)
- Seismic requirements: see 4.3.7.
- Requirement for floor load: See 4.3.2.1
- Fire safety: see 4.3.5

For cast in place caves

- Provide Strategy for installation with minimal contamination (dust)
- For decommissioning we need an analysis containing:
  - No radioactive waste from cast concrete (No or low activation)
  - Strategy for decommissioning without contaminating the environment (dust or liquid)
- Separation from floor

There is no detailed description of the allowable level of contamination, but as general rule, we can say that it shall be similar as in case of the block structure.

4.3.5. Fire safety

Inside the bunker: there is no fire safety requirement for instruments.

Along the beamline: you shall use non-combustible materials. (ie. Borated plaster, sintered boron, or borated substrate)

In the Chopper Pit: Reasonable mitigation:

- No mitigation if there is no combustible material around the chopper (except cables).
- If there is combustible material, (i.e.: PE shielding) it shall be covered with not combustible material.

In the Cave and Control Hutch:

- Fire suppression system (ie. water, powder, gas or FM-200 or similar) [44]
- R30 Fire classification for structural elements
- Illuminated exit sign
- Alarm

For more details see [47]

Note.: No drain is necessary for sprinkler water.

4.3.6. Lifting

- ESS-0402063 - ESS Handbook for Rigging & Lifting Operations
- **Remote handling lifting interfaces collection:** CATIA assy: ESS-0243444 (DIN 580, DIN 582, CERTEX, PN JA.8271006-Mx)

Figure 23: Lifting point for blocks

- Preferred lifting point for concrete blocks: Spherical anchor (for example: DEHA Spherical anchor 6000-4)
- Design for lifting (EN 13155): No permanent deformation for twice the load. No failure for 3 times the load.
- Supported lifting thread sizes
  (The nominal values below has to be verified with the specific product.)
  - M12 (Nominal load for lifting bolts: 7 500 - 20 000 N)
  - M20 (Nominal load for lifting bolts: 23 000 - 60 000 N)
  - M30 (Nominal load for lifting bolts: 45 000 - 120 000 N)

Please find details about cranes in 4.4.28.

4.3.7. Seismic requirements:

4.3.7.1. Buildings

- In general: There is no direct seismic demand on NSS buildings (EUROCODE 8), but they shall not jeopardize any safety function or safety related function of Systems, Structures and Components in seismic category 1 or P. [24]
- E01 – E02: No Seismic requirements
- D01 – D03: The shielding should not fall on the structural pillars of the building.

4.3.7.2. Instrument components

- NBOA (monolith optics) and BBGOA (Light Shutter)
  - Load-case 1 (earthquake load): own weight (EW) + internal loads + earthquake load (EQ) of 0.4g in horizontal or vertical direction. In this scenario the alignment of components shall not be changed within the accuracy values after the event.
  - Load-case 2 (high earthquake load): own weight (EW) + internal loads + earthquake load (EQ) of 2.0g in source direction. In this scenario the component shall not shift by more than 2mm to make sure the safety windows are kept intact.

- Components downstream the BBGOA
  Load-case 2 (high earthquake load): own weight (EW) + internal loads + earthquake load (EQ) of 2.0g in source direction. In this scenario the component closest to the BBGOA shall not shift by more than 5mm to make sure the safety windows are kept intact.

- Rest of the components
  Everything shall be bolted down, or mounted safely with other method.

4.4. ESS Facility Infrastructure and utilities

Ref: Outlets in D E Experimental halls [11]

CATIA model number of the utilities to be designed and built by ESS: LESS-0047079

- Instrument Power
- Vacuum
- Cooling
- Network
- Helium recovery

4.4.1. Bunker infrastructure/utilities

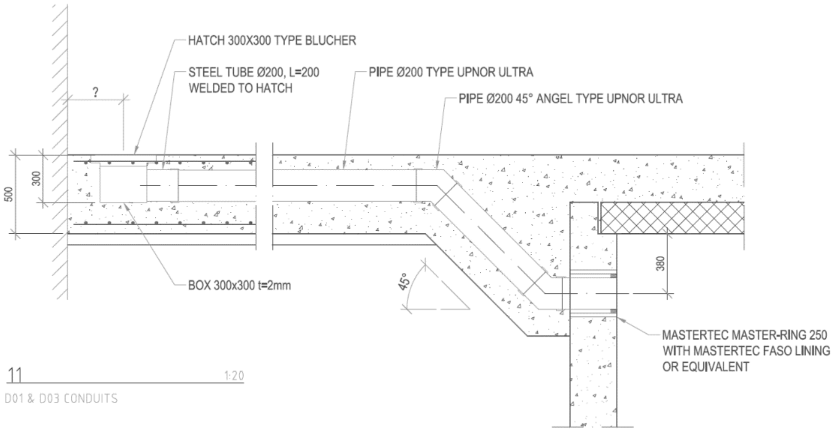
CATIA model number: LESS-0047079 (sub-assembly of LESS-0047079)

4.4.2. CF infrastructure/utilities models

See 4.2.2

4.4.3. Conduits and potential floor penetrations from the D01 and D03 galleries

It is possible to drill holes from the Experimental Hall floor level down through the slab in to the conduits. The holes shall have a maximum diameter of 180 mm and the distance between the holes shall not be less than 2000 mm.



