Instrument Safety Readiness Review

Test beamline (TBL): Overview of Instrument Hazard Analysis

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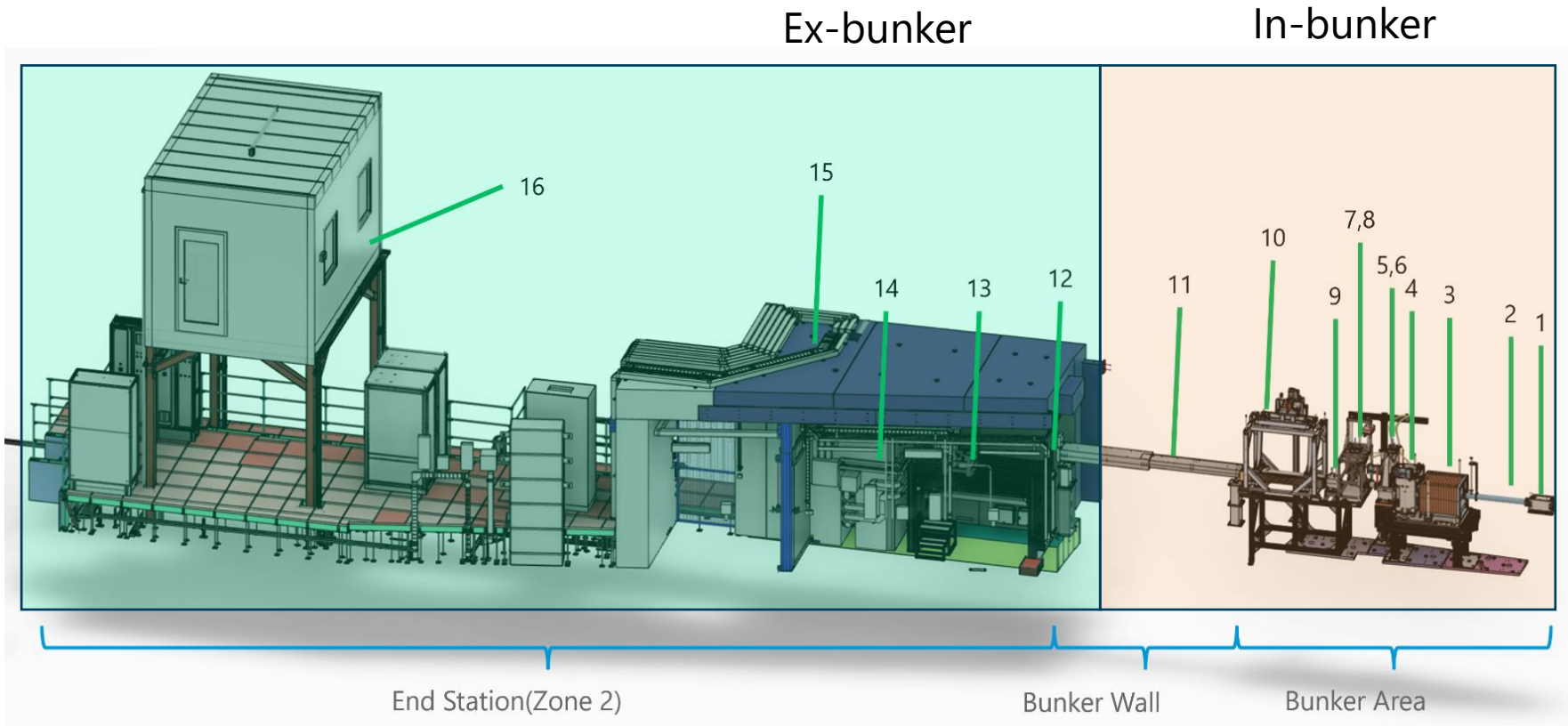
10 October 2025

Outline

- ❑ Overview
- ❑ Ex-bunker activities
- ❑ In-bunker activities
- ❑ Safety-related components



No.	Component Name	Distance from target coordinate system
1	BBGOA and Light Shutter	5.5 m – 6 m
2	Flight Tube 1	6 m – 7.4 m
3	Heavy Collimator	7.4 m – 8.2 m
4	Adjustable Collimator	8.3 m – 8.5 m
5,6	Chopper, Flight Tube 2	8.5 – 8.7 m
7,8	Filter station, In-bunker Beam Monitor	8.7 – 9.3 m
9	Final Collimator	9.3 – 9.5 m
10	Heavy Shutter	9.5 m – 11.3 m
11	Bunker Wall Feedthrough	11.5 m – 15 m
12	In-cave Beam Monitor	15.1 – 15.2 m
13	Detector Table	15.2 – 17.5 m
14	Beam Stop	17.5 m
15	Experimental Cave	15 – 21 m
16	Control Hutch	25 m

