Overview of Instrument Hazards

LOKI Instrument Safety Readiness Review Meeting

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2025-12-05

Overview

1. Instrument Hazard Analysis
2. Area Risk Assessment
3. Task Risk Assessments
4. Local Rules

1

Instrument Hazard Analysis

Instrument Hazard Analysis (IHA)

ESS-1084771

- Identifies hazards and assesses risk before and after mitigation.
- Equipment supplied with CE marking is supplied with operational instructions clearly stating intended use and hazards of operation and is not included in the IHA.

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LoKI - Instrument Hazard Analysis

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Page: 1 of 64 First Sheet

Instrument Hazard Analysis (IHA)

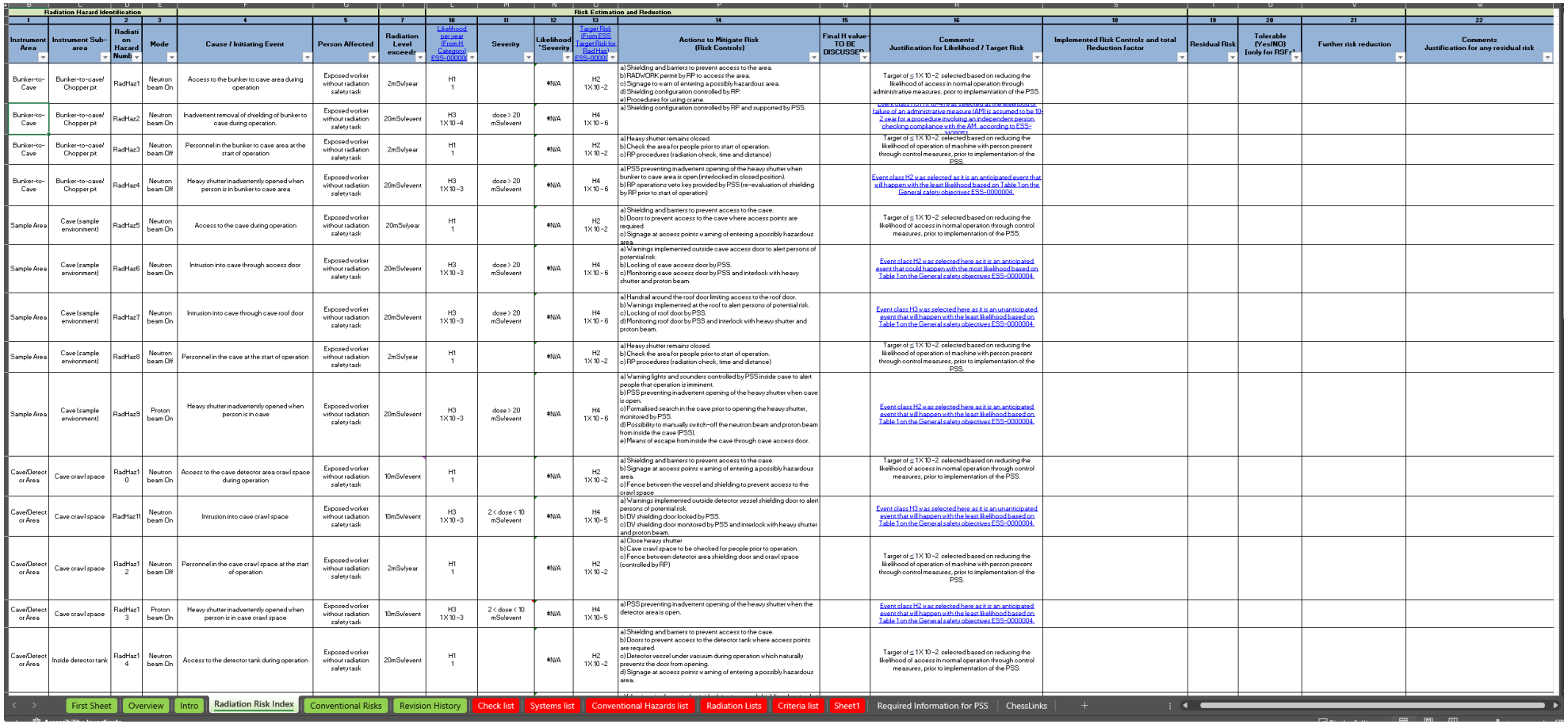
ESS-1084771

- Individual Design Risk Assessments (DRA) are supplied as required by EU directives
- The IHA records any residual risks identified in equipment design risk assessments that require further mitigation.
- The IHA includes risks that are not included in the design risk assessments and result from integration of the equipment or use of equipment outside it's intended use.

Equipment	DRA Reference
Chopper 1	ESS-3749883
Chopper 2	ESS-3805876
Heavy Shutter	ESS-4170570
Collimation Selector	ESS-4752105
Sample Snout	ESS-5072422
Detector Systems	ESS-5081613
Translating Monitor	ESS-5072425
Sample Stack	ESS-3972789
Slits Sets	ESS-4913719

Instrument Hazard Analysis (IHA)

Radiation Risk Index



Radiation Hazard Identification							Risk Estimation and Reduction												
1		2	3	4	5	7	10	11	12	13	14	15	16	18	19	20	21	22	
Instrument Area	Instrument Sub-area	Radiation Hazard Number	Mode	Cause / Initiating Event	Person Affected	Radiation Level exceeds	Likelihood per year (From H Category) ESS-0000004	Severity	Likelihood * Severity	Target Risk (From ESS Target Risk for RadHaz) ESS-0000004	Actions to Mitigate Risk (Risk Controls)	Final H value - TO BE DISCUSSED	Comments Justification for Likelihood / Target Risk	Implemented Risk Controls and total Reduction factor	Residual Risk	Tolerable (Yes/NO) (only for RSFs)	Further risk reduction	Comments Justification for any residual risk	
Bunker-to-Cave	Bunker-to-cave/ Chopper pit	RadHaz1	Neutron beam On	Access to the bunker to cave area during operation	Exposed worker without radiation safety task	2mSv/year	H1 1		#N/A	H2 1X10-2	a) Shielding and barriers to prevent access to the area. b) RADWORK permit by RP to access the area. c) Signage to warn of entering a possibly hazardous area. d) Shielding configuration controlled by RP. e) Procedures for using crane.		Target of ≤ 1X10-2 selected based on reducing the likelihood of access in normal operation through administrative measures, prior to implementation of the PSS.						
Bunker-to-Cave	Bunker-to-cave/ Chopper pit	RadHaz2	Neutron beam On	Inadvertent removal of shielding of bunker to cave during operation.	Exposed worker without radiation safety task	20mSv/event	H3 1X10-4	dose > 20 mSv/event	#N/A	H4 1X10-6	a) Shielding configuration controlled by RP and supported by PSS.		Event class H4 is selected as it is an anticipated event that will happen with the least likelihood based on Table 1 on the General safety objectives ESS-0000004. Likelihood of failure of an administrative measure (AM) is assumed to be 10-2 year for a procedure involving an independent person checking compliance with the AM, according to ESS-0000004.						
Bunker-to-Cave	Bunker-to-cave/ Chopper pit	RadHaz3	Neutron beam Off	Personnel in the bunker to cave area at the start of operation	Exposed worker without radiation safety task	2mSv/year	H1 1		#N/A	H2 1X10-2	a) Heavy shutter remains closed. b) Check the area for people prior to start of operation. c) RP procedures (radiation check, time and distance)		Target of ≤ 1X10-2 selected based on reducing the likelihood of operation of machine with person present through control measures, prior to implementation of the PSS.						
Bunker-to-Cave	Bunker-to-cave/ Chopper pit	RadHaz4	Neutron beam Off	Heavy shutter inadvertently opened when person is in bunker to cave area	Exposed worker without radiation safety task	20mSv/event	H3 1X10-3	dose > 20 mSv/event	#N/A	H4 1X10-6	a) PSS preventing inadvertent opening of the heavy shutter when bunker to cave area is open (interlocked in closed position). b) RP operations veto key provided by PSS (re-evaluation of shielding by RP prior to start of operation)		Event class H2 was selected as it is an anticipated event that will happen with the least likelihood based on Table 1 on the General safety objectives ESS-0000004.						
Sample Area	Cave (sample environment)	RadHaz5	Neutron beam On	Access to the cave during operation	Exposed worker without radiation safety task	20mSv/year	H1 1		#N/A	H2 1X10-2	a) Shielding and barriers to prevent access to the cave. b) Doors to prevent access to the cave where access points are required. c) Signage at access points warning of entering a possibly hazardous area.		Target of ≤ 1X10-2 selected based on reducing the likelihood of access in normal operation through control measures, prior to implementation of the PSS.						
Sample Area	Cave (sample environment)	RadHaz6	Neutron beam On	Intrusion into cave through access door	Exposed worker without radiation safety task	20mSv/event	H3 1X10-3	dose > 20 mSv/event	#N/A	H4 1X10-6	a) Warnings implemented outside cave access door to alert persons of potential risk. b) Locking of cave access door by PSS. c) Monitoring cave access door by PSS and interlock with heavy shutter and proton beam.		Event class H2 was selected here as it is an anticipated event that could happen with the most likelihood based on Table 1 on the General safety objectives ESS-0000004.						
Sample Area	Cave (sample environment)	RadHaz7	Neutron beam On	Intrusion into cave through cave roof door	Exposed worker without radiation safety task	20mSv/event	H3 1X10-3	dose > 20 mSv/event	#N/A	H4 1X10-6	a) Handrail around the roof door limiting access to the roof door. b) Warnings implemented at the roof to alert persons of potential risk. c) Locking of roof door by PSS. d) Monitoring roof door by PSS and interlock with heavy shutter and proton beam.		Event class H3 was selected here as it is an unanticipated event that will happen with the least likelihood based on Table 1 on the General safety objectives ESS-0000004.						
Sample Area	Cave (sample environment)	RadHaz8	Neutron beam Off	Personnel in the cave at the start of operation	Exposed worker without radiation safety task	2mSv/year	H1 1		#N/A	H2 1X10-2	a) Heavy shutter remains closed. b) Check the area for people prior to start of operation. c) RP procedures (radiation check, time and distance)		Target of ≤ 1X10-2 selected based on reducing the likelihood of operation of machine with person present through control measures, prior to implementation of the PSS.						
Sample Area	Cave (sample environment)	RadHaz9	Proton beam On	Heavy shutter inadvertently opened when person is in cave	Exposed worker without radiation safety task	20mSv/event	H3 1X10-3	dose > 20 mSv/event	#N/A	H4 1X10-6	a) Warning lights and sounders controlled by PSS inside cave to alert people that operation is imminent. b) PSS preventing inadvertent opening of the heavy shutter when cave is open. c) Formalised search in the cave prior to opening the heavy shutter, monitored by PSS. d) Possibility to manually switch-off the neutron beam and proton beam from inside the cave (PSS). e) Means of escape from inside the cave through cave access door.		Event class H2 was selected here as it is an anticipated event that will happen with the least likelihood based on Table 1 on the General safety objectives ESS-0000004.						
Cave/Detector Area	Cave crawl space	RadHaz10	Neutron beam On	Access to the cave detector area crawl space during operation	Exposed worker without radiation safety task	10mSv/event	H1 1		#N/A	H2 1X10-2	a) Shielding and barriers to prevent access to the cave. b) Signage at access points warning of entering a possibly hazardous area. c) Fence between the vessel and shielding to prevent access to the crawl space		Target of ≤ 1X10-2 selected based on reducing the likelihood of access in normal operation through control measures, prior to implementation of the PSS.						
Cave/Detector Area	Cave crawl space	RadHaz11	Neutron beam On	Intrusion into cave crawl space	Exposed worker without radiation safety task	10mSv/event	H3 1X10-3	2 < dose < 10 mSv/event	#N/A	H4 1X10-5	a) Warnings implemented outside detector vessel shielding door to alert persons of potential risk. b) DV shielding door locked by PSS. c) DV shielding door monitored by PSS and interlock with heavy shutter and proton beam.		Event class H3 was selected here as it is an unanticipated event that will happen with the least likelihood based on Table 1 on the General safety objectives ESS-0000004.						
Cave/Detector Area	Cave crawl space	RadHaz12	Neutron beam Off	Personnel in the cave crawl space at the start of operation	Exposed worker without radiation safety task	2mSv/year	H1 1		#N/A	H2 1X10-2	a) Close heavy shutter b) Cave crawl space to be checked for people prior to operation. c) Fence between detector area shielding door and crawl space (controlled by RP)		Target of ≤ 1X10-2 selected based on reducing the likelihood of operation of machine with person present through control measures, prior to implementation of the PSS.						
Cave/Detector Area	Cave crawl space	RadHaz13	Proton beam On	Heavy shutter inadvertently opened when person is in cave crawl space	Exposed worker without radiation safety task	10mSv/event	H3 1X10-3	2 < dose < 10 mSv/event	#N/A	H4 1X10-5	a) PSS preventing inadvertent opening of the heavy shutter when the detector area is open.		Event class H2 was selected here as it is an anticipated event that will happen with the least likelihood based on Table 1 on the General safety objectives ESS-0000004.						
Cave/Detector Area	Inside detector tank	RadHaz14	Neutron beam On	Access to the detector tank during operation	Exposed worker without radiation safety task	20mSv/event	H1 1		#N/A	H2 1X10-2	a) Shielding and barriers to prevent access to the cave. b) Doors to prevent access to the detector tank where access points are required. c) Detector vessel under vacuum during operation which naturally prevents the door from opening. d) Signage at access points warning of entering a possibly hazardous area.		Target of ≤ 1X10-2 selected based on reducing the likelihood of access in normal operation through control measures, prior to implementation of the PSS.						