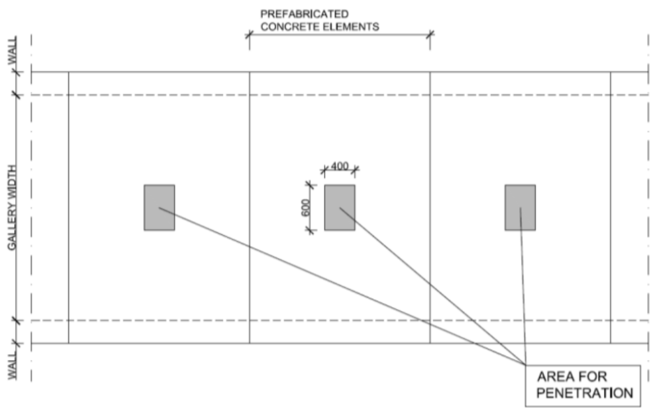


Figure 24: Conduits and gallery penetrations

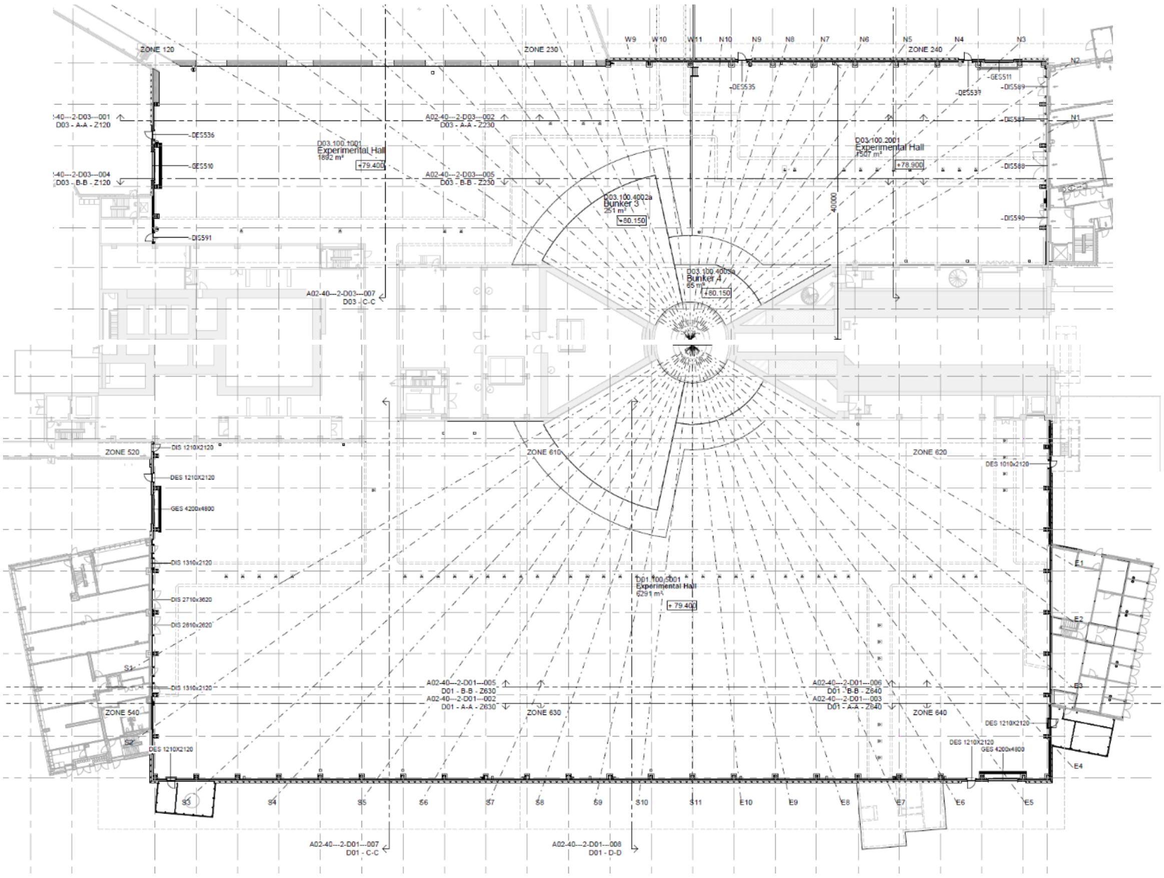


Figure 25: Gallery Penetrations

- Ref. Drawings (only penetrations): A02-40---1-D03100--- (D03) , A02-40---1-D01100--- (D01)
- Ref. Models:
  - ESS-0346214 (D03)
  - ESS-2721512 (D01 conduits)
  - ESS-2588770 (D01 potential penetrations)

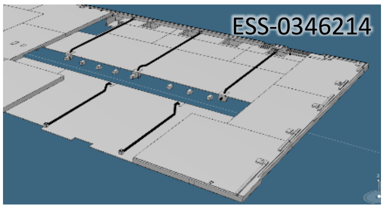


Figure 26: D03 Conduits

4.4.4. Standard ESS racks

CHESS models for the cabinets with access and interface indication

- Instrument Power: ESS-….(H: 2.2m, W: 1.2m, D: 0.6mm). See 4.4.7.
- Chopper: ESS-0478916 (H: 2.63 m, W: 0.8m, D: 0.8 m) [12]/RITTAL
- Motion Control: ESS-… (H: 2-2.2 mm, W: 0.4 m, D: 0.8 m)/ to be confirmed
- Beam monitor: ESS-….(H: …m, W: …m, D: …m) /separate racks
- Detector: ESS-….(H: 2m, W: 0.8m, D: 1.2m) /PENTAIR VHD 1800X8X12 EMC
- PSS: 12937-088_BET.STEP (H: 2.2m, W: 0.6m, D: 1m)
- Cooling skid: see 4.4.12 (H: 1m, W: 1m, D: 1m)

- ICS: the same as PSS (for the bunker)
- Vacuum: ESS-….(H:2m, W:0.6, D: 0.8) (for the bunker) [48]
- ICS, vacuum, cooling: these modules can be also placed into other cabinets. If there is no room for it, then the PSS type rack can be used.

ICS components of racks

- Chopper/detector/beam monitor rack: EVR, Breakout board, IOC Machine, Copper patch panel, 0-n powerful switches
- MCA rack: Virtual machine, Copper patch panel
- Utility supply: 0-n PLC`s, 0-n terminal blocks,

4.4.4.1. Rack utility interfaces for the facility

The connection for cooling is on the top.
The electrical cables and pneumatic pipes shall go throuh the pedestal at the bottom.