IHA: Conventional (In-bunker): O

Acceptable

Tolerable

ESS-3078238

Sub-System Designation	Initiating event	Accident description
Beam geometry conditioning	Vacuum window explode	While venting, the pressure is accidentally pressurized beyond design levels
Beam geometry conditioning	Vacuum window failure	While under vacuum the window is accidentally punctured and vacuum vessel is suddenly vented
Beam geometry conditioning	Vacuum window is punctured	Loud noise is produced from sudden venting
Beam geometry conditioning	Component not correctly grounded	Electrical shock while maintaining
Beam geometry conditioning	Craning heavy equipment	Dropping Heavy collimator assembly on a person while craning
Beam geometry conditioning	Craning heavy equipment	Dropping Adjustable collimator assembly on a person while craning
Beam geometry conditioning	Movement of two linear axis	Moves and traps on fingers while working on it
Beam geometry conditioning	Cables not protected	Personnel handle the cable
Beam geometry conditioning	Exposed wire	Electrical shock while maintaining
Beam geometry conditioning	Component not correctly grounded	Electrical shock while maintaining
Chopper system	Vacuum window is punctured	Loud noise is produced from sudden venting
Chopper system	Vacuum window explode	While venting, the pressure is accidentally pressurized beyond design levels
Chopper system	Chopper disk failure	Chopper disk fails while spinning
Chopper system	Cables not protected	Personnel handle the cable
Chopper system	Component not correctly grounded	Electrical shock while maintaining
Chopper system	Craning heavy equipment	Dropping chopper CHIMS on a person while craning
Chopper system	Craning running choppers	Choppers are craned without being stopped, leading to disk failure and debris
Chopper system	Exposed wire of choppers	Electrical shock while maintaining
Beam filtering System	Craning heavy equipment	Dropping Filter Station assembly on a person while craning
Beam filtering System	Movement of 3 independent linear Stages	Moves and traps on fingers while working on it
Beam filtering System	Cables not protected	Personnel handle the cable
Beam filtering System	Exposed wire of choppers	Electrical shock while maintaining
Beam filtering System	Component not correctly grounded	Electrical shock while maintaining
Beam filtering System	Person in contact with toxic subtances (Cadmium, Beryllium)	Possible poisoning
Beam geometry conditioning	Component not correctly grounded	Electrical shock while maintaining
Beam geometry conditioning	Craning heavy equipment	Dropping final collimator assembly on a person while craning
Beam Validation	Fire caused by arcing	Exposed wires arcing
Beam Validation	Exposed wire of guide beam monitors	Electrical shock while maintaining
Beam Transport and Conditioning System	Power supply not correctly grounded	Electrocution
Beam Transport and Conditioning System	Vacuum gauge not correctly grounded.	Electrical shock while maintaining
Beam Transport and Conditioning System	Bunker open causing a pit	Falling into the bunker during maintenance

IHA: Conventional (Ex-bunker) : O

Acceptable

Tolerable

ESS-3078238

Sub-System Designation	Initiating event	Controls to mitigate risk
Shielding on Cave	Craning heavy equipment	No bunker access during operation.
Shielding on Cave	Partially removed shielding	Not applicable during operation
Shielding on Cave	A shielding block is removed leaving a pit	Only ESS-trained staff that follow ESS guidelines should be used
TBL Vacuum System Bunker Zone	Vacuum pumps for in-bunker not correctly grounded	Only ESS-trained staff that follow ESS guidelines should be used
TBL Vacuum System Bunker Zone	Vacuum gauge not correctly grounded.	Only ESS-trained staff that follow ESS guidelines should be used
Craning	D03 crane maneuver	Power consumption limit on pumps/ personnel protection devices installed (differential interruptor)
Craning	D03 crane maneuver	Correct grounding.
Shielding on Cave	People falling	Cranes can only be operated by ESS trained staff.
Shielding on Cave	Dropping tools from height	Cranes can only be operated by ESS trained staff.
Shielding on Cave	Cave roof collapsing	Anchor points for fall restraint in place. PPE and follow procedures.
Neutron Detector Positioning	Adjustable Table on Aluminium profiles	a) Correct working practice, b) Fence off area below
Neutron Detector Positioning	Movement of linear axis X,Y or Z in Detector/Sample table	a) Rigging team highly trained, b) Cranes can only be operated by ESS trained staff, c) Designate zone for restricted loading in operation
Craning	Craning heavy equipment inside the cave	Ensure procedure is implemented. Redundancy based on mechanical stoppers.
Craning	Cave crane maneuver	Risk mitigation is transferred to the Motion Safty Work Unit of the common MCA Project (CMCA)
Craning	Cave crane maneuver	Only ESS trained and authorised staff that follow ESS guidelines should perform the task
Shielding on Cave	Loading/unloading goods from top inside the Cave	Only ESS trained and authorised staff that follow ESS guidelines should perform the task
Neutron Detector System	Cables not protected	Only ESS trained and authorised staff that follow ESS guidelines should perform the task
Neutron Detector System	Fire caused by arcing	Only rigging team can perform the maneuver. Personnel follows procedure.
Electrical Power & Earthing	Connections and cables may be under power	No access during operation
Electrical Power & Earthing	Damaged cable	No access during operation
Shielding Door	Trapped body parts	Design safety into the control cabinet, cover cables. Main Switch can be locked in Off position. No access in operation.
Shielding Door	Trapped body parts	Cables can only run in cable channels or under covers.
Shielding Door	Maintenance of sliding door mechanism	Entry Door preventing access
Entry Door	Entry door starts to move unintentedly, while person (or goods) are in its way	Entry Door preventing access
Cave structure	A forklift hits the cave	Entry Door preventing access
Shielding Door	Door can not be opened, due to gearbox failure	Door designed and balanced to prevent unintended movements. The weight of door and torque is negligible to be harmful. No motorized mechanism.
Shielding Door	Trapped person can't find the manual door opening wheel	The strucure was designed to withstand an impact. Cave is unreachable by forklift due to prescence of false floors and be visible by Guard rails.
Shielding Door	A person remains in the cave while the door is intended to be closed	a) Choose an oversized gearbox for the drive unit, b) Provide mean to disconnect the driving pinion from the rack
Control Hutch	Electrocution	Cave is small and door will be kept open at all cases.
Control Hutch	Electrocution	Searcing tour implemented by PSS. Signage and sound indicates the procedure to close has been started.
Control Hutch	Electrical shortcut	Follow procedures. Only trained personel
Control Hutch	Vehicle impact	Follow procedures. Only trained personel
False Floor	People falling	Follow procedures. Only trained personel
False Floor	People falling	a) Maximum speed allowed in circulation areas b) Identify risk areas witha different color or pattern in the floor c) Install protective bollards near the control hutch
False Floor	People falling	Ensure stairs are of the correct gradient and with slip safe cover.
False Floor	Dropping tools from height	Ensure false floor is always covered.
False Floor	People falling	Correct protection Handrails implemented.
False Floor	People falling	a) Correct working practise b) Correct protection barrier
False Floor	Object dropped	Ensure stairs are of the correct gradient and with slip safe cover. Protection handarils implemented in the design
False Floor	Fire in hutch	a) Correct working practise b) Open window only from the top (not fully open from the side).