First Sheet | Overview | Intro | Radiation Risk Index | Conventional Risks | Revision History | Check list | Systems list | Conventional Hazards list | Radiation Lists | Criteria list | Sheet1 | Required Information for PSS | ChessLinks

Instrument Hazard Analysis (IHA)

Conventional Risks

Hazard number	Building	Instrument Area	Instrument System Designation	Equipment	Haz ID	Hazard Category (mechanical, chemical, ergonomic..)	Source of Hazard	PSS Staff	Users	Visitors	Initiating event	Accident description	Consequence	Lifecycle Phase	Unmitigated Consequence Severity	Unmitigated Probability of Occurrence	Column1	Unmitigated Probability of Avoidance	Column2	Unmitigated Frequency of Exposure	Column3	Likelihood	Column4	Level of Risk	Unmitigated RISK Rating
ConHaz62	D03	Sample Area	Sample Exposure System	Sample Stack with unknown SE equipment	13.6.3 H62	HazMechanical	Motorized components	X	X	X	Local operation of sample stack with sample trolley loaded with unknown SE equipment that presents a crushing hazard	Crushing hazard	Crushing of body parts	Normal Operation	D - Single Fatality	Even Chance - Could easily happen	0.5	Probable - Likely, but not certain	0.1	Hourly - Multiple times a day	0.5	0.025	2 - Occasional	DX2	Unacceptable
ConHaz63	D03	Sample Area	Sample Exposure System	Sample Stack with unknown SE equipment	13.6.3 H63	HazMechanical	Motorized components	X	X	X	Remote operation of sample stack with sample trolley loaded with unknown SE equipment that presents a crushing hazard	Crushing hazard	Crushing of body parts	Normal Operation	D - Single Fatality	Even Chance - Could easily happen	0.5	Highly Unlikely - Possible, but very difficult to avoid	0.99	Hourly - Multiple times a day	0.5	0.2475	2 - Occasional	DX2	Unacceptable
ConHaz64	D03	Sample Area	Sample Exposure System	Sample Stack with Trolley attached	13.6.3 H64	HazMechanical	Motorized components	X	X	X	Sample trolley (or SE equipment) on Sample stack is driven into detector vessel or snout	Damage to vacuum vessels, fractured parts	Vacuum hazard, noise, shrapnel	Normal Operation	C - Injuries requiring support of emergency services	Probable - Not surprised	0.75	Unlikely - Possible, but hard to avoid	0.9	Hourly - Multiple times a day	0.5	0.3375	2 - Occasional	CX2	Tolerable
ConHaz65	D03	Sample Area	Sample Exposure System	Sample Trolley	13.6.3 H65	HazMechanical	Slippery surfaces	X	X		manouvring overloaded/top heavy trolley, causes instability/loss of control, or tipping	loaded trolley falls (400kg) of equipment dropped	Crushing of body parts	Normal Operation	C - Injuries requiring support of emergency services	Probable - Not surprised	0.75	Even Chance - 50/50 chance that it will be avoidable	0.5	Daily - Every day, or less frequently for long durations (hours)	0.25	0.09375	2 - Occasional	CX2	Tolerable
ConHaz66	D03	Sample Area	Sample Exposure System	Detector Vacuum Vessel	13.6.3 H70	HazMechanical	Vacuum	X	X	X	window damaged by exceeding pump down cycles	Vacuum window failure	Flying debris from proximity of broken window are projected in the proximity	Normal Operation	D - Single Fatality	Even Chance - Could easily happen	0.5	Even Chance - 50/50 chance that it will be avoidable	0.5	Constant - Large proportion of the day involves exposure to the hazard	0.9	0.225	2 - Occasional	DX2	Unacceptable
ConHaz67	D03	Sample Area	Sample Exposure System	Detector Vacuum Vessel	13.6.3 H71	HazMechanical	Vacuum	X			window damaged through overpressure of vacuum vessel	Vacuum window failure	Flying debris from proximity of broken window are projected in the proximity	Maintenance	D - Single Fatality	Possible - Unusual for it to happen	0.1	Even Chance - 50/50 chance that it will be avoidable	0.5	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.001	3 - Remote	DX3	Unacceptable
ConHaz68	D03	Detector Vessel	Scattering Characterization System	Detector Vacuum Vessel	13.6.3 H66	HazMechanical	Vacuum	X			Person working in vacuum vessel for prolonged periods	Claustrophobia, lack of adequate air supply.	Fainting, falling	Maintenance	C - Injuries requiring support of emergency services	Likely - To be expected	0.9	Almost Impossible - Not possible to avoid the hazardous event, i.e. invisible hazard, fast moving	0.999	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.01798	2 - Occasional	CX2	Tolerable
ConHaz69	D03	Detector Vessel	Scattering Characterization System	Detector Vacuum Vessel	13.6.3 H67	HazMechanical	Vacuum	X			Person/s accidentally shut inside vessel then vacuum is turned on	Person inside vacuum has no air supply	Asphyxiation	Maintenance	E - Multiple Fatalities	Unlikely - Could occur, but would be quite surprising	0.009	Highly Unlikely - Possible, but very difficult to avoid	0.99	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.00018	3 - Remote	EX3	Unacceptable
ConHaz70	D03	External to instrument	Experimental Cave	Raised flooring	13.6.3 H72	HazMechanical	Unprotected heights	X	X	X	Falling from edge (1m)	Falling from raised platform	Falling from 1m height	Normal Operation	C - Injuries requiring support of emergency services	Likely - To be expected	0.9	Unlikely - Possible, but hard to avoid	0.9	Constant - Large proportion of the day involves exposure to the hazard	0.9	0.729	2 - Occasional	CX2	Tolerable
ConHaz71	D03	External to instrument	Experimental Cave	Raised flooring	13.6.3 H73	HazMechanical	Slippery surfaces	X	X	X	Uneven flooring	Tripping whilst transversing floored area	Falling over	Normal Operation	B - Injuries requiring professional treatment, includes LTIs	Probable - Not surprised	0.75	Possible - Avoidance is possible and feasible	0.75	Constant - Large proportion of the day involves exposure to the hazard	0.9	0.50625	2 - Occasional	BX2	Tolerable
ConHaz72	D03	External to instrument	Experimental Cave	Raised flooring	13.6.3 H74	HazMechanical	Unprotected heights	X			Floor tile removed and not replaced, exposing a unprotected height	Falling 1m through hole	Falling	Maintenance	B - Injuries requiring professional treatment, includes LTIs	Probable - Not surprised	0.75	Possible - Avoidance is possible and feasible	0.75	Few Years - Every few years	0.001	0.00056	3 - Remote	BX3	Tolerable
ConHaz73	D03	External to instrument	Auxiliary Equipment	Instrument Crane	13.6.3 H75	HazMechanical	Suspended loads	X	X	X	Overloading of crane	Mass too heavy - crane or lifting equipment fracture	debris and falling mass	Normal Operation	D - Single Fatality	Even Chance - Could easily happen	0.5	Unlikely - Possible, but hard to avoid	0.9	Hourly - Multiple times a day	0.5	0.225	2 - Occasional	DX2	Unacceptable
ConHaz74	D03	External to instrument	Auxiliary Equipment	Instrument Crane	13.6.3 H76	HazMechanical	Suspended loads	X	X	X	Lifting using inappropriate lifting equipment	Incorrect lifting equipment (e.g. liftings eyes, slings) fail during lifting causing loads to fall	debris and falling mass	Normal Operation	D - Single Fatality	Even Chance - Could easily happen	0.5	Unlikely - Possible, but hard to avoid	0.9	Hourly - Multiple times a day	0.5	0.225	2 - Occasional	DX2	Unacceptable
ConHaz75	D03	External to instrument	Auxiliary Equipment	Instrument Crane	13.6.3 H77	HazMechanical	Suspended loads	X	X		Incorrect use of crane by inexperienced operators	Driving suspended loads into nearby persons or structures	hitting people, damaging nearby equipment resulting in debris	Normal Operation	C - Injuries requiring support of emergency services	Probable - Not surprised	0.75	Possible - Avoidance is possible and feasible	0.75	Hourly - Multiple times a day	0.5	0.28125	2 - Occasional	CX2	Tolerable
ConHaz76	D03	Detector Vessel	Scattering Characterization System	Detector Vacuum Vessel	13.6.3 H78	HazErgonomic	Poor illumination	X			Carrying out detector maintenance activities in vessel with inadequate lighting	Tripping, dropping of 20kg loads	Injuries from falling, injuries from dropping loads	Maintenance	C - Injuries requiring support of emergency services	Certain	1	Almost Impossible - Not possible to avoid the hazardous event, i.e. invisible hazard, fast moving	0.999	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.01998	2 - Occasional	CX2	Tolerable

First Sheet | Overview | Intro | Radiation Risk Index | Conventional Risks | Revision History | Check list | Systems list | Conventional Hazards list | Radiation Lists | Criteria list | Sheet1 | Required Information for PSS | ChessLinks

Instrument Hazard Analysis (IHA)

Conventional Risks (Cont)

Hazard number	Unmitigated Probability of Avoidance	Column 2	Unmitigated Frequency of Exposure	Colum n3	Likelih ood	Column4	Level of Risk	Unmitigated RISK Rating	Control Measures	Residual Risk Severity	Residual Probability of Occurrence	Column19	Residual Probability of Avoidance	Colum n21	Residual Frequency of Exposure	Column 23	Likelih ood24	Column25	Level of Risk26	Residual RISK Rating	Action Owner	Mitigations to be implemented	Reference
ConHaz62	Probable - Likely, but not certain	0.1	Hourly - Multiple times a day	0.5	0.025	2 - Occasional	DX2	Unacceptable	Handover to Motion Safety (Common MCA)	D - Single Fatality	Unlikely - Could occur, but would be quite surprising	0.009	Likely - It is most likely that you can avoid the hazardous event, i.e. see the hazard approaching and move	0.01	Hourly - Multiple times a day	0.5	5E-05	4 - Improbable	DX4	Tolerable	CMCA	Handover to Motion Safety (Common MCA)	Motion risk analysis of Neutron Instruments ESS-5467337 Table of Motion ESS-0114726
ConHaz63	Highly Unlikely - Possible, but very difficult to avoid	0.99	Hourly - Multiple times a day	0.5	0.2475	2 - Occasional	DX2	Unacceptable	Handover to Motion Safety (Common MCA)	D - Single Fatality	Highly Unlikely - Conceivable, but extraordinary	0.001	Likely - It is most likely that you can avoid the hazardous event, i.e. see the hazard approaching and move	0.01	Hourly - Multiple times a day	0.5	5E-06	4 - Improbable	DX4	Tolerable	CMCA	Handover to Motion Safety (Common MCA)	Motion risk analysis of Neutron Instruments ESS-5467337 Table of Motion ESS-0114726
ConHaz64	Unlikely - Possible, but hard to avoid	0.9	Hourly - Multiple times a day	0.5	0.3375	2 - Occasional	CX2	Tolerable	Handover to Motion Safety (Common MCA)	C - Injuries requiring support of emergency services	Unlikely - Could occur, but would be quite surprising	0.009	Probable - Likely, but not certain	0.1	Hourly - Multiple times a day	0.5	0.0005	3 - Remote	CX3	Tolerable	CMCA	Handover to Motion Safety (Common MCA)	Motion risk analysis of Neutron Instruments ESS-5467337 Table of Motion ESS-0114726
ConHaz65	Even Chance - 50/50 chance that it will be avoidable	0.5	Daily - Every day, or less frequently for long durations (hours)	0.25	0.09375	2 - Occasional	CX2	Tolerable	Manual operation of pallet truck by trained operator. Task risk assessment required for unusual or hazardous SE equipment	C - Injuries requiring support of emergency services	Possible - Unusual for it to happen	0.1	Probable - Likely, but not certain	0.1	Daily - Every day, or less frequently for long durations (hours)	0.25	0.0025	3 - Remote	CX3	Tolerable		Task risk assessment for manoeuvring and storage of SE equipment	Task Risk Assessment ESS-1549699
ConHaz66	Even Chance - 50/50 chance that it will be avoidable	0.5	Constant - Large proportion of the day involves exposure to the hazard	0.9	0.225	2 - Occasional	DX2	Unacceptable	a) Window guard limits debris in sample area. b) Close the window guard, or vent the vacuum in the detector vessel, prior to allowing access to the sample area by PSS. c) PSS interlock window guard when access is allowed. d) Signage	D - Single Fatality	Almost Impossible - Possible only under extreme circumstances, or after the failure of several control measures	0.0001	Likely - It is most likely that you can avoid the hazardous event, i.e. see the hazard approaching and move	0.01	Constant - Large proportion of the day involves exposure to the hazard	0.9	9E-07	5 - Highly improbable	DX5	Tolerable		Maintenance schedule	PSS documentation ESS-3731373 ESS-2638795 ESS-4710284 ESS-2443067
ConHaz67	Even Chance - 50/50 chance that it will be avoidable	0.5	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.001	3 - Remote	DX3	Unacceptable	a) Window guard limits debris in sample area. b) Close the window guard, or vent the vacuum in the detector vessel, prior to allowing access to the sample area by PSS. c) PSS interlock window guard when access is allowed. d) Signage e) Overpressure protective device. Dry air let up not required. Vacuum procedures	D - Single Fatality	Almost Impossible - Possible only under extreme circumstances, or after the failure of several control measures	0.0001	Probable - Likely, but not certain	0.1	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	2E-07	5 - Highly improbable	DX5	Tolerable		Operational Manual. Task risk assessment	PSS documentation ESS-3731373 ESS-2638795 ESS-4710284 ESS-2443067
ConHaz68	Almost Impossible - Not possible to avoid the hazardous event, i.e. invisible hazard, fast moving	0.999	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.01798	2 - Occasional	CX2	Tolerable	Installation to be carried out with end flange removed (air supply). Ventilation provided through gate valves and side door. Operational Manual. Task risk assessment	C - Injuries requiring support of emergency services	Highly Unlikely - Conceivable, but extraordinary	0.001	Likely - It is most likely that you can avoid the hazardous event, i.e. see the hazard approaching and move	0.01	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	2E-07	5 - Highly improbable	CX5	Acceptable		Task risk assessment	ESS-5081614
ConHaz69	Highly Unlikely - Possible, but very difficult to avoid	0.99	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.00018	3 - Remote	EX3	Unacceptable	a) PSS interlock on detector vessel door and vacuum pumps. b) PSS safety token released upon access to detector vessel to prevent unauthorized closure of the detector vessel. c) Controlled maintenance following Task risk assessment. d) Limit access to the detector vessel according to ESS Rules for Working in Confined spaces (ESS-2017107)	E - Multiple Fatalities	Almost Impossible - Possible only under extreme circumstances, or after the failure of several control measures	0.0001	Probable - Likely, but not certain	0.1	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	2E-07	5 - Highly improbable	EX5	Tolerable		PSS control of vacuum vessel and vacuum pumps. Search procedures to be created and documented. Maintenance staff training following RAMS	Detector Manual ESS-5081614 PSS Documentation ESS-3731373 ESS-2638795 ESS-4710284 ESS-2443067
ConHaz70	Unlikely - Possible, but hard to avoid	0.9	Constant - Large proportion of the day involves exposure to the hazard	0.9	0.729	2 - Occasional	CX2	Tolerable	Guard Rail edge protection	C - Injuries requiring support of emergency services	Likely - To be expected	0.9	Unlikely - Possible, but hard to avoid	0.9	Constant - Large proportion of the day involves exposure to the hazard	0.9	0.729	2 - Occasional	CX2	Tolerable		Design and construction of North sector bunker raised platform to integrate with exposed edge	
ConHaz71	Possible - Avoidance is possible and feasible	0.75	Constant - Large proportion of the day involves exposure to the hazard	0.9	0.50625	2 - Occasional	BX2	Tolerable	Use of COTS flooring product. Good housekeeping and maintenance	B - Injuries requiring professional treatment, includes LTIs	Highly Unlikely - Conceivable, but extraordinary	0.001	Likely - It is most likely that you can avoid the hazardous event, i.e. see the hazard approaching	0.01	Constant - Large proportion of the day involves exposure to the hazard	0.9	9E-06	4 - Improbable	BX4	Acceptable			
ConHaz72	Possible - Avoidance is possible and feasible	0.75	Few Years - Every few years	0.001	0.00056	3 - Remote	BX3	Tolerable	Flooring dos not contain services expected to require regular maintenance. Provide temporary barriers create Task risk assessment	B - Injuries requiring professional treatment, includes LTIs	Unlikely - Could occur, but would be quite surprising	0.009	Likely - It is most likely that you can avoid the hazardous event, i.e. see the hazard approaching and move	0.01	Few Years - Every few years	0.001	9E-08	5 - Highly improbable	BX5	Acceptable		Produce Task risk assessment for any works needed	Task Risk Assessment ESS-1549699
ConHaz73	Unlikely - Possible, but hard to avoid	0.9	Hourly - Multiple times a day	0.5	0.225	2 - Occasional	DX2	Unacceptable	Crane compliant with relevant EU standards. Clearly marked lifting limit. Mechanical overload protection. Inspection and load test. Operational Manual in Swedish. Trained operators. Maintenance schedule	D - Single Fatality	Almost Impossible - Possible only under extreme circumstances, or after the failure of several control measures	0.0001	Probable - Likely, but not certain	0.1	Hourly - Multiple times a day	0.5	5E-06	4 - Improbable	DX4	Tolerable		Operator training. Maintenance schedule	ESS-0402063 (ESS Handbook for rigging)
ConHaz74	Unlikely - Possible, but hard to avoid	0.9	Hourly - Multiple times a day	0.5	0.225	2 - Occasional	DX2	Unacceptable	Follow ESS rigging rules and only use registered lifting equipment. Lifting inspection procedure	D - Single Fatality	Highly Unlikely - Conceivable, but extraordinary	0.001	Unlikely - Possible, but hard to avoid	0.9	Hourly - Multiple times a day	0.5	0.0005	3 - Remote	DX3	Unacceptable	Rigging	Lifting inspection plan and control of lifting equipment	ESS-0402063 (ESS Handbook for rigging)
ConHaz75	Possible - Avoidance is possible and feasible	0.75	Hourly - Multiple times a day	0.5	0.28125	2 - Occasional	CX2	Tolerable	2 tonne load limit. Only trained operators use crane. Crane can be electrically isolated and locked to prevent unwanted use.	C - Injuries requiring support of emergency services	Unlikely - Could occur, but would be quite surprising	0.009	Likely - It is most likely that you can avoid the hazardous event, i.e. see the hazard approaching and move	0.01	Hourly - Multiple times a day	0.5	5E-05	4 - Improbable	CX4	Tolerable		Operator training	ESS-0402063 (ESS Handbook for rigging)
ConHaz76	Almost Impossible - Not possible to avoid the hazardous event, i.e. invisible hazard, fast moving	0.999	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	0.01998	2 - Occasional	CX2	Tolerable	Internal lighting included. Task lighting to be used where internal lighting is not deemed sufficient. Task risk assessment	C - Injuries requiring support of emergency services	Unlikely - Could occur, but would be quite surprising	0.009	Probable - Likely, but not certain	0.1	Annually - Annually, or once in the equipment lifetime lasting weeks	0.02	2E-05	4 - Improbable	CX4	Tolerable		SAR inspection. Task risk assessment (check lighting is adequate for activity before starting task)	Loki detector operation and maintenance manual ESS-5081614 Task risk assessment ESS-1549699