4.4.5. Utilities connections

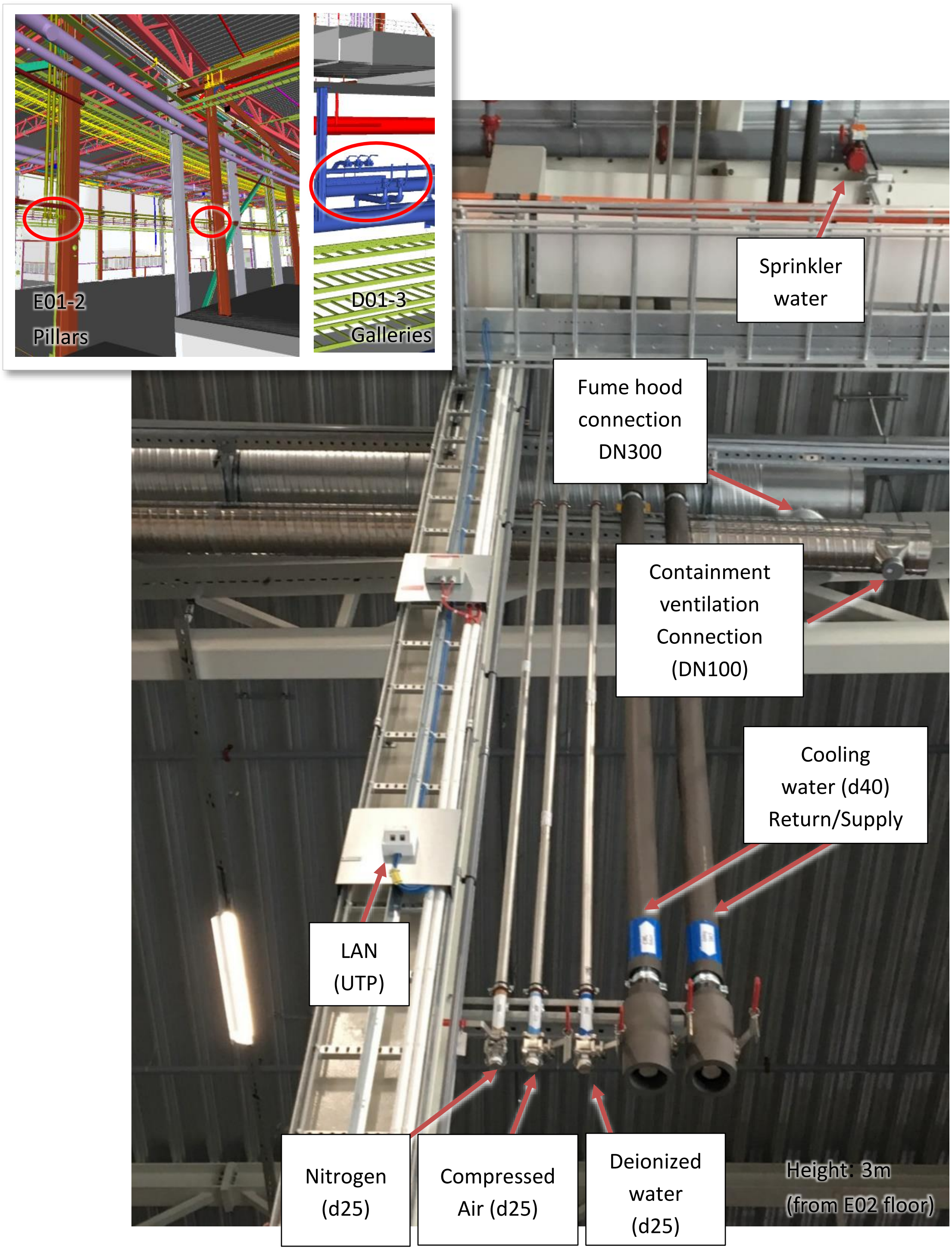


Figure 27: E01 – E02 Connectors

Type of pipe connectors

The type of the connectors will be the same in the E and D buildings.

For pipes, it is Klinger ball valve, Type KHA-SL, with butt weld end and female pipe thread. The thread is 1 ½'' in case of the cooling and 1" for the others.

Height: 3m (from E02 floor)

Figure 28: E02 Connectors/ Conventional (Installation) Power Network (230V /400V). See 0 for details

4.4.6. Conventional Power Network (230V /400V)

3 and 1 phase outlets in close vicinity of each beamline, either in the galleries, or at the building walls. [11]

- 16A 1 phase outlets
- 16A/32A 3 phase outlets

The network is designed primarily for installation purposes. The instrument shall not use these connectors! There is a power connector at any point of the building in 20m distance.

For interface details see 4.4.5.

4.4.7. Instrument Power (230V /400V)

Capacity/ average instrument: Peak: 55kW, Typical: 30kW [28]
3 Substations [13]
Responsible: CF (substations) & NSS (instrument connections)

ESS procures and installs the power distribution boards and the connection with the substations.