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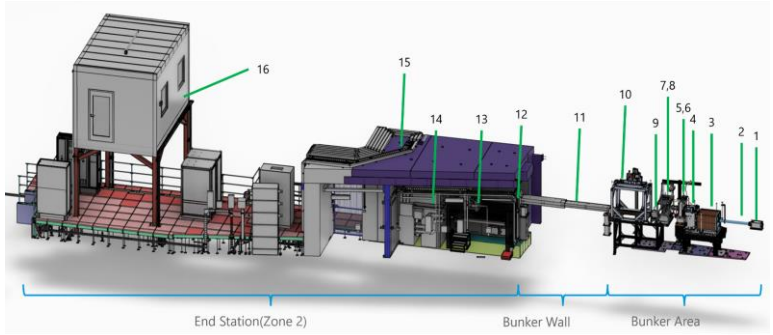
- ❑ Overview
- ❑ Ex-bunker activities
- ❑ In-bunker activities
- ❑ Safety-related components

Safety Readiness: Ex-bunker

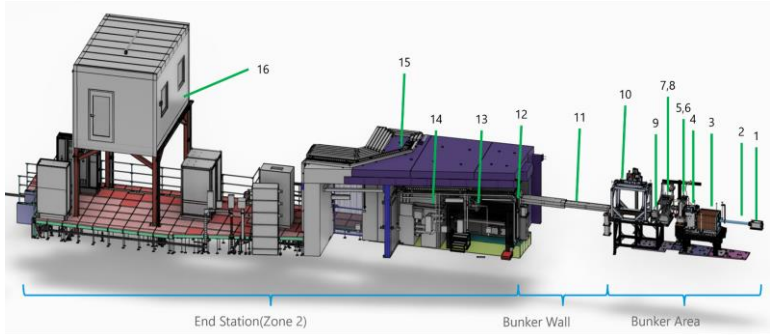
- Experimental cave (13,14,15)



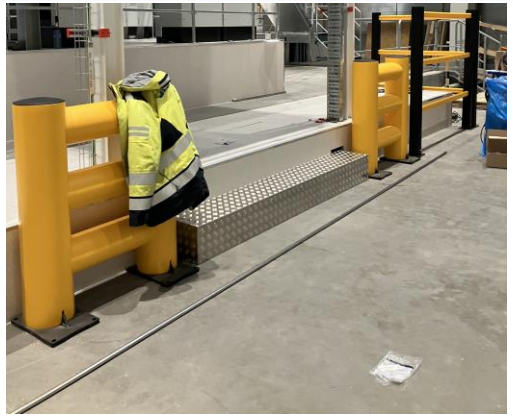
Issue	Operation mode	Maintenance mode
Adjustable table changes position or falls	Use mechanical stopper Disassemble if needed.	Use mechanical stopper Disassemble if needed.
Trapped fingers while working with motion stages	Motion Safety buttons	Motion Safety buttons
Electric shock / arcing on detectors	Power consumption limited. No live work on electrical work	Power consumption limited. No live work on electrical work
Electric shock on power outlets/cables	No live electrical works	Technical Group/CEP scope
Pressurized vessel (He3 detector)	Transport in a cushion-filled box	Transport in a cushion-filled box
Dark environment	Put a signage in front of the cave	Put a signage in front of the cave

Safety Readiness: Ex-bunker

- Experimental cave (13,14,15)



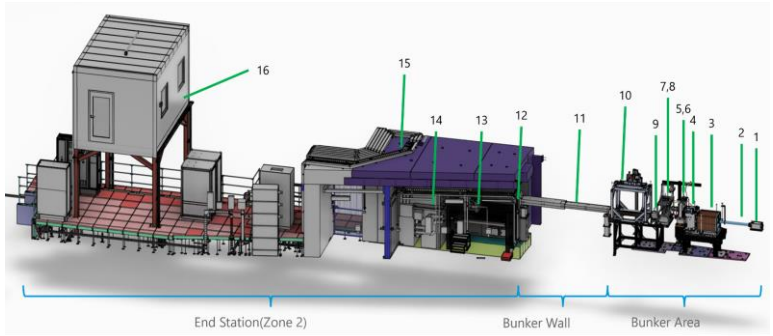
Issue	Operation mode	Maintenance mode
Trapped in Heavy door gap	The moving rate is very slow (1 mm / rev. of the wheel).	The moving rate is very slow (1 mm / rev. of the wheel).
Heavy door can not be opened, due to gearbox failure	- Exit Signage guides the evacuation way. - Leave the door opened when access mode is possible (but entry door can be closed.)	
Trapped in Entry door gap	Use a wedge if needed	Regular check of hinge balance
Forklift hits the cave	Bollard protection installed	Bollard protection installed

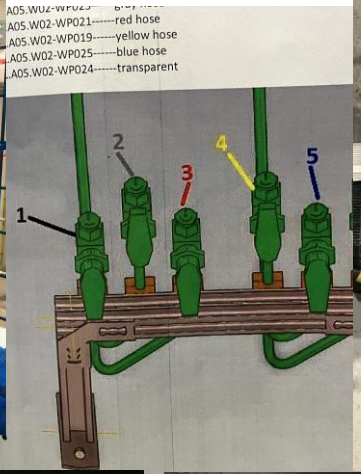


Safety Readiness: Ex-bunker

- Utilities

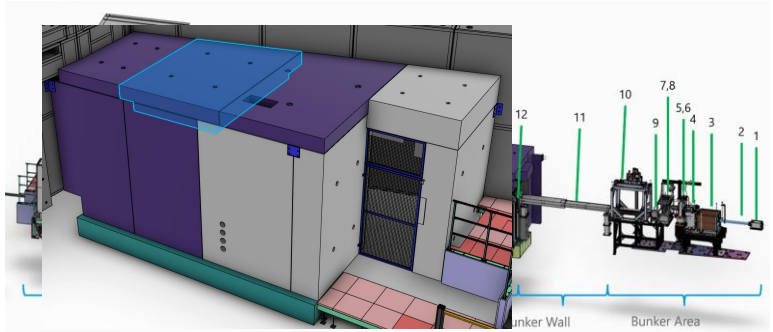
Issue	Operation mode	Maintenance mode
Gas bottle connection	Use regulator to limit pressure	Use regulator to limit pressure
Exhausted gas line	Always leave the valves opened	Always leave the valves opened
Gas line connection	Refer to the diagram at the manifold.	Refer to the diagram at the manifold.
Water line connection	Ensure there is no leak before energize equipment	Ensure there is no leak before energize equipment
Water Chiller	Do not set temperature below 15°C to avoid condensation.	Do not set temperature below 15°C to avoid condensation.