First Sheet | Overview | Intro | Radiation Risk Index | Conventional Risks | Revision History | Check list | Systems list | Conventional Hazards list | Radiation Lists | Criteria list | Sheet1 | Required Information for PSS | ChessLinks

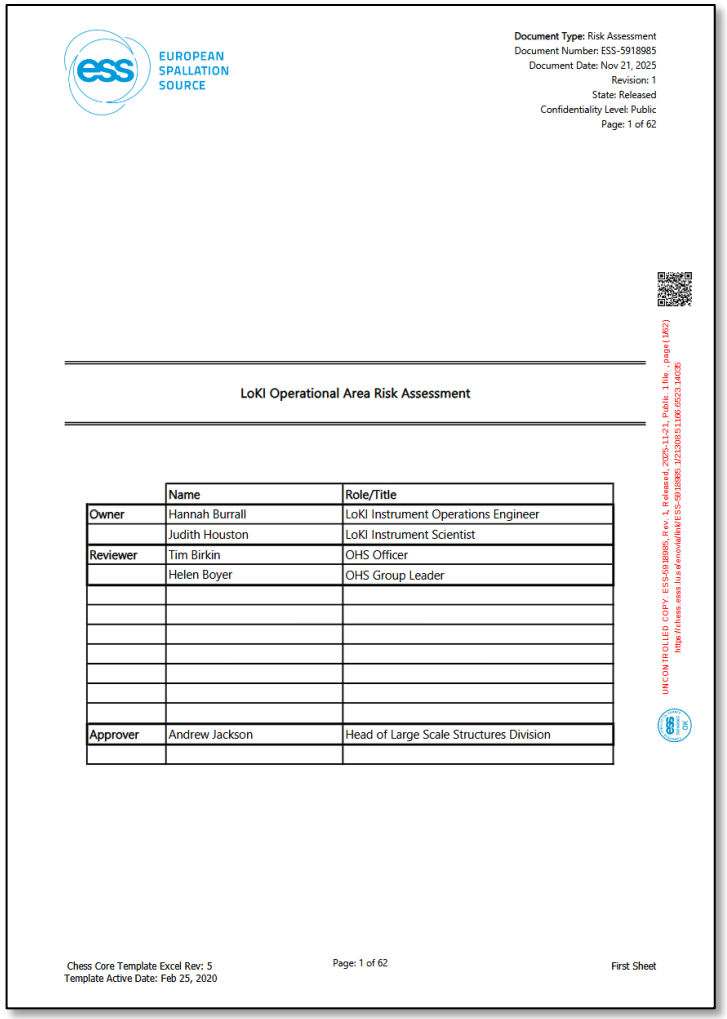
2

Area Risk Assessment

LoKI Operational Area Risk Assessment (ARA)

ESS-5918985

- Identify, evaluate and control potential risks associated with operational areas
- Operational areas have been classifed as laboratory spaces, office spaces or general workspaces reflecting the differing levels of risk and safety control measures required in each environment
- As a general guide an area risk assessment informs staff and those entering the area about the hazards that may be present in the area, all or part of the time.
- A living document that will be updated as new risks are identified as LoKI enters SSO and full operational mode



EUROPEAN SPALLATION SOURCE

Document Type: Risk Assessment
Document Number: ESS-5918985
Document Date: Nov 21, 2025
Revision: 1
State: Released
Confidentiality Level: Public
Page: 1 of 62

LoKI Operational Area Risk Assessment

	Name	Role/Title
Owner	Hannah Burrall	LoKI Instrument Operations Engineer
	Judith Houston	LoKI Instrument Scientist
Reviewer	Tim Birkin	OHS Officer
	Helen Boyer	OHS Group Leader
Approver	Andrew Jackson	Head of Large Scale Structures Division

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Template Active Date: Feb 25, 2020

Page: 1 of 62

First Sheet

LoKI Operational Area Risk Assessment

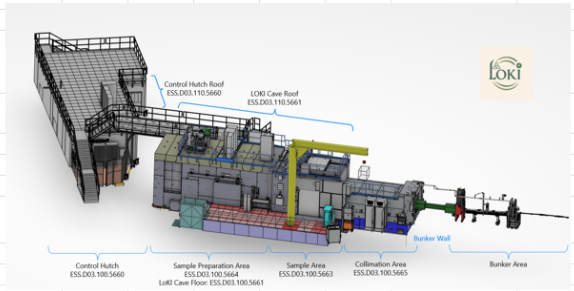
Area Information

Document Type: Risk Assessment
Document Number: ESS-5918985

Document Date: Nov 13, 2025
Revision: 1
State: Released

2. Area Information

Building number	D03
Location breakdown structure	ESS.D03
Sub areas (LBS)	Control Hutch: ESS.D03.100.5660 Sample Prep Area: ESS.D03.100.5664 LOKI Cave Roof: ESS.D03.110.5661 Sample Area: ESS.D03.100.5663 Collimation Area: ESS.D03.100.5665 Control Hutch Roof: ESS.D03.110.5660
Division	Large Scale Structures
Area responsible	Hannah Burrall



Areas can be divided into smaller areas where either the hazards or the mitigations that apply are significantly different.
For the purpose of this assessment workers means people working in the area regardless of whether they are staff, contractors or in-kind partners.

First Sheet | Introduction | Method Description | Area Information | Cave & Cave Roof ARA | Sample Prep ARA | Control Hutch ARA | Workshop ARA | Area Risk Assessment Template | Risk Mat

LoKI Operational Area Risk Assessment

Area Classification

Document Type: Risk Assessment
Document Number: ESS-5918985

Document Date: Nov 13, 2025
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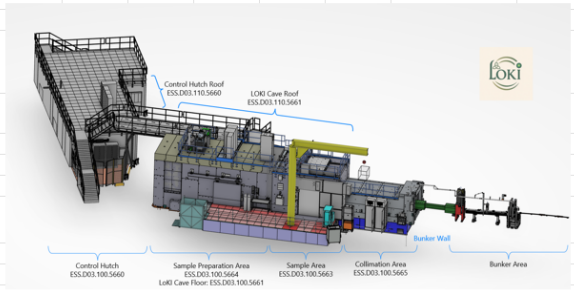
State: Released

2. Area Information

Building number	D03
Location breakdown structure	ESS.D03
Sub areas (LBS)	Control Hutch: ESS.D03.100.5660 Sample Prep Area: ESS.D03.100.5664 LOKI Cave Roof: ESS.D03.110.5661 Sample Area: ESS.D03.100.5663 Collimation Area: ESS.D03.100.5665 Control Hutch Roof: ESS.D03.110.5660
Division	Large Scale Structures
Area responsible	Hannah Burrall



Areas can be divided into smaller areas where either the hazards or the mitigations that apply are significantly different.
For the purpose of this assessment workers means people working in the area regardless of whether they are staff, contractors or in-kind partners.

Laboratory

General Workspace

Office Space

First Sheet | Introduction | Method Description | Area Information | Cave & Cave Roof ARA | Sample Prep ARA | Control Hutch ARA | Workshop ARA | Area Risk Assessment Template | Risk Mat

LoKI Operational Area Risk Assessment (ARA)