Cabinet details (preliminary)

- 1 cabinet 2m high + wide as necessary
- 1 cable input (from substation), max peak power 40 kW

Circuits out:

- 1 for light (1 phase)
- 3 for sockets 230V (1 phase)
- 1 for CEE sockets 400V, 16A (3 phase)
- 1 for CEE socket 400V, 32A (3 phase)
- 6 for control cabinets 16A (3 phase)
- 4 for control cabinets 32A (3 phase)
- Inner lightning protection (over voltage) SPD2
- Mains diagnostics and earth leaking measurement

Estimate will include 20 % of spare space (according to Handbook)
Estimate will include signal contacts for monitoring purpose
Socket groups 230V shall include residual current protective device (RCD)

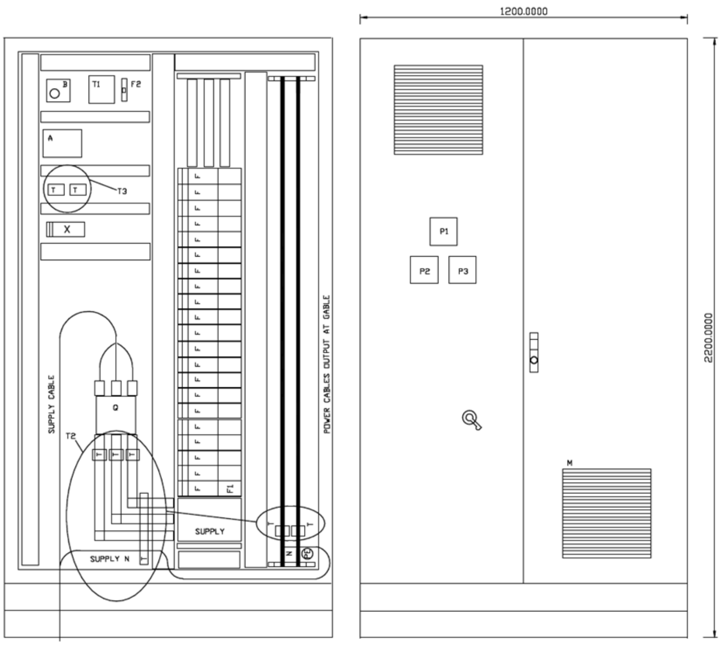


Figure 29: Power distribution cabinet concept

Power Distribution Cabinet placement

…

4.4.8. UPS: No centralized UPS

4.4.9. Domestic and waste water

Ref: ESS-0046984

2pcs are in each hall, by the walls (D01, D03, E02, E01). Also see figure below.

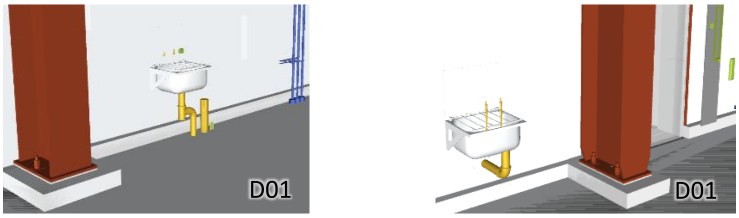


Figure 30: Domestic water

4.4.10. Radiological and risk waste water drainage

Process flow chart: ESS-0046901, Layout: ESS-0055781, ESS-0055780
Only drains at the thresholds. No dedicated connection for the instruments!

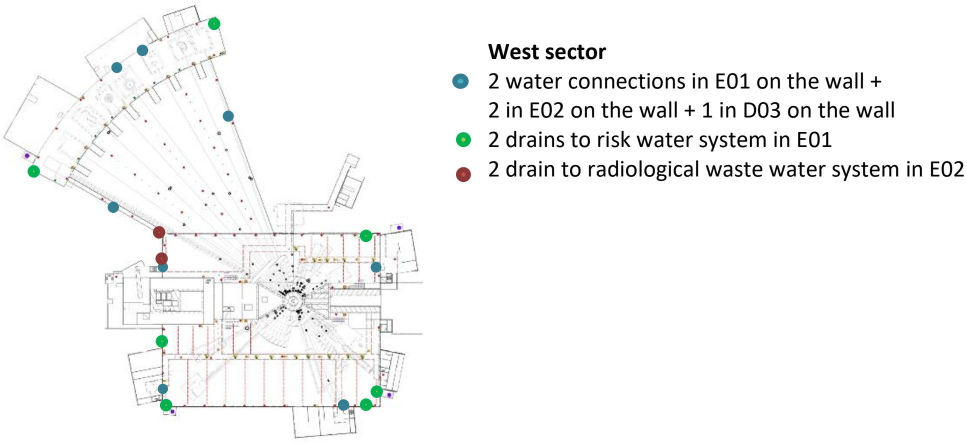


Figure 31: Water connections and drains

4.4.11. Air conditioning

Average temperature 22.0 ±2.0°C, No humidity requirement. Heating of the building. (No air conditioning, only ventilation system). Occasional higher temperature is possible in case of the hottest summer days. [15][16]

Temperature inside the bunker: The expected heat transferred from one side of the monolith is less than 3kW[27]. Considering the area of the bunker wall, the expected temperature is not more than 24±2.0°C.

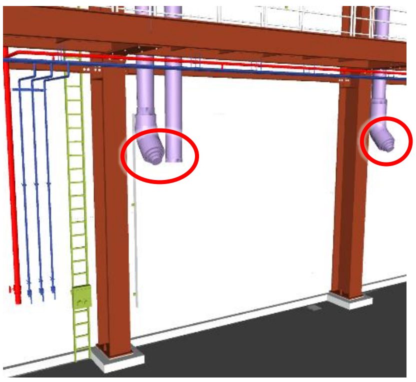


Figure 32: HVAC

4.4.12. Cooling water system (CWL)

- Process flow chart: ESS-0046901
- Layout: ESS-0046984
- Specification [33]:
  - Return: 15-22^{o}C
  - Maximum flow: 3 m3/h

    - Maximum pressure drop: 3bar
    - Supply: 8°C/7Bar [14]
- Cooling capacity / average instrument: 27kW [17]

Cooling skid is necessary for the in-bunker and close-bunker components (provided by the bunker project). Separate loop (skid) is necessary if the cooling water is in the direct vicinity of the neutron beam. For the other components (e.g. Racks & cave components) the central cooling can be linked with a shunted loop with a mixing valve and pump without skid. There shall be a filter on the return pipe.