Safety Readiness: Ex-bunker

- Experimental cave (13,14,15)

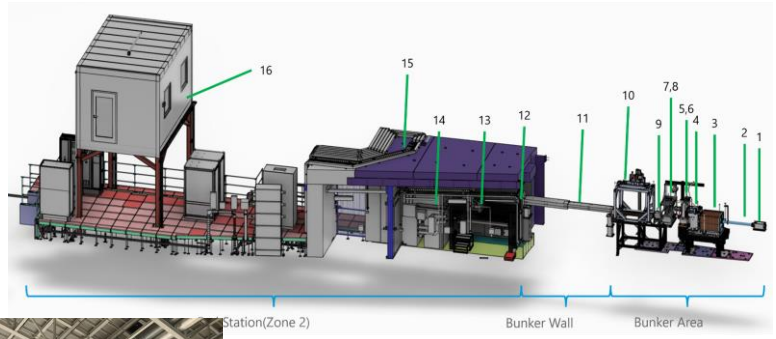


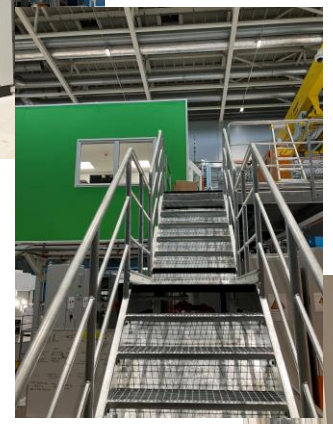
Issue	de
Falling from s	truction, no pass led component.
Falling throug pit	erson can do
Falling from h	fall restraint in ow procedures.
Falling object	performing work
Cave roof coll	can do lifting
Suspended ol component ir	owly and ensure a
Dropping obj hoist	before lifting

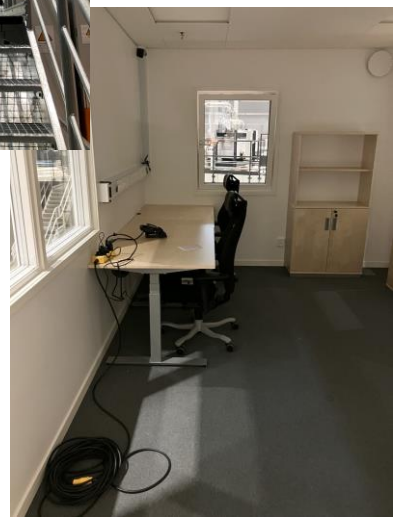
Safety Readiness: Ex-bunker

- Control Hutch (16)

Issue	Operation mode	Maintenance mode
Forklift hits the hutch.	Bollard protection installed	Bollard protection installed
Electric shock	Follow "ESS Rules for Coordination of Electrical Safety: ESS-0328120"	Follow "ESS Rules for Coordination of Electrical Safety: ESS-0328120"
Falling from the stairs	No run, handrails installed.	No run, handrails installed.
False Floor pit	Ensure the cover is properly placed.	Ensure the cover is properly placed.
Falling from the hutch	Open window for ventilation only. Not fully open the gap.	Open window for ventilation only. Not fully open the gap.
Falling objects from the hutch	Do not carry an object when open/close the window	Do not carry an object when open/close the window
Fire inside the hutch	Sprinkler installed	Sprinkler and fire detector installed