LoKI Cave & Cave Roof

LoKI Cave & Cave Roof Area Risk Assessment

Area Classification: Laboratory

LBS: ESS.D03.100.5663 & ESS.D03.110.5661

HazId No.	Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating			Further action needed	Owner	Follow up	Comments
					Severity	Likelihood	Risk H, M, L, A		Severity	Likelihood	Risk H, M, L, A				
1	Electrical	X	Electrical hazards are present due to energized instrument racks and control electronics, cable trays and cabling, motors, electrical outlets, and other energized sub-systems in the sample cave and on the roof of	Electric shock, burns, or fire on contact with live parts during maintenance, installation or alignment tasks. Faulty or damaged cabling leading to short circuits, sparking, or fire. Accidental activation of motors or other	4	3	H	Only qualified personnel handle live circuits, lock-out/tag-out procedures, regular inspection, appropriate protection as needed. Follow ESS electrical self audit scheme.	4	1	M				
2	Mechanical / Motion	X	Moving stages, stack motions, or other motorized and/or pneumatic assemblies	Contact with moving or actuated components such as linear stages, rotary stages, stack mechanisms, or pneumatic actuators. Pinch points, entanglement, or crushing between moving assemblies and stationary structures or personnel. Unexpected motion during alignment, calibration, or maintenance. Possible collisions with tools, instruments, or personnel in proximity.	4	2	M	Software and physical interlocks; motion emergency & operational stops; enable switch required for movement of sample stack while cave door is open; barriers where needed; maintain safe distance; refer to motion risk assessment	4	1	M				
3	Fall from Height	X	Working on elevated roof structures	Fall leading to serious injury	4	2	M	Barriers and handrails on roof and around hatch, including chained section in place; maintain 3 points of contact; use harness where required	4	1	M				
4	Slips, Trips & Falls	X	Cables, uneven flooring, tools, or cooling lines specifically inside the cave	Minor injury or sprain	2	3	L	Good housekeeping, cable management, adequate lighting	2	1	A				
5	Fall / Drop Hazard	X	Changes in working elevation around the instrument: step up to false floor (stairs to sample cave), and steps to the top of the cave/hutch. Potential for slips, missteps, or falls while carrying tools or equipment.	Sprains, bruising, lacerations; possible fractures; in worst case a fall from height could result in serious injury.	3	3	M	Handrails installed on access stairs; good general lighting; personnel trained to maintain 3 points of contact when climbing; work on cave roof only permitted by authorized personnel.	3	1	L				
6	Vehicles moving	X	Forklifts and other service vehicles may operate in the corridor and shared space between LoKI and TBL during installation, maintenance, and material transport activities. Potential for collision with personnel or	Crushing injury, fractures, contusions; potential severe or fatal injury in case of direct impact; damage to instrument components.	4	3	M	Marked walkways and exclusion zones; forklift operators certified; radio/visual communication in shared work areas; spotter used during tight maneuvers; speed limits enforced; general lighting adequate.	4	2	M				
7	Chemical (IPA, Coolants, Samples)	X	Cleaning and maintenance fluids (IPA, glycol). Water based samples (H2O, D2O).	Skin/eye irritation, fire risk	3	2	L	Chemical handling training; use in ventilated area, PPE (gloves, goggles), SDS available; suitable storage; no ignition sources.	3	1	L				
8	Cooling Systems	X	Water baths, Julabos circulators, or cold lines	Frostbite, leaks, burns	3	2	L	Trained users, leak checks, pressure relief where needed	3	1	L				
9	Radiation (Supervised Area)	X	Beamline exposure	Exposure to ionizing radiation	4	2	M	Area classified, interlocked access; controlled by RP & PSS team, regular surveying of area, personal dosimeter required	4	1	M				
10	Radiation (Supervised Area)	X	Activation of materials	Exposure to ionizing radiation	3	2	L	Area classified, interlocked access; controlled by RP & PSS team, regular surveying of area, personal dosimeter required	3	1	L				
11	Laser Radiation (Class II)	X	A Class II visible laser is used for aligning sample environment components inside the sample cave. The beam is low-powered but can be hazardous if intentionally stared into.	Temporary flash blindness; discomfort; possible minor and reversible eye irritation. No permanent injury expected under normal avoidance response.	2	2	A	Laser safety signage at sample cave entrance; alignment procedure documented; operators trained not to look directly into the beam; beam directed away from viewing height; beam switched off when not actively in use.	2	1	A				
12	Fire	X	Electrical faults or flammable materials (IPA, cabling)	Burns, smoke inhalation, property damage	4	2	M	CO_2 fire extinguisher inside/nearby cave; no hot work without permit; minimize combustible storage; self-extinguishing bins	4	1	M				
13	Noise	X	Operation of motors, pumps, or vacuum systems	Hearing damage (prolonged)	3	2	L	Hearing protection available, limit exposure time	3	1	L				
14	Manual Handling	X	Handling components	Back or muscle strain	3	3	M	Lifting aids, team lifting, manual handling training	3	1	L				
15	Lifting / Crane Operation	X	The LoKI crane, overhead crane, and bunker crane are present and regularly operated in this area.	Dropped load, crush injury, equipment damage	4	3	H	Crane certified, load limits posted, trained and authorized operators only, taglines used, exclusion zone enforced	4	1	M				
16	Environmental / Waste	X	Disposal of rags, cleaning solvents, and packaging	Contamination, slip hazards	3	2	L	Segregated waste bins, spill kits	3	1	L				
17	Ventilation / Fume Exposure	X	Limited ventilation during IPA use or in-situ reactions	Dizziness, irritation	3	2	L	Local extraction fans, short-duration tasks	3	1	L				
18	Lighting / Visibility	X	Low light areas within cave	Trip, poor visibility of hazards	2	2	A	Portable lighting, fixed illumination	2	1	A				
19	Access Control	X	Unauthorized access to cave during active	Injury due to motion or electrical hazards	4	2	M	Lockable access doors, signage, key control	4	1	M				
			Not present in general operations, but potential for low oxygen levels during specific					ODH monitors installed inside and outside cave; ensure adequate							

Cave & Cave Roof ARA | Sample Prep ARA | Control Hutch ARA | Workshop ARA | Area Risk Assessment Template | Risk Matrix | Revision History | ChessLinks

LoKI Operational Area Risk Assessment (ARA)

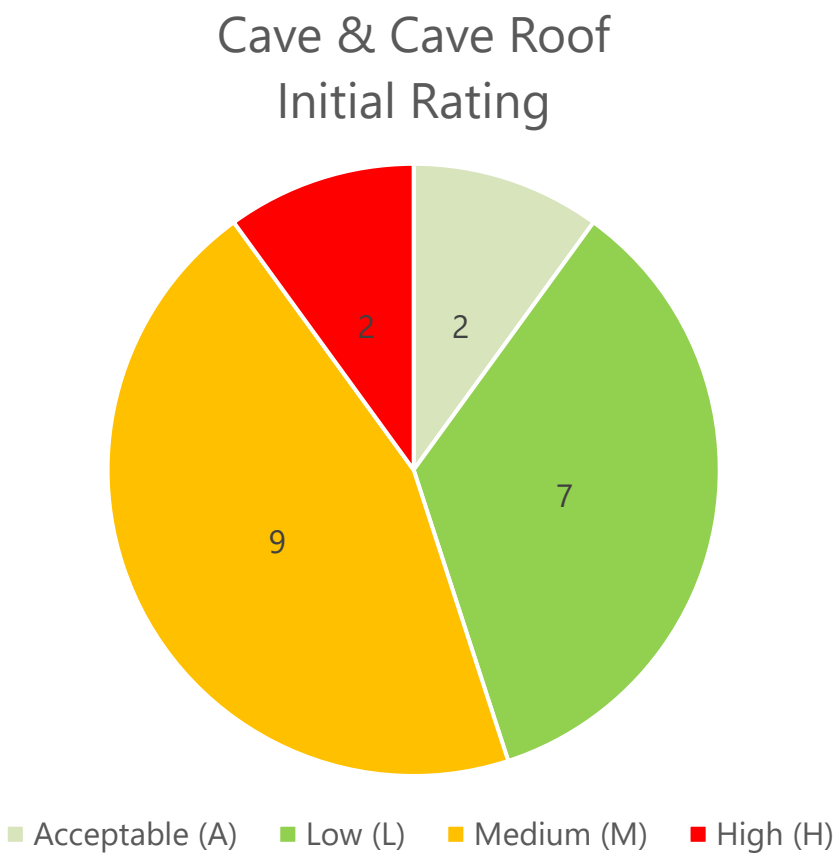
ARA Template

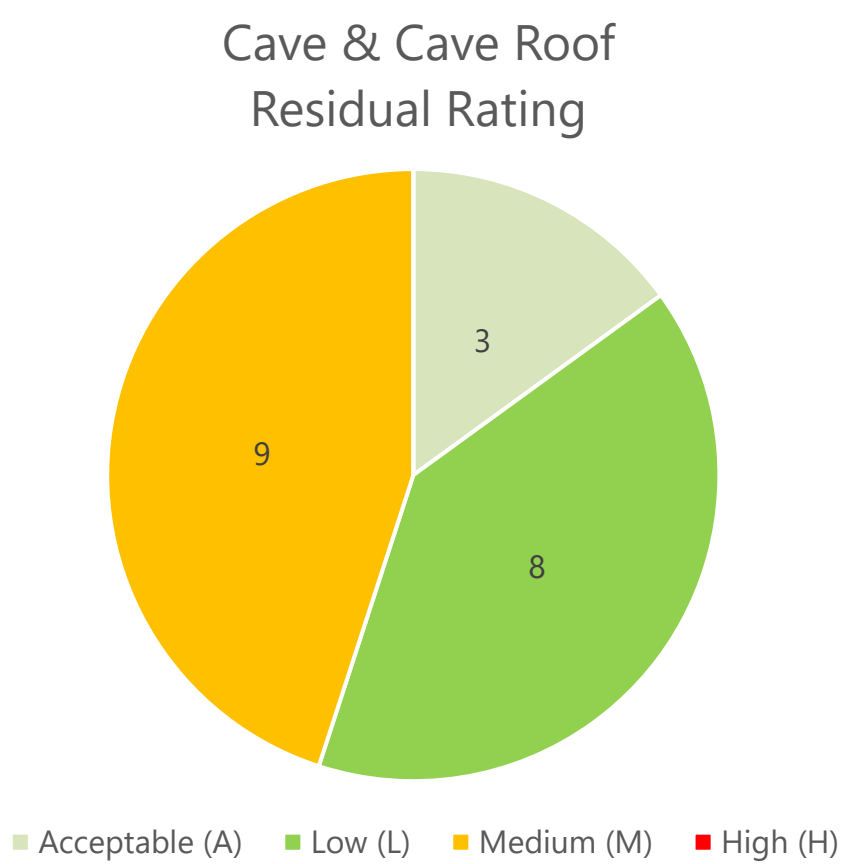
HazId No.	Hazard type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Severity	Likelihood	Initial risk	Existing mitigations to control risk	Severity 2	Likelihood 2	Residual risk	Further action needed	Owner	Follow up	Comments
	Area Hazard Analysis / Work Environment Risk Assessment														
HazId No.	Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating			Further action needed	Owner	Follow up	Comments
					Severity	Likelihood	Risk H, M, L, VL		Severity	Likelihood	Risk H, M, L, VL				
1	Electrical safety														
1.1	Is there any electrical equipment?														
1.2	Is there any residual voltage > 60 V, more than 1 second after switching off?														
1.3	Is any static electricity present which could present a hazard?														
2	Fire & Chemical safety														
2.1	Are there any substances that are toxic, oxidising, irritant, harmful, corrosive (if so, state which)														
2.2	Carcinogenic, Mutagenic, Reprotoxic? (CMR)														
2.3	Flammable? (ie. Liquids, gases or dust)														
2.4	Explosive?														
2.5	Dangerous for the environment?														
2.6	Is there any asbestos used in the equipment?														
3	Biological safety														
3.1	Is there any Biological agent involved? If so state which.														
3.2	Could growth of microorganisms occur? (E.g. legionella)														
4	Cryogenic safety, Oxygen Deficiency Hazards (ODH) & Oxygen enrichment														
4.1	Is there any Cryogenic fluid?														
4.2	Are any inert gases used that could be an ODH?														
4.3	Are any other gases present that could be an ODH?														
4.4	Could oxygen enrichment occur?														
5	Ionizing radiation														
5.1	Open sources?														
5.2	Sealed sources?														
5.3	Activated or contaminated material?														
5.4	Radioactive waste?														
5.5	Equipment generated? (Generated by the equipment under consideration. E.g. particle beam, x-ray equipment)														
6	Artificial optical radiation (except laser)														
6.1	Is there any Ultraviolett radiation? (wavelength 100 - 400 nm)														
6.2	Visible radiation? (wavelength 380 - 780 nm.)														

Cave & Cave Roof ARA | Sample Prep ARA | Control Hutch ARA | Workshop ARA | Area Risk Assessment Template | Risk Matrix | Revision History | ChessLinks

LoKI Operational Area Risk Assessment (ARA)

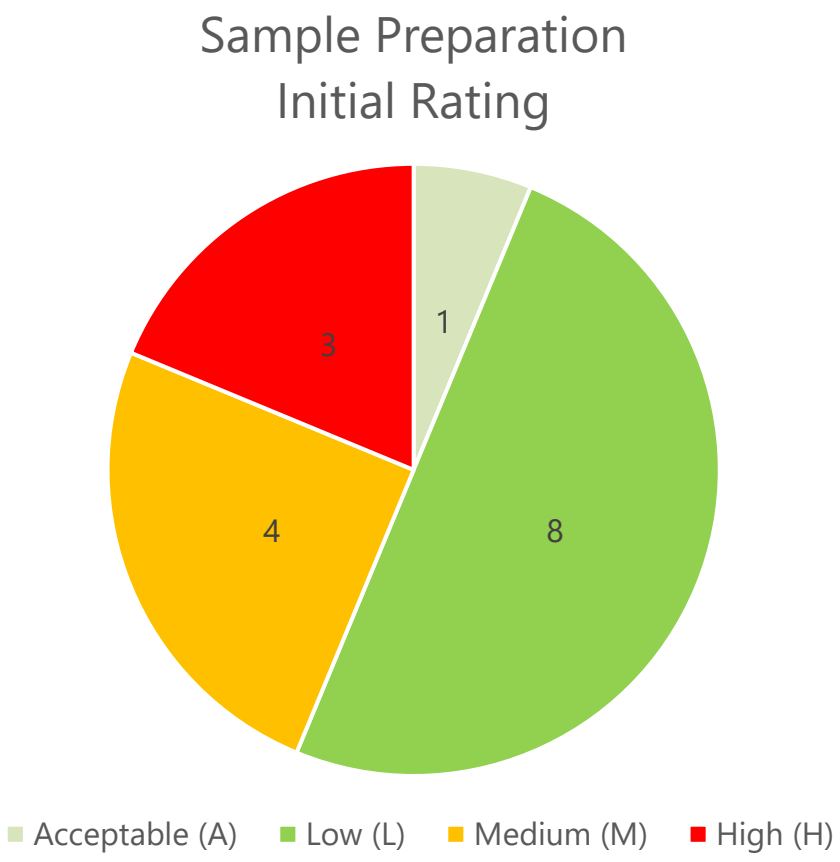
Cave & Cave Roof

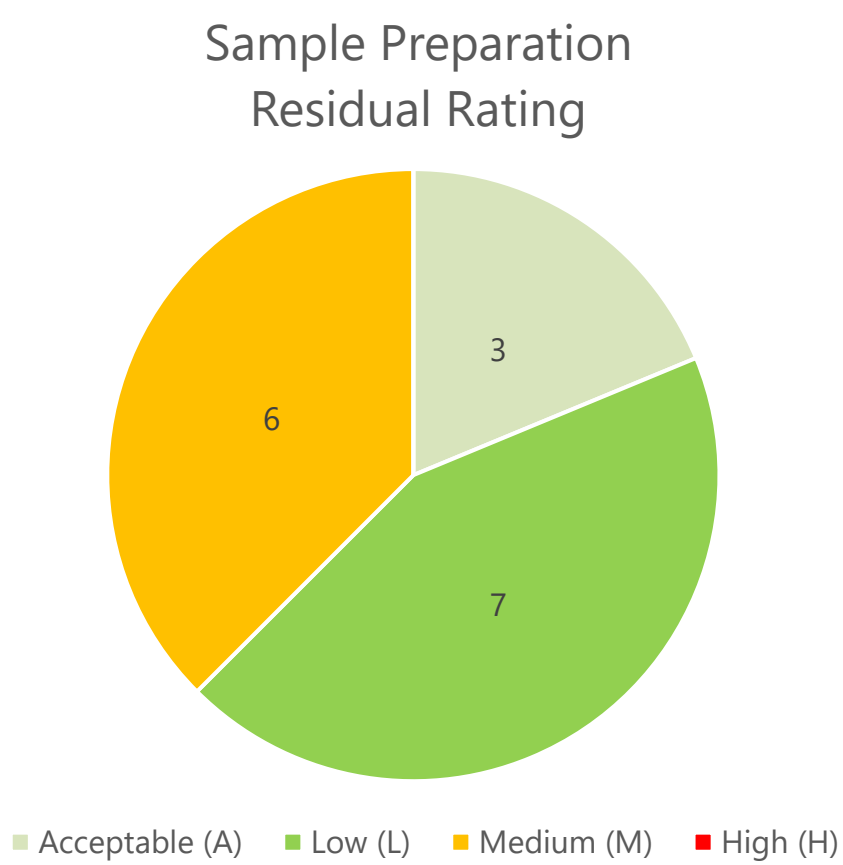




LoKI Operational Area Risk Assessment (ARA)