- Type of the recommended cooling skid: ….
- 3D model for cooling skid: ESS-… (Expected size: 1mx1mx1m)

For interface details see 4.4.5

4.4.13. Deionized water (DIW)

- Process flow chart: ESS-0046901
- Layout: ESS-0046984
- Specification [33]:
    - Capacity: 2 m3/h
    - 8Bar
    - Purity: RO filtered + polishing
    - Planned total shutdowns: Max one (1) per 5 years
- For prohibited materials see [34]
- For interface details see 4.4.5

4.4.14. Compressed air (IAR)

All labs, workshops and instruments shall be supplied with instrument grade compressed air.

- Process flow chart: ESS-0046901
- Layout: ESS-0046984
- E01 (Experimental hall 3) connections: on the pillars between E01 and E02 (see Figure 27)
- D01-D03 connections: next to the power distribution cabinet (NSS installation)
- Specification [33]:
    - 6±1Bar (7Bar at the compressors) [14]
    - Solids: ISO 8573 class 1
    - Dew point: ISO 8573 class 2 (-40°C)
    - Oil: ISO 8573 class 0 (oil free)
    - Planned total shutdowns: Max one (1) per 5 years
- The connection point type is DN AL25.
- Capacity: 50m^3/h, considering maximum 5 instruments using it at the same time in a building [14]

For interface details see 4.4.5.

4.4.15. Nitrogen

- Process flow chart: ESS-0046901
- Layout: ESS-0046984
- Gas from pipes
  - Pressure: 10Bar
  - flow:10l/min

  - E01 (Experimental hall 3) connections: on the pillars between E01 and E02 (see Figure 27)
  - D01-D03 connections: next to the power distribution cabinet (NSS installation)
- Liquid in dewars

Responsible: Gas – CF, Liquid: SAD

For interface details see 4.4.5.

4.4.16. Argon gas

Cylinder; Responsible: SAD

4.4.17. Liquid Helium (dewars)

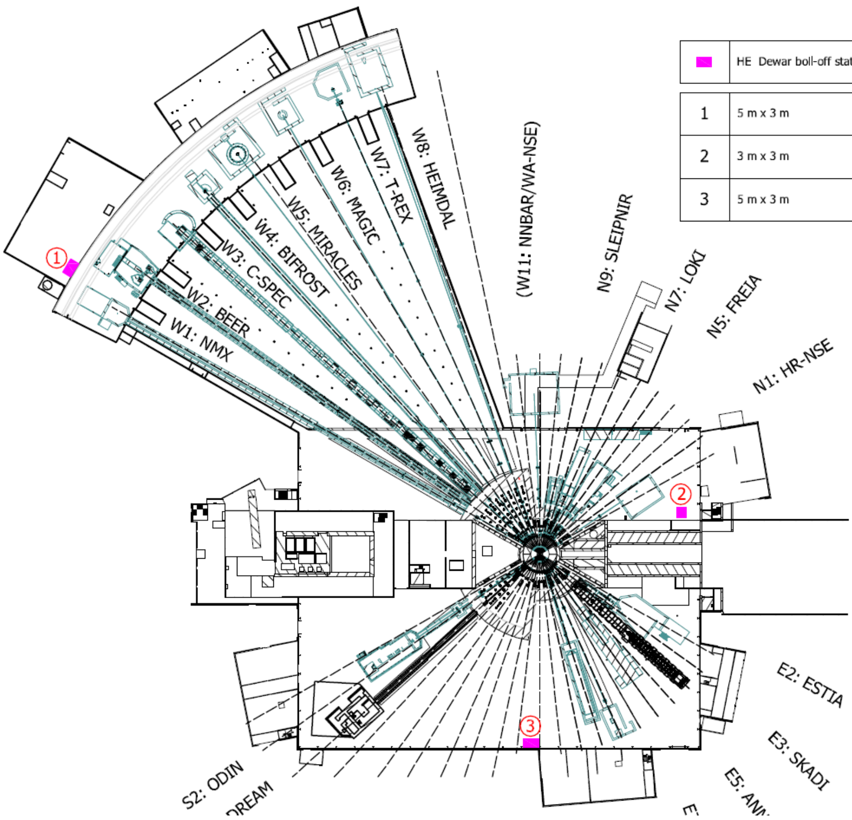


Figure 33: Preliminary plan for He dewar stations

4.4.18. Helium gas

Cylinder; Responsible: SAD

4.4.19. Helium Recovery from caves

Responsible: SAD
Liquefier and recovery layout: A02-40---1-D--100---
(Pipes up to the collection point in the gallery and E02 pillars)

4.4.20. Hydrogen

Cylinder: in labs

4.4.21. Exhaust connections/Containment Ventilation (Radiological waste)

There will be a containment ventilation system provided for the experimental halls.

- The interface in E01 is on the pillars between E01-E02 at high level.
- The interface in D01 and D03 is on the internal face of the external building walls at high level.

Each connection point will be a flange connection DN100 with a cover that shall be removed when connecting the duct. Each connection can provide an airflow of 20 l/s at 150 Pa. /ESS-0056058, ESS-0048000, Flow chart: ESS-0318232/

The containment ventilation goes to the main stack of ESS and can be used on the sample area even if materials are radioactive. Instrument teams are responsible for running a pipe from their area to the connection point, installing a suitable HEPA filter and keeping the line closed, when not in use. [22]

The containment ventilation is meant to be used in the cave close to the sample environment for

- pump exhaust (when pumping is on sample/sample environment)
- gas lines (when gases are flowing over samples)

4.4.22. Fume hoods (Chemical waste)

There will be a fume hood system provided for the experimental halls.