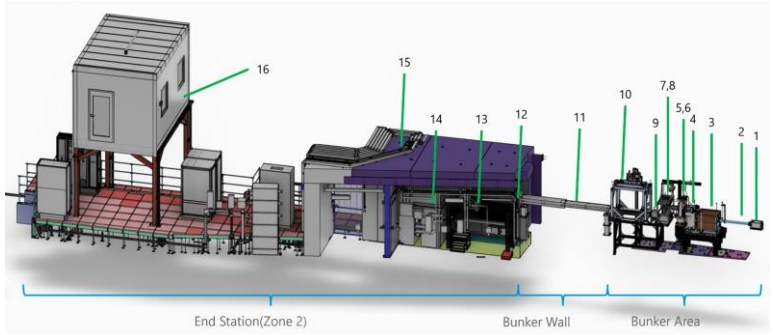


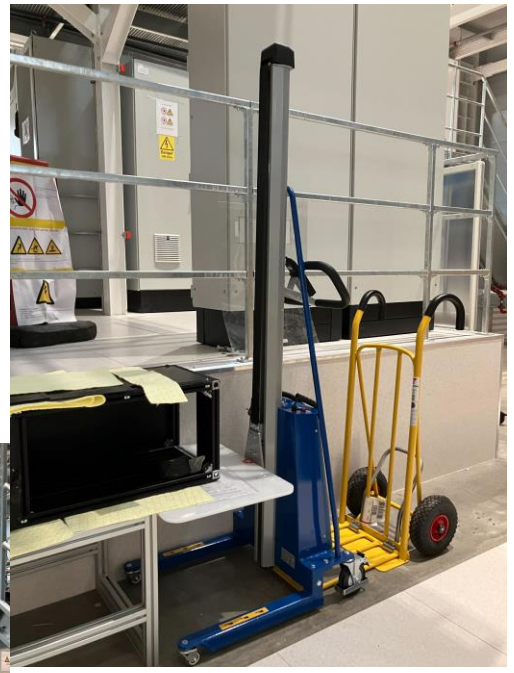


Safety Readiness: Ex-bunker

- Utilities

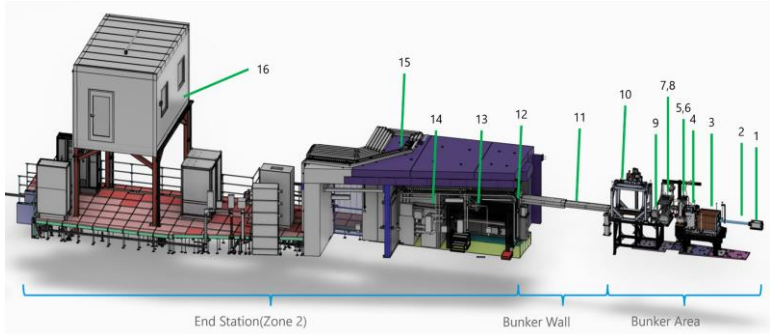
Issue	Operation mode	Maintenance mode
Power socket	Use correct voltage/freq equipment	Use correct voltage/freq equipment
Lifting table	Do not stack load > 85 kg	Do not stack load > 85 kg
Cables on the ground	Use cable protector	Use cable protector
Work on Detector Table	Use an approved platform	Use an approved platform
ODH	Ensure functionality of ODH monitor	Ensure functionality of ODH monitor



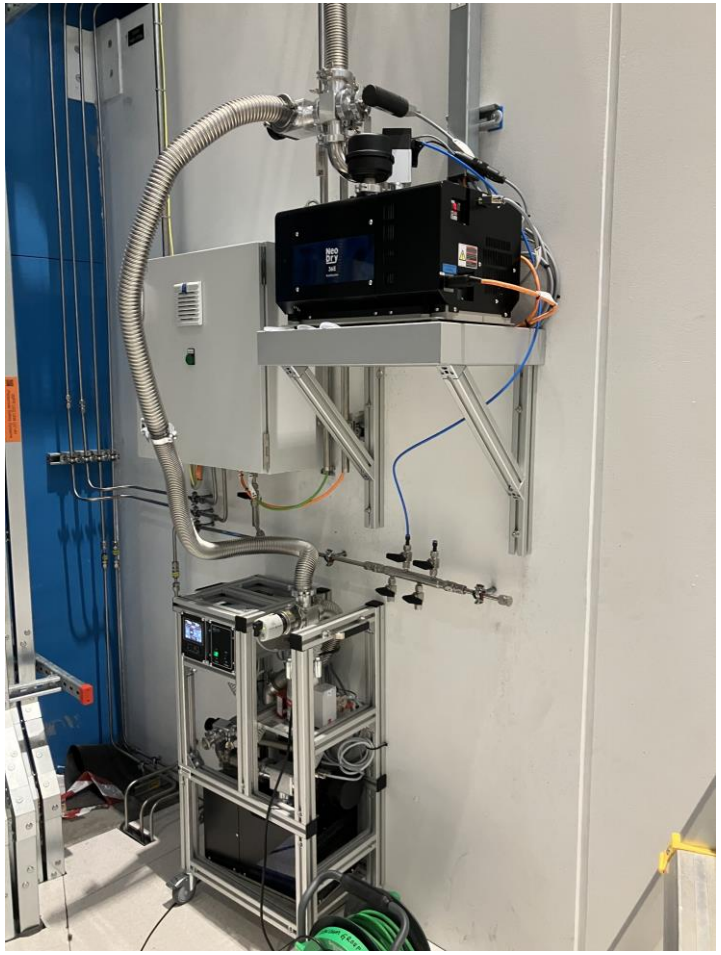


Safety Readiness: Ex-bunker

- Vacuum pump and gauge



Issue	Operation mode	Maintenance mode
Electric shock	Correctly grounding	Correctly grounding
Venting vacuum line	Only Vacuum team can perform work	Only Vacuum team can perform work
Disconnect vacuum hose	Only Vacuum team can perform work	Only Vacuum team can perform work



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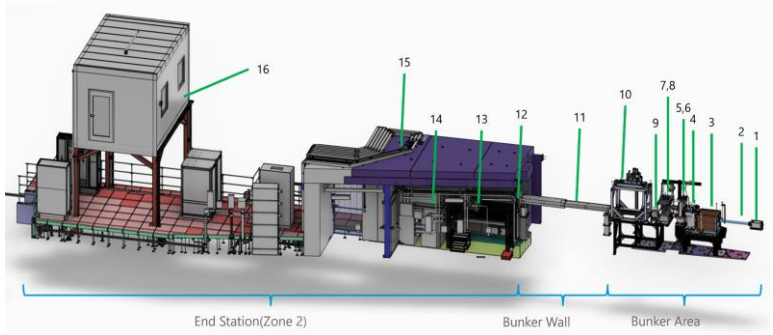
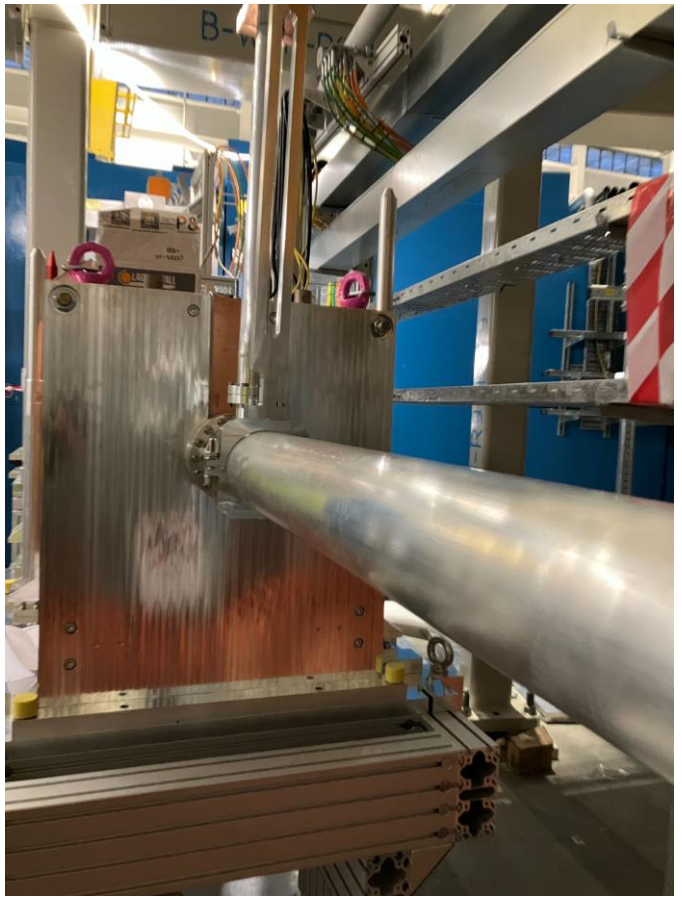
Safety Readiness: In-bunker