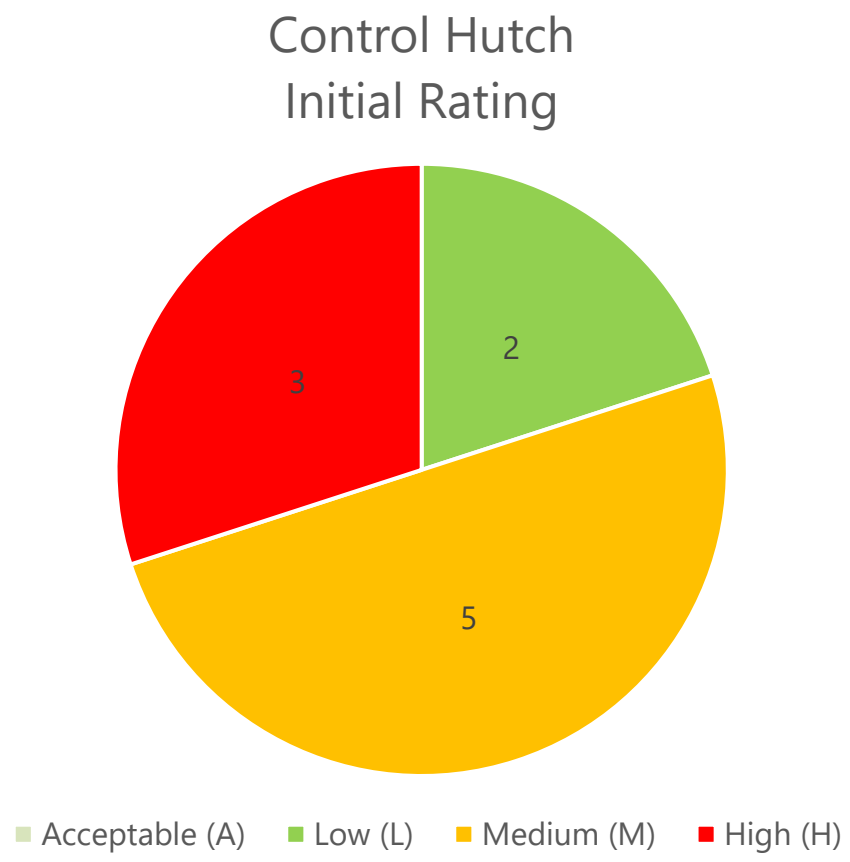
Sample Preparation Area

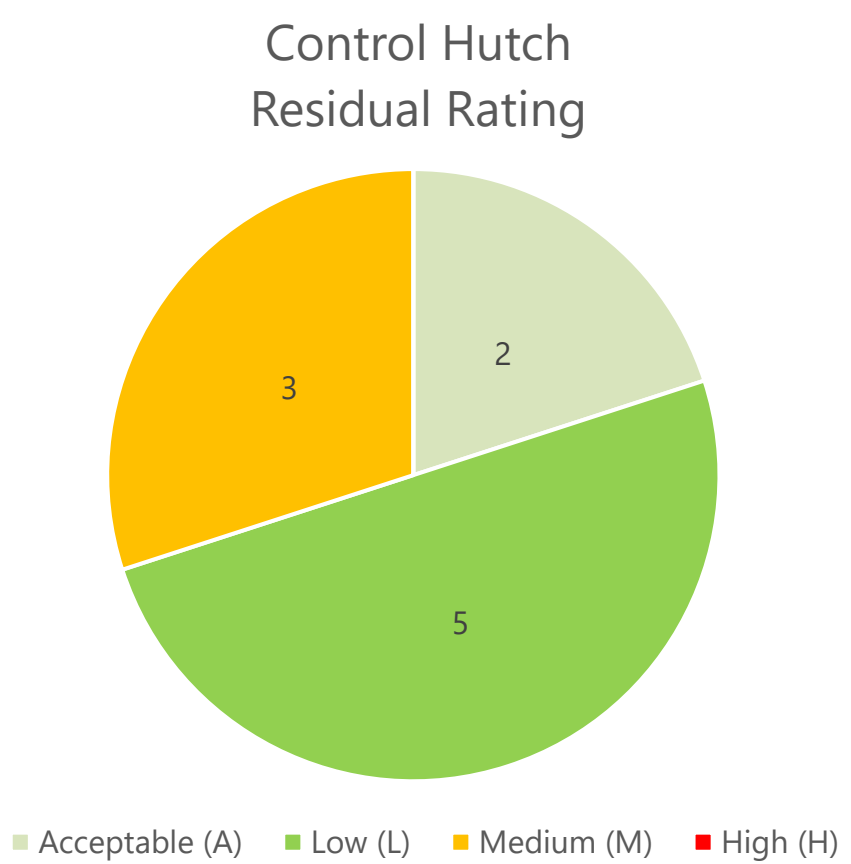




LoKI Operational Area Risk Assessment (ARA)

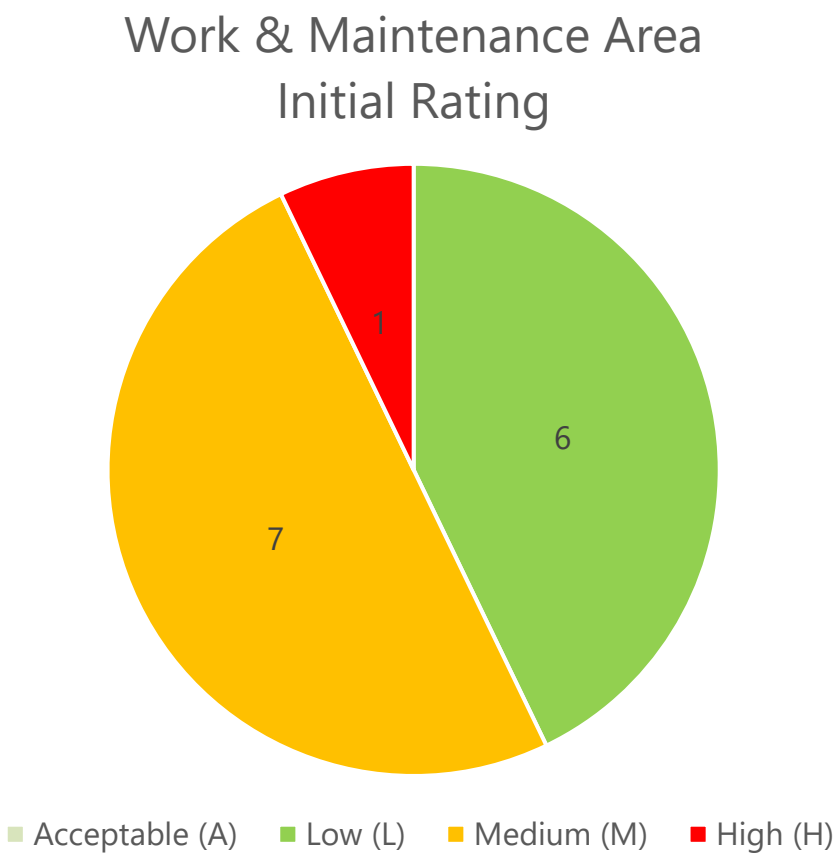
Control Hutch

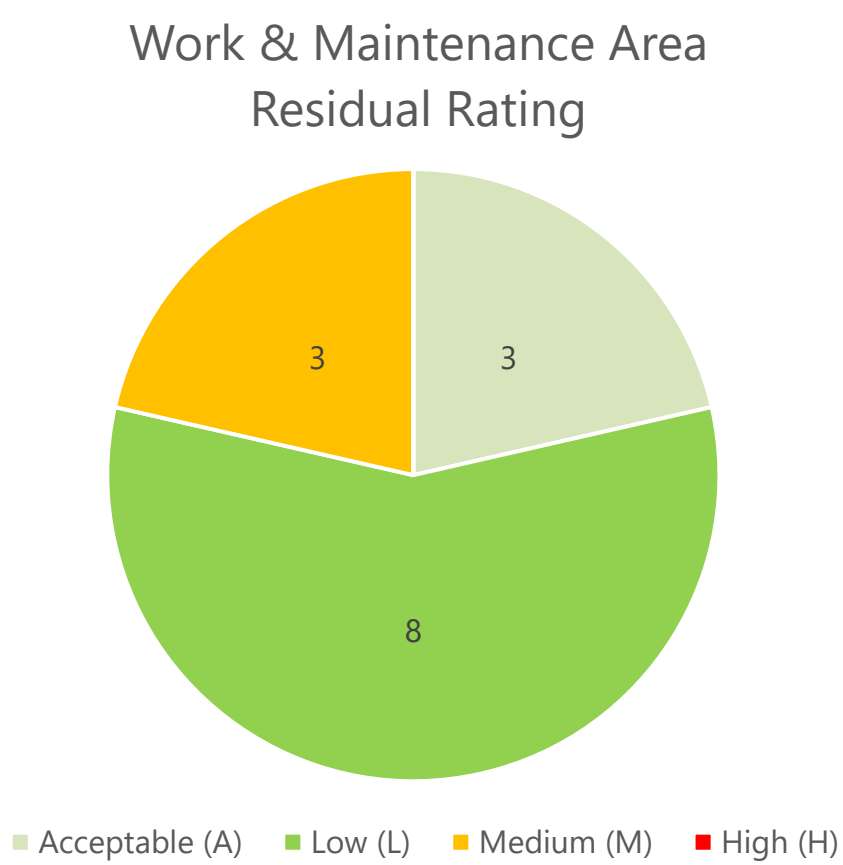




LoKI Operational Area Risk Assessment (ARA)

Work & Maintenance Area

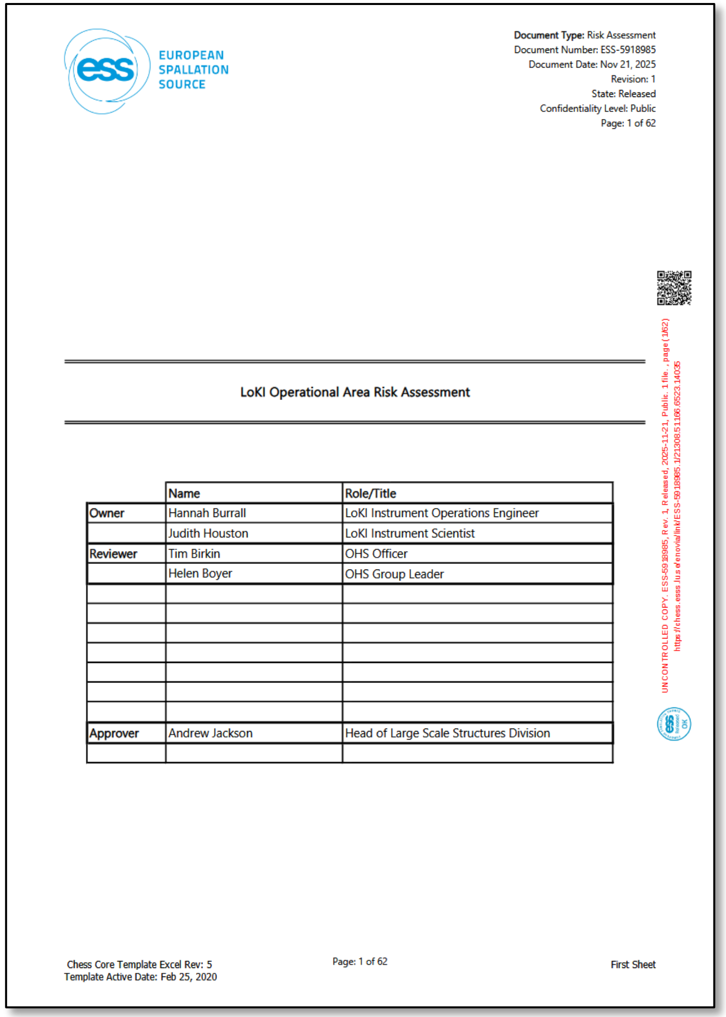




LoKI Operational Area Risk Assessment (ARA)

Summary

- Hazards have been identified, evaluated, and mitigated
- In all cases there are no remaining high-level risks
- Living document and will be updated as new risks are identified during SSO and full operational mode



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Confidentiality Level: Public
Page: 1 of 62

LoKI Operational Area Risk Assessment

	Name	Role/Title
Owner	Hannah Burrall	LoKI Instrument Operations Engineer
	Judith Houston	LoKI Instrument Scientist
Reviewer	Tim Birkin	OHS Officer
	Helen Boyer	OHS Group Leader
Approver	Andrew Jackson	Head of Large Scale Structures Division