- The interface in E01 is on the pillars between E01-E02 at high level.
- The interface in D01 and D03 is in the galleries

The duct dimension is 315mm. The NSS-CF interface consists of a flat end with a cover.
/ESS-0056058, ESS-0048000, Layout: ESS-0046984/
Airflow: 40-375 l/s considering 25% of the connections simultaneously used.
The conventional ventilation system goes to a regular exhaust, hence NO radioactive fumes are allowed! It can be used for fume hoods, overhead extraction, flammable solvent/gas cylinder cabinets, or sample storage cabinets. Instrument teams are responsible for running a pipe from the instrument specific lab area to the connection point, providing and installing the damper/filter for the fume hood/overhead extraction and to cover the end flange if not in use.[22]

4.4.23. Vacuum (Independently built for the instruments)

Responsible: Vacuum Group (ESS)
For recommended gaskets see ESS-0059912 - Vacuum gaskets and seals
Connections: ….

4.4.24. Sprinkler system in the instrument halls and labs.

Sprinkler water connections can be provided upon request. Envelopes for internal instrument sprinklers/fire protection in caves shall be covered by the instruments. ESS will supply the detailed design and installation.

/Process flow chart: ESS-0046901, Layout: ESS-0055781, ESS-0055780, ESS-0046984/

Areas that will have sprinkler:

Occupancy	Type
Utility area in D02, level 90, 100, 110	wet pipe
Installation gallery, level 90	wet pipe
Technical gallery in D02, level 90, 110	wet pipe
Ventilation room in D02, level 130, 140	wet pipe
Sprinkler control room in E03	wet pipe
Sprinkler control room in D05	wet pipe

Areas that will have preparations for sprinkler:

Occupancy	Type
Instrument caves in D01, level 100	wet pipe
Instrument caves in D03, level 100	wet pipe
Instrument caves in E01, level 100	wet pipe

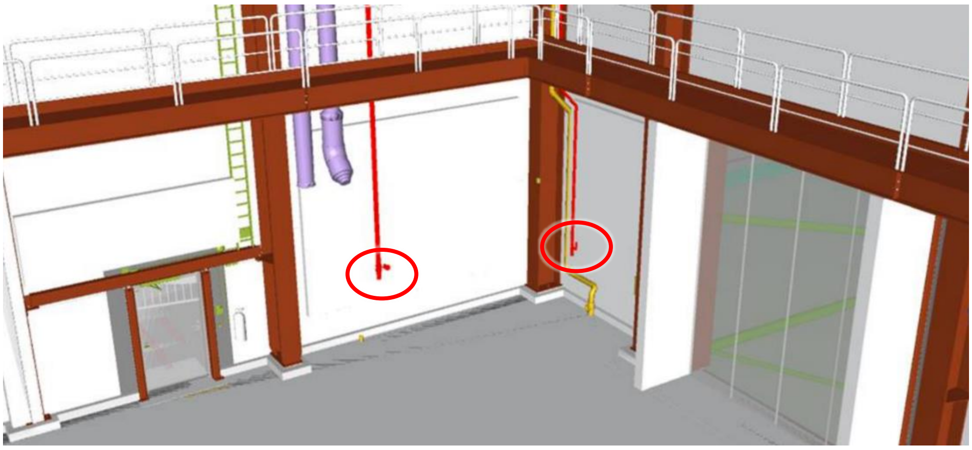


Figure 34: D01 Sprinkler connections

4.4.25. Conventional LAN

Next to the power distribution cabinet (NSS installation)

ESS will also provide wireless network

4.4.26. Fiber network

E01 (Experimental hall 3) connections: on the pillars between E01 and E02
D01-D03 connections: next to the power distribution cabinet (NSS installation)

Networks through fiber:

- EPICS
- Timing
- Detector
- Diagnostics
- Sample environment

4.4.27. Overhead crane coverage and capacity

Crane coverage and hook height drawings:

D01 : ESS-0055303 (5ton), ESS-0055308 (7.5ton), ESS-0055305 (30ton)
D03 : ESS-0055307 (5ton), ESS-0055304 (7.5ton), ESS-0055306 (30ton)
D02 : ESS-0051771 (5ton), ESS-0051772(20ton)
E01 : ESS-0052338 (10ton)
E02 : design :ESS-0052338 (5ton)
E03, E04: ESS-0048477 (5/15 ton)
As built: NCR-452

Speed requirements for the cranes [45]:

- Travelling: 0-40m/min
- Traversing: 0-20m/min
- Hoisting: 0-5m/min

Preliminary estimation for the distance between the crane hook (5t evo L5) and the top of the bunker roof [35].

North and East sector:
- X=2450mm (roof: TCS+3100mm)

West and South sector:
- <15m: X=2250mm (roof: TCS+3300)
- >15m: X=2550mm (roof: TCS+3000)

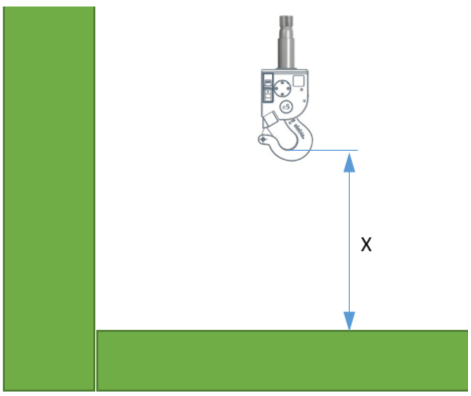


Figure 35: Distance of the Bunker crane hook from the roof

4.4.28. Instrument Cranes

On the D01 and D03 floor, cranes as shown in Figure 36 could be placed anywhere. [43]