- Flight tube (2) and Heavy Collimator (3)



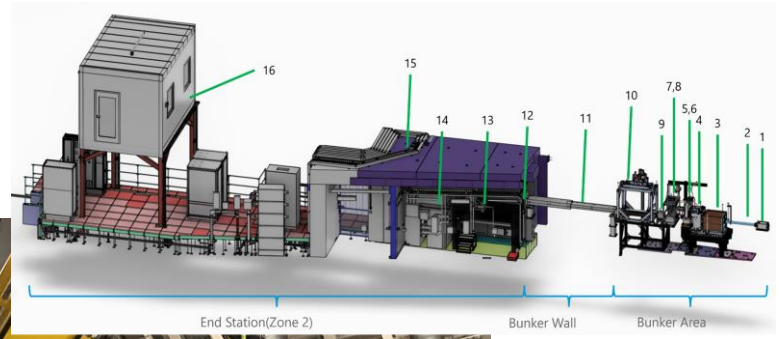
Issue	Operation mode	Maintenance mode
The vessel is accidentally pressurized beyond design levels while venting	N/A	Vacuum pumps turned off and valve closes when accidentally over-pressurized.
While under vacuum the window is accidentally punctured.	N/A	Protect the window during maintenance
Vacuum window is broken, generating loud noise	N/A	Protect the window during maintenance
Arcing due to neighbor electrical components	N/A	Properly grounding by CEP
Falling from suspended crane	N/A	Follow Rigging instruction, no pass under the suspended component.

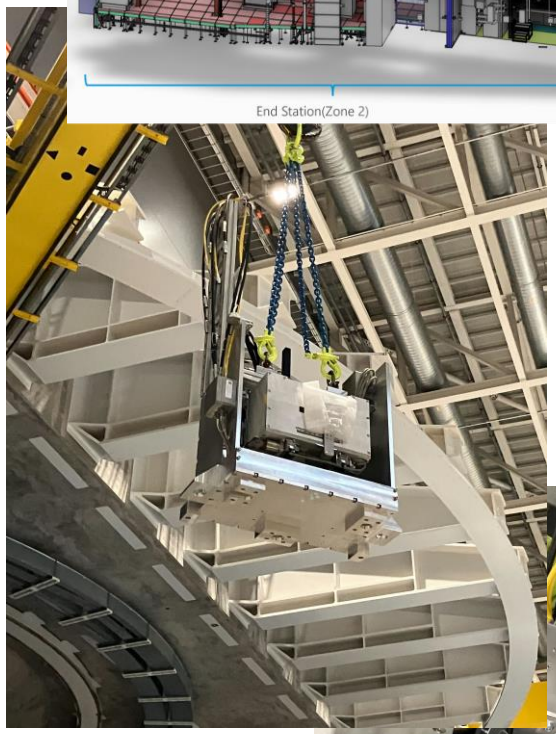


Safety Readiness: In-bunker

- Adjustable collimator (4)

Issue	Operation mode	Maintenance mode
Falling from suspended crane	N/A	Follow Rigging instruction, no pass under the suspended component.
Trapped fingers while working on movement units	N/A	Motion Safety
Electric shock on exposed cable	N/A	Operate at Extra Low Voltage (ELV) (< 50V)
Electric shock on live wire	N/A	Operate at Extra Low Voltage (ELV) (< 50V)
Arcing	N/A	Operate at Extra Low Voltage (ELV) (< 50V) Properly grounding by CEP

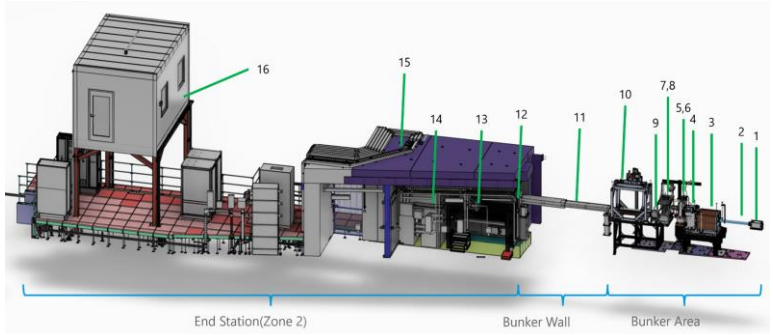




Safety Readiness: In-bunker

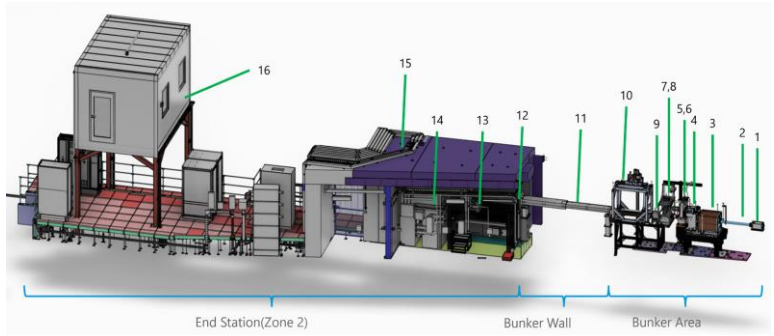
- Chopper (5+6)