Chess Core Template Excel Rev: 5
Template Active Date: Feb 25, 2020

Page: 1 of 62

First Sheet

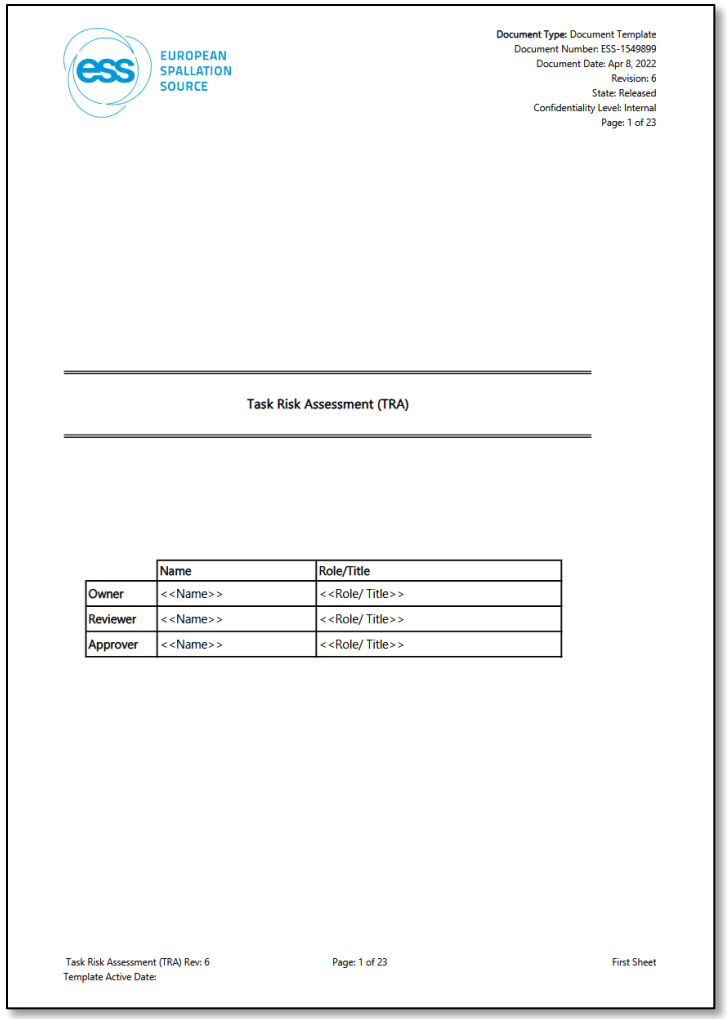
3

Task Risk Assessments

Taks Risk Assessments (TRA)

General Overview

- Used to identify hazards and required controls for specific tasks before work begins
- Follow the general ESS template (ESS-1549899)
  - Task description, hazards, risk level, and control measures
- Required for new, non-routine, or higher-risk activities, especially during commissioning and maintenance
- Ensure consistent evaluation, clear responsibilities, and proper documentation
- Improve coordination between teams and reduce the likelihood of accidents or equipment damage



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Document Date: Apr 8, 2022
Revision: 6
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Confidentiality Level: Internal
Page: 1 of 23

Task Risk Assessment (TRA)

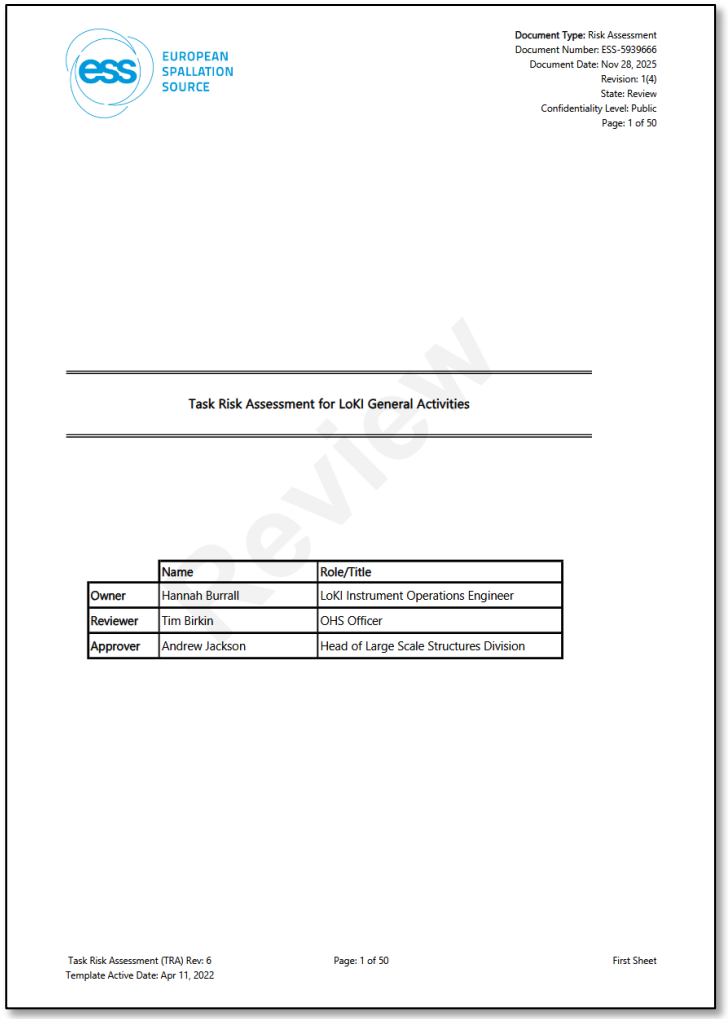
	Name	Role/Title
Owner	<<Name>>	<<Role/ Title>>
Reviewer	<<Name>>	<<Role/ Title>>
Approver	<<Name>>	<<Role/ Title>>

Task Risk Assessment (TRA) Rev: 6
Template Active Date:
Page: 1 of 23
First Sheet

Task Risk Assessment for LoKI General Activities

ESS-5939666

- Covers all general operational, maintenance, handling and support activities routinely performed on the instrument
- Included hazards associated with mechanical equipment, lifting operations, electrical systems, RP, compressed air, thermal systems, hand tools, facility infrastructure and general sample handing activities
- To be read in parallel with LoKI Operational ARA (ESS-5918985)
- A living document and will be updated as new tasks arise, especially as LoKI enters SSO and full operational mode



EUROPEAN SPALLATION SOURCE

Document Type: Risk Assessment
Document Number: ESS-5939666
Document Date: Nov 28, 2025
Revision: 1(4)
State: Review
Confidentiality Level: Public
Page: 1 of 50

Task Risk Assessment for LoKI General Activities

Review

	Name	Role/Title
Owner	Hannah Burrall	LoKI Instrument Operations Engineer
Reviewer	Tim Birkin	OHS Officer
Approver	Andrew Jackson	Head of Large Scale Structures Division

Task Risk Assessment (TRA) Rev: 6
Template Active Date: Apr 11, 2022

Page: 1 of 50

First Sheet

Task Risk Assessment for LoKI General Activities

ESS-5939666

Task Risk Assessment (TRA)

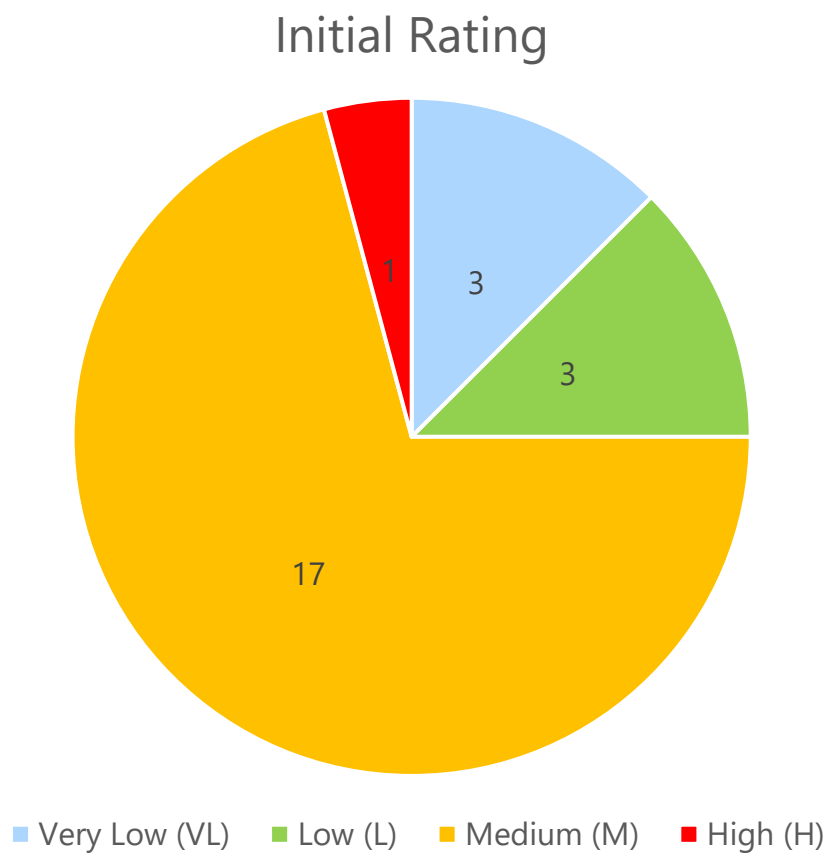
Work package, Project or System: LoKI Instrument (ESS.NSS.H01.LOKI)
Area Coordinator (AC): Hannah Burrall
Responsible Manager (RM): Andrew Jackson

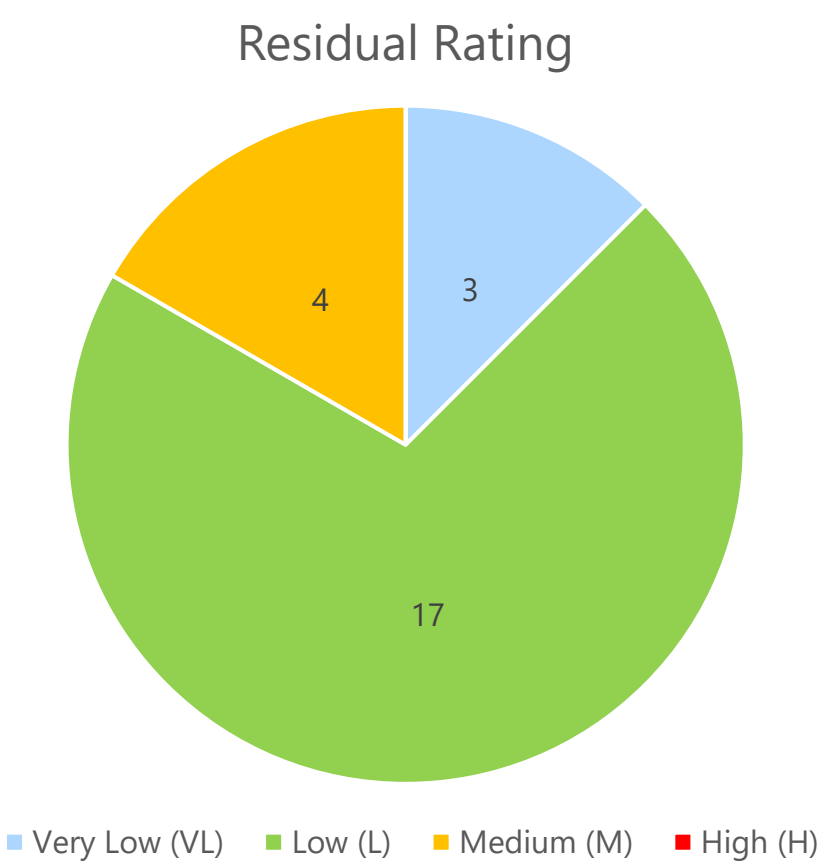
Ref. no	Location	What is the Task or Activity?	What is the Hazard?	What are the possible Consequence?	Who is affected?	Initial rating			Mitigations to control risk	Residual rating			Further action needed	Owner	RM	Ref. doc.	Follow up
						Severity	Likelihood	Risk H, M, L, VL		Severity	Likelihood	Risk H, M, L, VL					
1	D03 LoKI	Moving around instrument, general access	Slips, trips, uneven floor, opened false-floor panels	Minor injury, sprain, fall	All personnel	3	3	M	Maintain clear walkways; secure false-floor panels; highlight open panels; good housekeeping. Refer to Area Risk Assessment (ESS-5918985), Access procedures in LoKI O&M Manual (ESS-1108652) and LoKI Local Rules for Safety (ESS-5928878)	3	1	L					
2	D03 LoKI Control Hutch	Normal office work (documentation, planning, phone/email)	Ergonomic hazards; slips/trips; eye strain	Musculoskeletal discomfort; minor slips/trips; eye fatigue	All personnel working in control hutch	2	2	VL	Maintain good posture at workstation; use ergonomic chairs and desk setup; keep floor area clear; take periodic breaks from screen; ensure adequate lighting; Refer to Area Risk Assessment (ESS-5918985).	2	1	VL					
3	D03 LoKI Control Hutch	Attending Zoom / video meetings	Ergonomic hazards; eye strain; slips/trips from cables; audio distraction	Musculoskeletal discomfort; eye fatigue; minor slips/trips; distraction leading to procedural mistakes	All personnel working in control hutch	2	2	VL	Maintain ergonomic posture; take periodic screen breaks; keep cables tidy and floor clear; ensure adequate lighting; avoid multitasking during sensitive operations	2	1	VL					
4	D03 LoKI Control Hutch	Operating computers / instrument control systems (NICOS, Phoebus GUI, EPICS)	Ergonomic hazards; electrical hazards; repetitive strain; eye strain	Musculoskeletal discomfort; minor electric shock; eye fatigue; minor strain injuries	Authorized operators, LoKI team personnel	2	2	VL	Use ergonomic workstation setup; maintain proper posture; take regular screen breaks; ensure computers and cables are properly installed and grounded; follow electrical safety rules. Refer to Area Risk Assessment (ESS-5918985)	2	1	VL					
5	D03 LoKI	Manual handling of tools, small components, sample magazines	Strain, dropped object	Strain injury, minor cuts	All authorized personnel	3	2	L	Use proper lifting technique; ask for assistance with awkward loads; use gloves if needed	3	1	L					
6	D03 LoKI	Use of standard hand tools (hex keys, spanners, screwdrivers)	Cuts, pinches, dropped tools	Minor injuries, tool damage	All authorized personnel	3	3	M	Inspect tools before use; wear appropriate PPE; store tools safely; avoid confined-space tool use	3	1	L					
7	D03 LoKI	Operating instrument systems remotely (motion systems, sample changer, etc.)	Unexpected motion; collision with components	Pinch injuries, component damage	All authorized personnel	3	3	M	Use webcams to verify clearance; enable button with operator stop when door open; trained operators only; refer to LoKI O&M Manual (ESS-1108652)	3	3	M					
8	D03 LoKI Cave	General use and handling of Sample Environment (SE) equipment (routine adjustments)	Manual handling; sharp edges; pinch points; hot/cold surfaces; pressurized gas lines; electrical connections; trip hazards	Minor injury (cuts, pinches, burns); strain; slips/trips; minor gas leaks; equipment damage	All authorized personnel	3	3	M	Only authorized/trained personnel to use SE equipment; clear system with radiation monitor before handling, follow PPE guidelines; avoid contact with hot/cold surfaces; ensure gas lines are properly connected and secured; check power is isolated before working on equipment; maintain clear access and routing for cables/hoses; follow procedures in SE manuals, LoKI O&M Manual (ESS-1108652), and refer to Sample Holder Task Risk Assessment (ESS-5939640)	3	1	L					
9	D03 LoKI	General handling of samples (loading, unloading, transferring to/from lab)	Manual handling; sharp edges; contamination; slips/trips; minor chemical hazards depending on sample	Strain injuries; cuts; minor contamination; slips or trips	All authorized personnel	3	3	M	Only authorized personnel may handle samples; personnel must have completed Chemical Handling Training; wear gloves and appropriate PPE; follow sample-specific handling instructions; maintain a clean and clear workspace; avoid overreaching or awkward lifting; use mechanical aids if necessary; keep chemical datasheets accessible in areas where samples are being handled. Refer to ESS Experiment Safety Review Procedure (ESS-0024107).	3	1	L					
10	D03 LoKI	General Housekeeping Tasks	Slips trips and falls	Injury	All authorized personnel	3	3	M	Safe access and egress should be maintained at all times. All work crews are responsible for cleaning up their work areas daily. Scaffolds and work platforms must not have items stored on them nor have any debris accumulate. Waste must be separated into different fractions.	3	1	L					
11	D03 LoKI	Use of battery-driven hand tools (drills, screwdrivers, impact drivers)	Cuts, pinches, battery electric hazards, tool slipping, flying debris	Minor cuts, bruises, electrical shock, eye injuries	LoKI team personnel, authorized technicians or	3	3	M	Only authorized personnel may operate; inspect tools before use; wear appropriate PPE; keep workspace clear; maintain firm grip and correct posture; ensure batteries are charged and in good condition; follow	3	1	L					