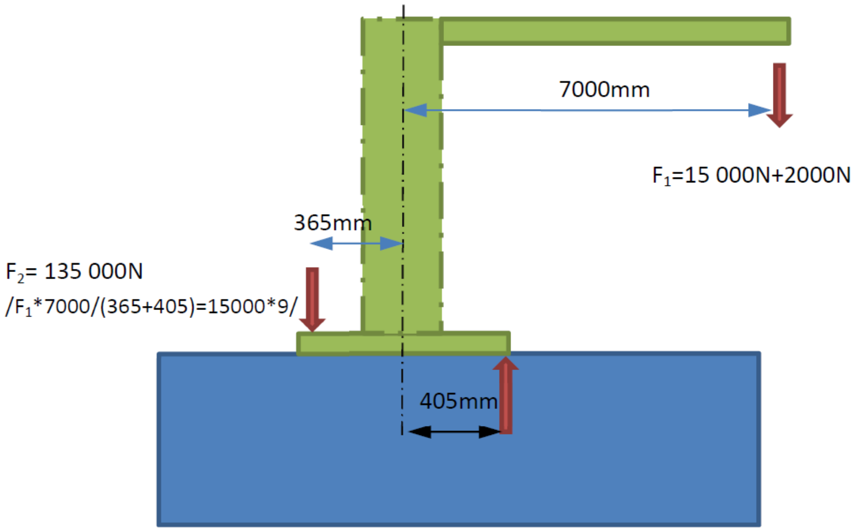


Figure 36: Slewing Crane Meister M (M15-7,0) to be placed in D01 and D03 (characteristic load values, no dynamic increase factor included).

4.4.29. Available mobile cranes

5. ES&H

5.1. Radiation Area classification (Radiation requirements)

Ambient equivalent dose rates [36]

- Non-designated area (White): <0.5µSv/h
- Supervised area (Green): <3µSv/h
- Blue controlled area: <25µSv/h
- Yellow controlled area: <2.5mSv/h
- Red controlled area: >2.5mSv/h

5.2. Access to instrument cave and hutch

ESS does not have requirements to facilitate disabled (wheelchair) access for the instrument hutches and caves.

ESS does not have requirements for special personal access control (card reader) at the entrance of the cave and hutch, apart from the PSS system of the instrument.

5.3. Hazard Analysis

The instrument hazard analysis covers conventional safety and radiological hazards and will be used for:

- Optimisation of the instrument design from a safety perspective
- Optimisation of maintenance procedures from a safety perspective
- Input for the personnel safety system for the instrument

- CE marking
- Shielding
- SSM submissions

Recommended procedure for hazard analysis:

1. Identify the hazards, based on ESS-1713369 (Hazard Identification template)
2. Consult with Maurice Looft (ESS CE marking expert) to identify the related standards
3. Create the Instrument Hazard Analysis based on ESS-0100583 (template) and ESS-0047810 (instruction)
4. Check and record the completeness of the CE documentation: ESS-2412694 (template)

6. QA

The ESS Quality classification of the not safety critical mechanical components is MQC4. The instrument components are falling into this category with the possible exception of the Shielding and PSS components. This regulation applies to all the mechanical pressure retaining and load bearing and non-pressure parts in main area of the ESS facility in Lund.

Quality requirements MQC4 C [40]

These requirements can be potentially applicable depending on the specific components. The actual requirements has to be defined according to the instructions of the NSS QA responsible.

- EN 13480 and EN 13445 + other harmonized standards
- Eurocode / EN 1090 can be used for load bearing equipment
- ISO 3834-2 certification is required for the welding company
- ISO 15614 welding procedure qualification is required for all welding
- Welders shall be qualified acc. to ISO 9606 / ISO 14732
- ISO 17025 accreditation for NDT is required for installation
- Installation of fasteners in concrete
- Installation of pipe couplings and pipe bending procedures
- Cleanliness requirement
- Vacuum requirements (Vacuum Handbook)
- Machine directive (CE marking)
- AFS 2017:3

Review before manufacturing/installation MQC4 C [40]

- Drawings with part lists and calculations
- Cleanliness procedures
- Surface treatment procedures

- Inspection plan
- Certification for welding (Company and welders)
- Certification for NDT (Company and NDT personell)
- WPS + WPQR (Welding procedures)
- Pipe coupling and bending procedure
- Fastener in concrete procedure
- NDT procedures
- Pressure- and leak testing procedures

Final documentation MQC4C [40]

- Material certificates (EN 10204 3.1 for pressure equipment and 2.1 for load bearing equipment)
- Welder certificates
- Certificate of filler material
- Welding procedure specifications (WPS)
- Welding procedure qualification records (WPQR)
- Welding inspection reports
- NDT procedures
- NDT examination and test results
- Procedures or instructions for manufacturing
- Dimension protocols
- Visual inspection protocols
- Marking and identification protocols
- Pressure- and tightness testing protocols
- Surface treatment protocols
- Cleanliness inspection protocols
- Certificate of compliance
- Non-conformance and deviation reports

7. DIRECTIVES APPLICABLE (CE MARKING)

Reference documents for design: ESS-0127031 and ESS-0145018

8. MISCELANEOUS

8.1. ESS confluence Pages

- ESS and instrument contacts:
https://confluence.esss.lu.se/display/SD/CONTACTS

- NSS instrument project page (summary page):
https://confluence.esss.lu.se/display/SPD/Instrument+Projects

- Neutron Optics and Shielding Group
https://confluence.esss.lu.se/display/NOSG

- Motion Control & Automation Group
https://confluence.esss.lu.se/display/MCAG
- Detector Group
https://confluence.esss.lu.se/display/DG
- DMSC
https://confluence.esss.lu.se/display/DMSC
- Scientific Activities Division
https://confluence.esss.lu.se/display/SA/Scientific+Activities+Division
- Chopper Group
https://confluence.esss.lu.se/display/CG
- Spatial Integration
https://confluence.esss.lu.se/display/EIS/Spatial+Integration+Instrument
- PSS
https://confluence.esss.lu.se/display/PS/Neutron+Instruments
- ESS installation
https://confluence.esss.lu.se/category/essinst
- Engineering Integration
https://confluence.esss.lu.se/display/PS/Neutron+Instruments
- CF
https://confluence.esss.lu.se/category/cf
- Vacuum group
https://confluence.esss.lu.se/display/VG/Vacuum+Section
- Remote Handling

https://confluence.esss.lu.se/display/SD/NSS+Remote+handling+Homepage
- Bunker wall inserts