Issue	Operation mode	Maintenance mode
While under vacuum the window is accidentally punctured.	N/A	Protect the window during maintenance
Vacuum window is broken, generating loud noise	N/A	Protect the window during maintenance
Flying debris due to blade failure	N/A	Housing designed to hold in case of failure. (ESS-5175000)
Electric shock on live wire	N/A	Only authorized person can work on it.
Arcing	N/A	Properly grounding by CEP
Falling from suspended crane	N/A	Follow Rigging instruction, no pass under the suspended component. Shutdown system before lifting.

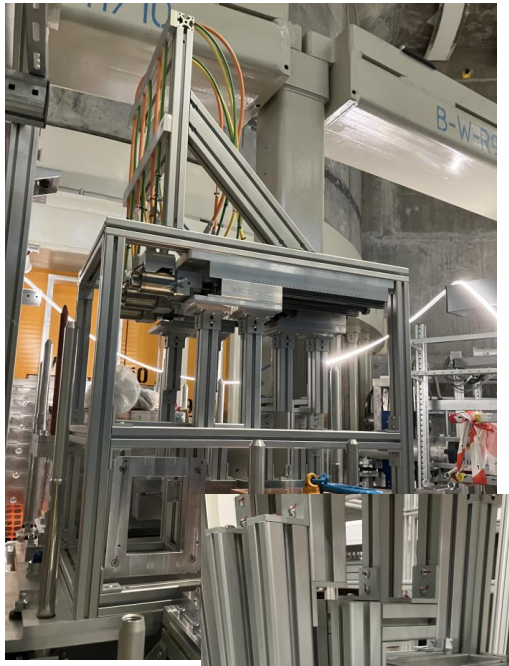


Safety Readiness: In-bunker

- Beam Filtering (7) + Beam Monitor (8)

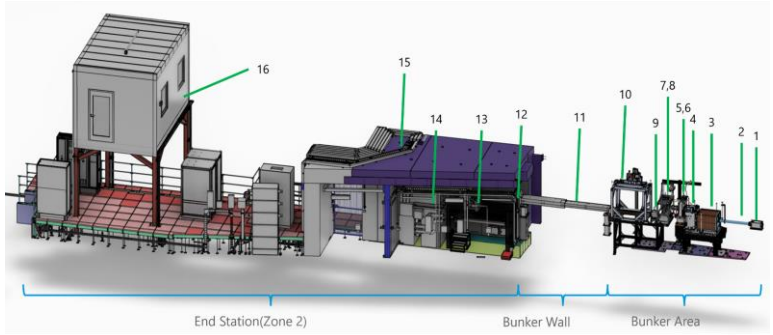


Issue	Operation mode	Maintenance mode
Falling from suspended crane (7)	N/A	Follow Rigging instruction, no pass under the suspended component.
Trapped fingers while working on movement units (7)	N/A	Motion Safety
Electric shock on exposed cable (7)	N/A	Operate at Extra Low Voltage (ELV) (< 50V)
Arcing (7)	N/A	Operate at Extra Low Voltage (ELV) (< 50V) Properly grounding by CEP
Contact toxic materials (Be, Cd) (7)	N/A	Aluminium cassette protects any direct contact. Follow SDS when exchanging filters.
Electric shock on live wire (8)	N/A	Only authorized person (DetG) can work on it.
Arcing (8)	N/A	Properly grounding by CEP



Safety Readiness: In-bunker

- Final Collimator (9)



Issue	Operation mode	Maintenance mode
Falling from suspended crane	N/A	Follow Rigging instruction, no pass under the suspended component.
Arcing due to neighbor electrical components	N/A	Properly grounding by CEP

Outline

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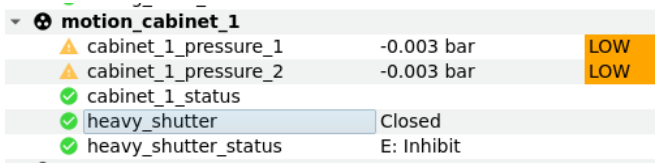
- ❑ Safety measures

Heavy Shutter

- Check the pressurized air in Motion Cabinet 1 is at Normal level.
- Contact MCA/PSS if the pressurized air is failed.
- Even the cave is in Access Mode, do not attempt to open the shutter.
- Despite shutter closed, regularly check the radiation dose rate inside the cave, especially around the bunker/cave gaps as well as the BWI.
- Although robustness was tested, avoid open and close the shutter several times in a short period.



Temporary shielding

- Mirrobor (B4C) sheets are available for neutron shielding.
- Keep the shielding away from fire.
- Lead blocks are available for gamma shielding, DO NOT put Lead Block in the beam directly.
- Wrap each Pb block with a plastic sheet before handling.
- Cadmium plate will be used in the beam, where a hand-tool used to cut the plate SHALL be separated from other tools.
- Gadolinium paints may be used on a metal surface. The painting shall be done inside the Fume Hood at E03 Optics Lab.
- Untraceable components, e.g., raceways shall be covered or removed from the neutron beam.
- In case of activated components, a barrier can be setup by Instrument Team to declare a safe distance. Radiation signage will be posted. This is referred to the Instrument Area only.