First Sheet | Scope and limitations | Method description | TRA | Risk Matrix (5x5) | Risks ex | Revision History | ChessLinks

Task Risk Assessment for LoKI General Activities

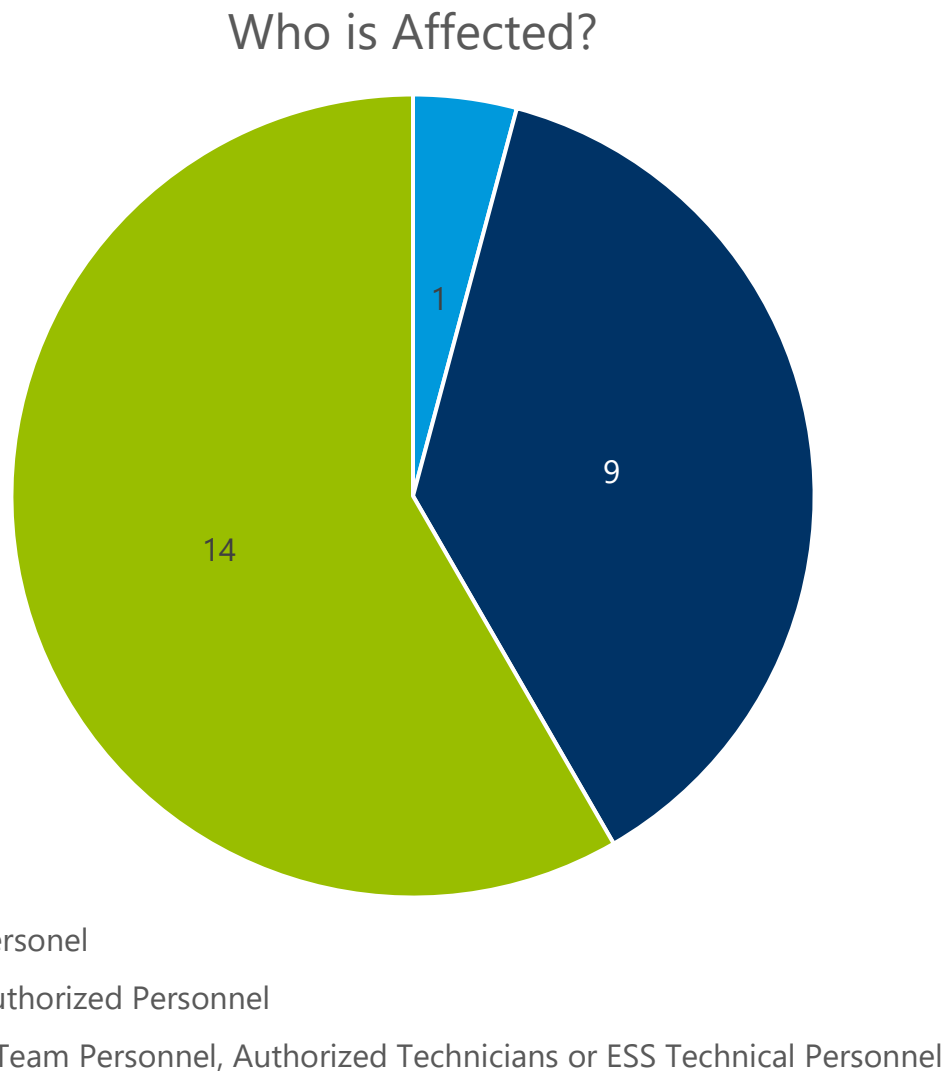
ESS-5939666





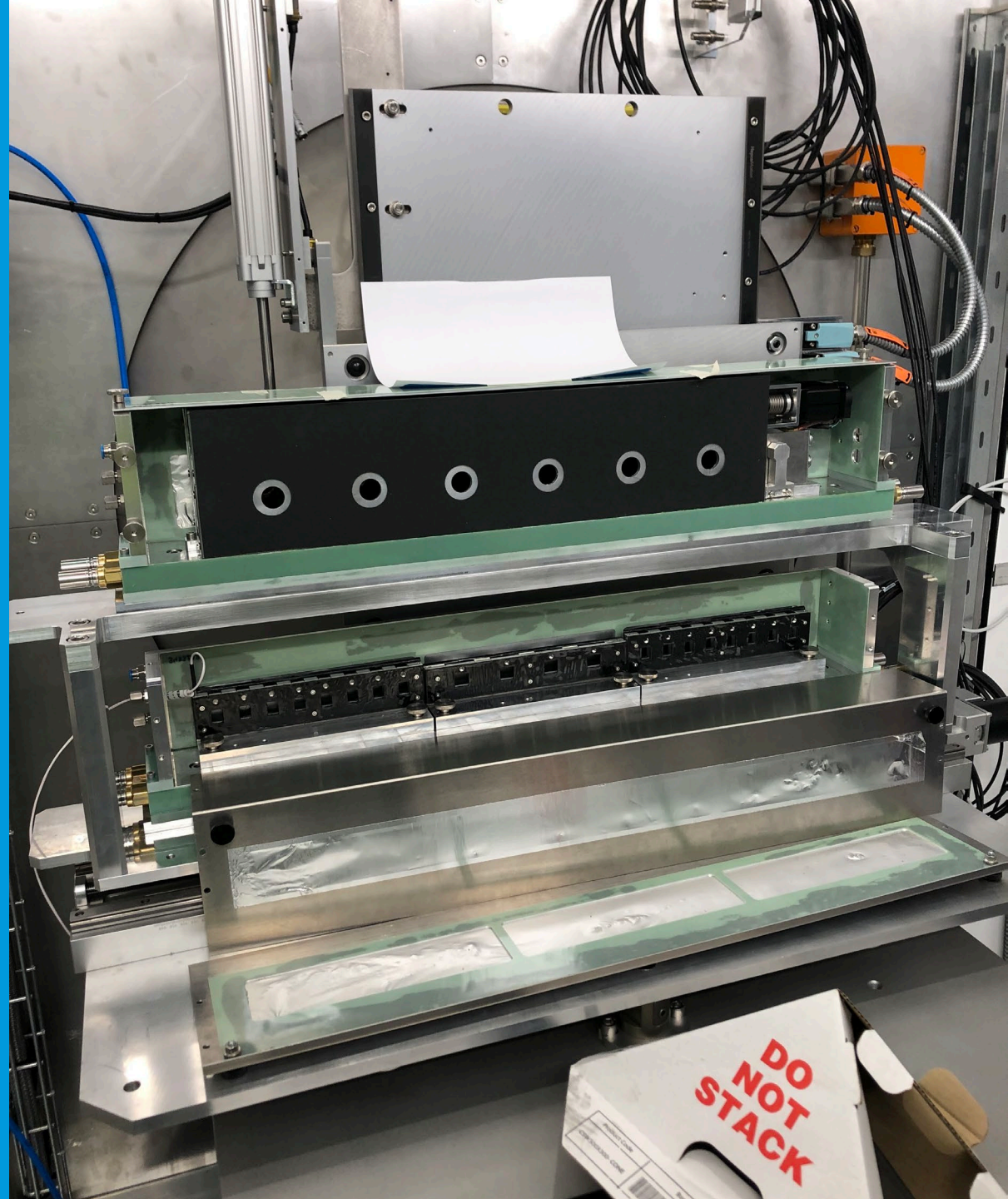
Task Risk Assessment for LoKI General Activities

ESS-5939666



3.2

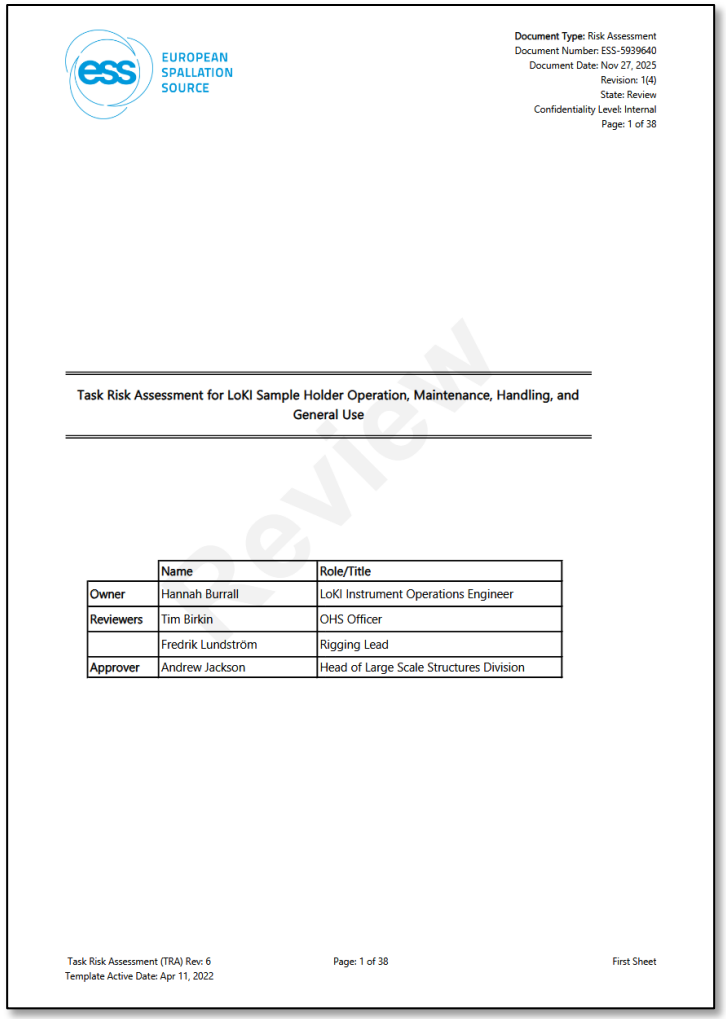
Task Risk Assessments – Sample Holder



Task Risk Assessment for LoKI Sample Holder Operation, Maintenance, Handling, and General Use

ESS-5939640

- All activities related to the operation, maintenance, handling and general use of the LoKI Sample Holder
- A living document and will be updated as new tasks arise, especially as LoKI enters SSO and full operational mode
- Read in parallel with Lifting Plan TRA
  - ESS-5940991: Lifting Plan for LoKI Sample Environment Systems



EUROPEAN SPALLATION SOURCE

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Document Number: ESS-5939640
Document Date: Nov 27, 2025
Revision: 1(4)
State: Review
Confidentiality Level: Internal
Page: 1 of 38

Task Risk Assessment for LoKI Sample Holder Operation, Maintenance, Handling, and General Use

Review

	Name	Role/Title
Owner	Hannah Burrall	LoKI Instrument Operations Engineer
Reviewers	Tim Birkin	OHS Officer
	Fredrik Lundström	Rigging Lead
Approver	Andrew Jackson	Head of Large Scale Structures Division

Task Risk Assessment (TRA) Rev: 6
Template Active Date: Apr 11, 2022

Page: 1 of 38

First Sheet

Task Risk Assessment for LoKI Sample Holder Operation, Maintenance, Handling, and General Use