https://confluence.esss.lu.se/display/SPD/Bunker+wall+insert+and+feed-trough+case+for+neutron+guides
- General Construction (FM)

https://confluence.esss.lu.se/x/ygP5Fg

9. GLOSSARY

Term	Definition
AMA	Allmän Material och Arbetsbeskrivning "General Material and Workmanship Specifications"
CF	Conventional Facilities
CWL	Cooling Water Low (Temperature)
EPL	ESS Plant Layout
E01	Instrument Hall 3
E02	Guide Hall
DIW	Deionized Water
DMSC	Data Management & Software Center
D01	Instrument Hall 1
D02	Instrument Hall 2
D03	Target Building
FBS	Facility Breakdown System
FM	Facility Management
IAR	Instrument Air (compressed air)
ICS	Integrated Control Systems
ISCS	Instrument Source Coordinate System
MCA	Motion Control Automation
NCR	Non Conformity Report
NSS	Neutron Scattering Systems
PBS	Product Breakdown System
PSS	Personal Safety Systems
RO	Reverse Osmosis
SAD	Scientific Activities Division
TCS	Target Coordinate System

10. REFERENCES

Documents

[1] ESS-0035090 - Main coordinate systems at the ESS
[2] ESS-0034841 - NSS PBS Number Designation
[3] ESS-0748789 - Generic NSS model breakdown for models
[4] ESS-0009095 - Neutron Instrument coordinate system
[5] ESS-0475569 - Overview for different levels of the D-E buildings
[6] ESS-0032665 - Experimental halls, foundation with precast driven concrete piles

[7] ESS-0462002 - Illustrative report expansion joints-Appendices
[8] ESS-0409664 - Illustrative report expansion joints
[9] ESS-0260358 - Design Report Expansion joints
[10] ESS-0376748 - In-monolith layout schematics
[11] ESS-0046984 - Outlets in D E Experimental halls
[12] ESS-0043775 - Requirements specification for neutron chopper control system hardware intended for use at the ESS
[13] ESS-0051373 - ESS Guidelines Power grounding
[14] ESS-0046901 - Process flow chart
[15] ESS-0056058 - NSS E01/E02 Interface description
[16] ESS-0048000 - NSS D01/D03 Interface description
[17] ESS-0011496 - Power requirements for NSS in the D&E buildings
[18] ESS-0482607 - Specifications Central Process System 3 MW Beam on target
[19] ESS-0055781 - Drains and thresholds in D-buildings
[20] ESS-0055780 - Drains and thresholds in E-buildings
[21] ESS-0318232 - Radiological Ventilation flow chart
[22] ESS-0040840 - ESS Safety and Sample Workflow for Instruments
[23] ESS-0127031 - ESS Rules for CE marking
[24] ESS-0061819 - General Civil Design Criteria (GCDC) for D01 D02 and D03
[25] K04-01---0-E-----003
[26] ESS-0145018 – Checklist for formal assessment of the EU conformity procedure
[27] ESS-0051536 - Heat Transmission from the Monolith to Connection Cell and Utility Rooms
[28] ESS-0011496 – Power requirements for NSS in the D&E buildings
[29] ESS-1105796 – Bridge Beam Guide Optics Requirements for Target
[30] ESS-1104269.2 – Capping plate assy. (drawing)
[31] ESS-0121896 – Ground floor slab level 095, Non-magnetic area
[32] ESS-0482607 – Specifications Central Process System 3 MW Beam on target
[33] ESS-0068371 – ESS Central Process Systems Technical Description
[34] ESS-0043566 – Process system for Site Infrastructure
[35] ESS-0047079.5 – Bunker cross-section drawing
[36] ESS-0001786 – ESS RULES FOR SUPERVISED AND CONTROLLED RADIATION AREAS
[37] ESS-1404151 – INSTALLATION OF ANCHORS IN E-BUILDINGS
[38] ESS-1404154 –Installation of Anchors in D-Buildings
[39] SS-EN 13670:2009 /Annex G. - e Execution of concrete structures
[40] ESS-0047989 – ESS Rules for Quality Regulation for Mechanical Equipment
[41] ESS-0402063 – ESS Handbook for Rigging & Lifting Operations
[42] ESS-0059912 – Vacuum gaskets and seals
[43] ESS-0061819 – General Civil Design Criteria
[44] ESS-0002642 – Fire Protection
[45] ESS-0048515 – DM--ID-TBSIDD----NSS-SI Transport
[46] ESS-0002381 – Fire Safety Strategy Report
[47] ESS-2595510 – PM HUTCHES AND SAMPLE PREPARATION LAB
[48] ESS-2778435 - VACUUM CONTROL SYSTEM NSS
[49] ESS-0003980 - DESIGN MANUAL STRUCTURAL, CONVENTIONAL FACILITIES
[50] ESS-3139153 - General instruction for loads on D01 and D03 slab

[51] ESS-0503621 - Generic checklist for Phase 2 evaluation
[52] ESS-2506444 - Instrument Hutch Requirement Check-list

Models

[53] Generic Instrument Skeleton (ESS-0748789)
[54] Obsolete ESS Plant Layout (ESS-0016885)
[55] Instrument Suite (ESS-0017897)
[56] Official ESS Plant Layout (ESS-0500000)
[57] Remote handling lifting interfaces collection (ESS-0243444)
[58] ESS-0207007
[59] ESS-0052572
[60] ESS-0122167

DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue	Gabor Laszlo	29.08.2019
3	5.2, 5.3, Crane speed, The utilities are by the caves in D	Gabor Laszlo	29.04.2020
4	Bunker model numbers, anchoring ,accessibility, CE-marking, minor details	Gabor Laszlo	29.05.2020
5	D01 Floor model numbers, Rack sizes	Gabor Laszlo	16.09.2020
8	Point loads, added FBS and references, updated floor properties	Gabor Laszlo	20.12.2021