Motion Safety

In-bunker area

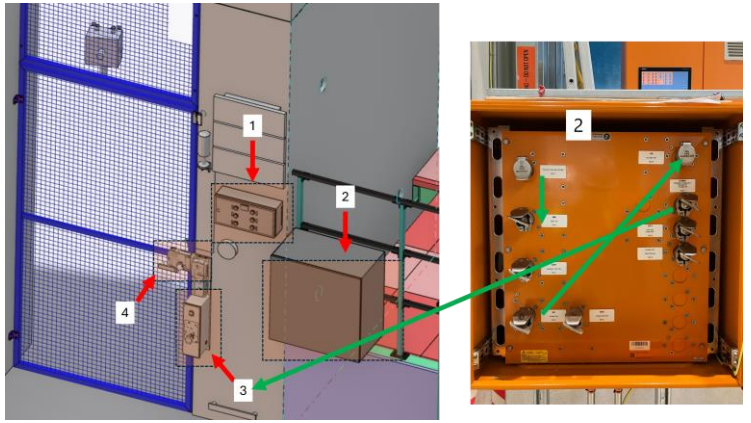
- E-stop button is provided inside the bunker area, where it will be used during Maintenance only
- The button should be pressed at the first occasion when access to the W11 area.
- Before closing the bunker, ensure that the button is released.

Inside the cave

- E-stop buttons are provided at 2 positions.
- A Reset button will be lid ON when the E-stop button is pressed.
- To activate the motions, release the E-stop buttons and then press the Reset button
- Do not move the stages at speed greater than 80 mm/s

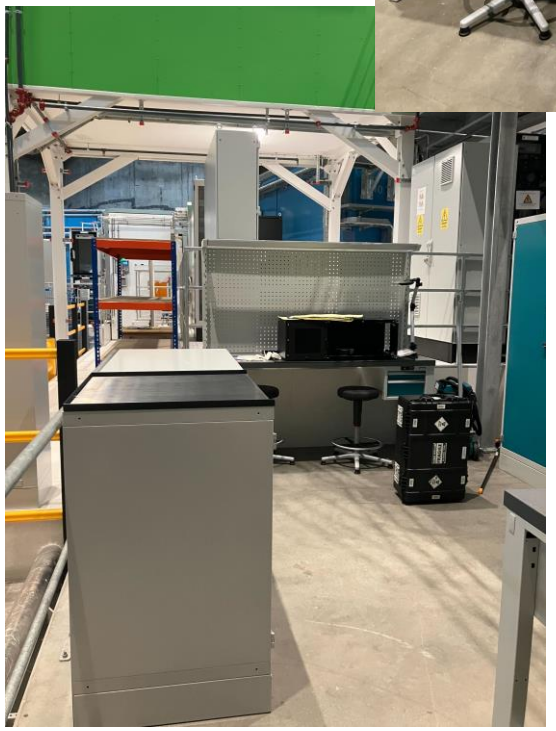
Personnel Safety System

- Search procedure and key exchange shall follow OM for TBL PSS (ESS-5797327).
- In case of emergency (e.g. shutter is opened, high radiation, blue lights ON) and cannot evacuate the cave, press the Emergency button and lay down the floor to avoid the beam. Avoid pressing the Emergency button without any emergency reason.
- Ensure that there is no object in the Heavy Door way.
- Break the glass at the entrance to enter the cave in case of Fire.
- Check the alarm on the display at the PSS rack in case of any errors.
- Keep the key for the TBL PSS key exchange cabinet in a locked place.
- OVK and AVK are controlled by RP.
- Lifting roof shall be done by Rigging team or authorized person.



Preparation area

- Hot work can be done with a temporary permit and training.
- Small mechanical work can be performed
- All cabinets/drawers share the same key.
- Load capacity are labelled on the shelf
- Keep away from sprinkler heads
- When storing activated components, keep the cabinet locked.
- Separate tools/components used inside the cave.
- Cables on the ground should be covered.



In case of Emergency

EUROPEAN SPALLATION SOURCE

EMERGENCY NOTICE

Raise Alarm

Raise alarm and isolate the incident if possible whilst ensuring your own safety

Evacuate the Area

When an evacuation alarm sounds, or when it becomes obvious that evacuation is required, evacuate the building through the nearest emergency exit and go to the nearest assembly point

Call 112 for Serious Incidents

Give following address to 112 for the Gate Guard position:
Partikelgatan 2, 224 84 Lund
Specify what has happened. Follow instructions from 112 and let 112 end the call

Give First Aid and Contact Gate Guard

Take care of the injured and provide with necessary assistance if possible. Contact the Gate Guard +46 72 179 2260 and ask to send the First Responders, indicating the incident location

Meet up First responders/Rescue services

Ensure that someone meets the First Responders/Rescue Services/Police to guide them to the incident

When the situation is under control, inform your local supervisor or Area Coordinator/Responsible about what has happened

Buildings

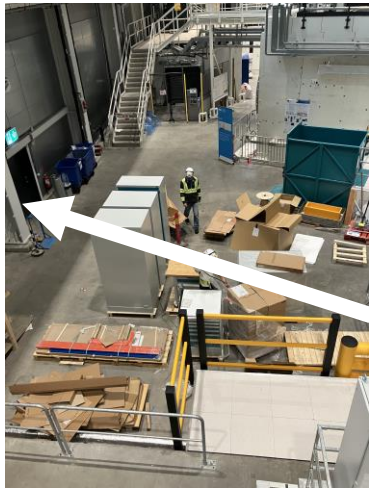
B01 - ESS Main Office
B02 - ESS Technical workshops
F04 - ESS main Entrance

F01 - Pump station
F03 - Logistics centre
G01 - Accelerator tunnel
G02 - Klystron gallery
G04 - Cryo compressor building

H01 - Central utility building
H05 - Primary substation
H06 - Distribution substation
H09 - Waste treatment facility
H10 - Sprinkler central

D01 - Experimental hall 1
D02 - Target station
D03 - Experimental hall 2
D04 - Lab
D05 - Substation
D06 - Substation
D08 - Lab

E01 - Experimental hall 3
E02 - Beamline gallery
E03 - Lab
E04 - Lab
E05 - Substation



Thank you!

Contacts:

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