ESS-5939640

Ref. no	Location	What is the Task or Activity?	What is the Hazard?	What are the possible Consequence?	Who is affected?	Initial rating			Mitigations to control risk	Residual rating			Further action needed	Owner	RM	Ref. doc.	Follow up
						Severity	Likelihood	Risk H, M, L, VL		Severity	Likelihood	Risk H, M, L, VL					
Installation of Sample Holder in Sample Cave via Instrument Crane																	
1	D03 LoKI	Lifting and installing sample holder via LoKI Instrument Crane	Dropped load / lifting failure, collision with nearby equipment or instruments, pinch points, crushing.	Severe injury, fatality, equipment damage	Authorized Crane Operators (LoKI IOE & Rigging Team), nearby personnel	5	2	H	Refer to lifting plan TRA (ESS-5940391). Use certified lifting equipment; trained & authorized operators and spotters; check load weight and rigging; establish exclusion zones during lifts; follow Rigging Handbook guidelines; consult Rigging Team for infrequent lifts.	5	1	M					
Installation of Sample Holder in Sample Cave via Small Pallet Truck																	
2	D03 LoKI	Moving sample holder system using small pallet truck	Loss of control; unstable load; uneven floor; tipping	Foot injuries, crush injury, equipment damage	Operators/LoKI IOE	3	3	M	Ensure load is stable and centered; check pallet truck condition; use slow controlled movements; maintain clear path; use spotter in narrow areas	3	1	L					
3	D03 LoKI	Moving pallet truck over cable covers, thresholds, or uneven surfaces	Load shifting; sudden stop; pallet truck tipping	Equipment damage, loss of load, operator injury	Operators/LoKI IOE	3	2	L	Inspect route beforehand; avoid transitions where possible; use ramps; push rather than pull; use spotter; reduce speed	3	1	L					
4	D03 LoKI Cave	Steering or positioning pallet truck in tight area in sample cave	Pinch points between sample table and objects/utilities in area	Equipment damage, loss of alignment/calibration, injury to personnel	Operators/LoKI IOE	3	3	M	Operate slowly; maintain distance from walls/obstacles; awareness training; use guides/markings on the floor as visual aids	3	1	L					
5	D03 LoKI	Using goods lift to move sample holder stack to/from instrument false floor	Load shifting; pinch points; crushing; collision with lift walls; improper securing; fall from lift platform	Crush or impact injuries; equipment damage; misalignment of sample holder stack; trapped fingers/hands	Operators/LoKI IOE	3	3	M	Ensure load is properly secured and stable; check lift weight rating; trained operators only; keep hands and feet clear of moving lift parts; communicate with other personnel; maintain exclusion zone; follow lift SOP. Personnel NOT allowed inside lift while in operation.	3	1	L					
6	D03 LoKI	Parking loaded pallet truck in work/maintenance area	Pallet truck rolling; obstruction causing trip	Trip hazard, equipment impact	Operators/LoKI IOE	2	3	L	Lower forks fully; park in designated area; keep away from walkways	2	1	VL					
Installation of Sample Holder Auxiliary Equipment in Sample Cave																	
7	D03 LoKI Cave	Using instrument air to lock/unlock sample table alignment pins	Sudden pin movement; pneumatic pressure; pinch points; unexpected table motion	Finger/hand injuries; crushed or trapped fingers; misalignment of sample table; minor equipment damage, loud noise from air release	Operators/LoKI IOE	3	2	L	Keep hands clear of system; maintain safe distance from air outlet; consider using hearing protection; verify table secured before pressurizing	3	1	L					
8	D03 LoKI Cave	Connecting Julabo water circulator to system	Water leaks; slip hazard; burns/cold exposure depending on fluid temp; incorrect connections	Equipment damage, slip/fall injuries, minor burns or frostbite	Operators/LoKI IOE	3	2	L	Inspect hoses and fittings for damage; use of quick connect/self sealing connectors	3	1	L					
9	D03 LoKI Cave	Connecting motion control cables (power, encoder, motor)	Electrical shock; tripping hazard; pinching/cutting during cable routing; accidental movement if system powered	Electric shock; short circuit; damage to motion system; hand injury; equipment misalignment	Operators/LoKI IOE	3	2	L	Ensure system powered off before connecting/disconnecting; route cables along designated paths; secure cables to avoid trip hazards; check connectors for damage; follow cable connection procedures	3	1	L					
10	D03 LoKI Cave	Connecting temperature sensors (LEMO connectors) and routing sensors to sample holder	Electrical shock; pinching during connector engagement; cable damage; tripping hazard; misconnection	Electric shock; short circuit; sensor malfunction; sample holder misreadings; hand injury; equipment damage	Operators/LoKI IOE	3	2	L	Ensure system powered off; inspect connectors and cables for damage; follow correct wiring diagram; gently align LEMO connectors before mating; secure cables along designated paths; avoid creating trip hazards; wear gloves if necessary	3	1	L					
11	D03 LoKI Cave	Connecting atmosphere control (compressed air) lines to sample holder	Compressed air release; sudden actuation; pinch points; hose whipping; tripping; incorrect connection	Finger/hand injuries; eye injuries; loud noise; minor equipment damage; accidental system actuation	Operators/LoKI IOE	3	2	L	Ensure air supply is isolated before connection; keep hands and face clear of hose ends; inspect hoses and fittings for damage; secure hoses to avoid whip; follow SOP and O&M Manual; label lines to ensure correct connections; maintain clear workspace; communicate with nearby personnel	3	1	L					
12	D03 LoKI Cave or Work Area	Configuring sample magazines / rotation cell holder using standard hand tools	Pinch points; hand tool injuries; sharp edges; dropped components; repetitive strain	Finger/hand injuries; cuts; bruising; minor equipment damage; strain injuries	Operators/LoKI IOE	2	3	L	Use appropriate hand tools in good condition; wear gloves; ensure stable positioning of magazines/holders; follow SOP; keep hands clear of pinch points; do not apply excessive force; maintain clean workspace; follow instructions in O&M Manual.	2	1	VL					
General Use/Operation of Sample Holder																	
13	D03 LoKI Cave	Entering or working inside sample cave	Risk of being trapped inside cave due to door malfunction, system interlocks, or accidental locking	Injury, delayed evacuation, panic, exposure to radiation	General Users, Operators/LoKI IOE	3	3	M	Verify door and interlock systems are functioning before entry; always follow cave access procedure; maintain communication with external personnel; ensure emergency release mechanisms are operable; only authorized personnel enter; follow SOP and O&M Manual. Refer to Area Risk Assessment (ESS-5915365).	3	1	L					
14	D03 LoKI Cave	Handling of activated samples/sample holder	Exposure to radiation or activated components	Radiation exposure; contamination	General Users, Operators/LoKI IOE	3	3	M	Use experiment/fast shutter to reduce activation; check system with gamma monitor (to be supplied by RP) prior to entering cave; follow cave access procedure; ensure only authorized personnel enter area; follow SOP and O&M Manual (ESS-1108652).	3	1	L					
15	D03 LoKI Cave	Loading/unloading samples into sample holder	Pinch points, sharp edges, fragile sample cuvettes	Finger cuts, sample breakage, minor hand injury	General Users, Operators/LoKI IOE	2	3	L	Train users on safe handling; gloves if appropriate; follow loading procedure; avoid excessive force. Material Safety Data Sheet (MSDS) posted in area, Chemical Handling Training.	2	1	VL					
16	D03 LoKI Cave	Operating motion stage (rotation/translation)	Unexpected motion, collision with nearby objects	Hand injury, misalignment, damage to sample holder	General Users	3	2	L	Motion hard and soft limits; enable switch required while door to cave is open; maintain distance; keep hands-off system during movement. Refer to Motion Risk Analysis (ESS-5467337) & Table of Motion Sheet 3 (ESS-0114726).	3	1	L					
17	D03 LoKI Cave	Operating sample holder system remotely	Unexpected motion; loss of awareness of surroundings; miscommunication, equipment collision	Hand/finger injuries; sample or equipment damage; misalignment; system errors	General Users, Operators/LoKI IOE	3	3	M	Use webcams in sample area to monitor motion; when cave door is open, require enable button with integrated operator stop; ensure interlocks and safety systems active; maintain visual confirmation of system status; communicate with nearby personnel; follow SOP and O&M Manual; hands-off system during automated movements; only trained personnel operate remotely	3	1	L					
General Maintenance																	
18	D03 LoKI Work Area	General maintenance, tinkering, or system improvements using standard hand tools	Pinch points; hand tool injuries; sharp edges; dropped components; repetitive strain; electrical contact	Finger/hand injuries; cuts; bruising; minor equipment damage; strain injuries; electric shock if near powered components	Instrument Personnel / LoKI IOE	3	2	L	Use appropriate, well-maintained hand tools; wear gloves and eye protection where needed; ensure system powered off; follow SOP and O&M Manual; maintain stable positioning of components; keep hands clear of pinch points; do not apply excessive force; maintain clean workspace; avoid tinkering on live electrical circuits	3	1	L					
19	D03 LoKI Work Area	Inspecting and lubricating moving parts	Pinch points; hand injury; oil/grease contact	Finger/hand injuries, slips, contamination of sample holder; minor burns from warm components	Instrument Personnel / LoKI IOE	3	3	M	Ensure system powered off; wear gloves; follow SOP; use proper tools; keep workspace clean	3	1	L					
20	D03 LoKI Cave	Servicing Julabo water circulator	Hot/cold fluid exposure; leaks; slip; electrical hazard	Burns/frostbite; electric shock; water damage; slips	Instrument Personnel / LoKI IOE	3	2	L	Ensure system is powered off; drain fluids if necessary; move system/work area away from other electrical hazards; wear PPE (gloves, goggles, etc.) as needed; inspect hoses and connections; maintain drip trays; follow manufacturer instructions and SOP; follow all instructions and procedures outlined in the O&M Manual; keep workspace clear	3	1	L					

First Sheet | Scope and limitations | Method description | TRA | Risk Matrix (5x5) | Risks ex | Revision History | ChessLinks

Task Risk Assessment for LoKI Sample Holder Operation, Maintenance, Handling, and General Use

[ESS-5939640]

Ref. no	Location	What is the Task or Activity?	What is the Hazard?	What are the possible Consequence?	Who is affected?	Initial rating			Mitigations to control risk	Residual rating			Further action needed	Owner	RM	Ref. doc.	Follow up
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Installation of Sample Holder in Sample Cave via Instrument Crane																	
1	D03 LoKI	Lifting and installing sample holder via LoKI Instrument Crane	Dropped load / lifting failure, collision with nearby equipment or instruments, pinch points, crushing.	Severe injury, fatality, equipment damage	Authorized Crane Operators (LoKI IOE & Rigging Team), nearby personnel	5	2	H	Refer to lifting plan TRA (ESS-5940931). Use certified lifting equipment; trained & authorized operators and spotters; check load weight and rigging; establish exclusion zones during lifts; follow Rigging Handbook guidelines; consult Rigging Team for infrequent lifts.	5	1	M					
Installation of Sample Holder in Sample Cave via Small Pallet Truck																	
2	D03 LoKI	Moving sample holder system using small pallet truck	Loss of control; unstable load; uneven floor; tipping	Foot injuries, crush injury, equipment damage	Operators/LoKI IOE	3	3	M	Ensure load is stable and centered; check pallet truck condition; use slow controlled movements; maintain clear path; use spotter in narrow areas	3	1	L					
3	D03 LoKI	Moving pallet truck over cable covers, thresholds, or uneven surfaces	Load shifting; sudden stop; pallet truck tipping	Equipment damage, loss of load, operator injury	Operators/LoKI IOE	3	2	L	Inspect route beforehand; avoid transitions where possible; use ramps; push rather than pull; use spotter; reduce speed	3	1	L					
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5	D03 LoKI	Using goods lift to move sample holder stack to/from instrument false floor	Load shifting; pinch points; crushing; collision with lift walls; improper securing; fall from lift platform	Crush or impact injuries; equipment damage; misalignment of sample holder stack; trapped fingers/hands	Operators/LoKI IOE	3	3	M	Ensure stack is properly secured and stable; check lift weight rating; trained operators only; keep hands and feet clear of moving lift parts; communicate with other personnel; maintain exclusion zone; follow lift SOP. Personnel NOT allowed inside lift while in operation.	3	1	L					
6	D03 LoKI	Parking loaded pallet truck in work/maintenance area	Pallet truck rolling; obstruction causing trip	Trip hazard, equipment impact	Operators/LoKI IOE	2	3	L	Lower forks fully; park in designated area; keep away from walkways	2	1	VL					
Installation of Sample Holder Auxiliary Equipment in Sample Cave																	
7	D03 LoKI Cave	Using instrument air to lock/unlock sample table alignment pins	Sudden pin movement; pneumatic pressure; pinch points; unexpected table motion	Finger/hand injuries; crushed or trapped fingers; misalignment of sample table; minor equipment damage, loud noise from air release	Operators/LoKI IOE	3	2	L	Keep hands clear of system; maintain safe distance from air outlet; consider using hearing protection; verify table secured before pressurizing	3	1	L					
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12	D03 LoKI Cave or Work Area	Configuring sample magazines / rotation cell holder using standard hand tools	Pinch points; hand tool injuries; sharp edges; dropped components; repetitive strain	Finger/hand injuries; cuts; bruising; minor equipment damage; strain injuries	Operators/LoKI IOE	2	3	L	Use appropriate hand tools in good condition; wear gloves; ensure stable positioning of magazine/holders; follow SOP; keep hands clear of pinch points; do not apply excessive force; maintain clean workspace; follow instructions in O&M Manual	2	1	VL					
General Use/Operation of Sample Holder																	
13	D03 LoKI Cave	Entering or working inside sample cave	Risk of being trapped inside cave due to door malfunction, system interlocks, or accidental locking	Injury, delayed evacuation, panic, exposure to radiation	General Users, Operators/LoKI IOE	3	3	M	Verify door and interlock systems are functioning before entry; always follow cave access procedure; maintain communication with external personnel; ensure emergence release mechanism/ are operable; only authorized personnel enter; follow SOP and O&M Manual. Refer to Area Risk Assessment (ESS-5916365).	3	1	L					
14	D03 LoKI Cave	Handling of activated samples/sample holder	Exposure to radiation or activated components	Radiation exposure; contamination	General Users, Operators/LoKI IOE	3	3	M	Use experiment/vault shutter to reduce activation; check system with gamma monitor (to be supplied by RP) prior to entering cave; follow cave access procedure; users only authorized personnel enter area; follow SOP and O&M Manual (ESS-1108652).	3	1	L					
15	D03 LoKI Cave	Loading/unloading samples into sample holder	Pinch points, sharp edges, fragile sample cuvettes	Finger cuts, sample breakage, minor hand injury	General Users, Operators/LoKI IOE	2	3	L	Train users on safe handling; gloves if appropriate; follow loading procedure; avoid excessive force. Material Safety Data Sheet (MSDS) posted in area, Chemical Handling Training.	2	1	VL					
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First Sheet | Scope and limitations | Method description | TRA | Risk Matrix (5x5) | Risks ex | Revision History | ChessLinks

Installation of Sample Holder in Sample Cave via Instrument Crane (Authorized Crane Operators: LoKI IOE & Rigging Team)

Installation of Sample Holder in Sample Cave via Small Pallet Truck (Operator/LoKI IOE)

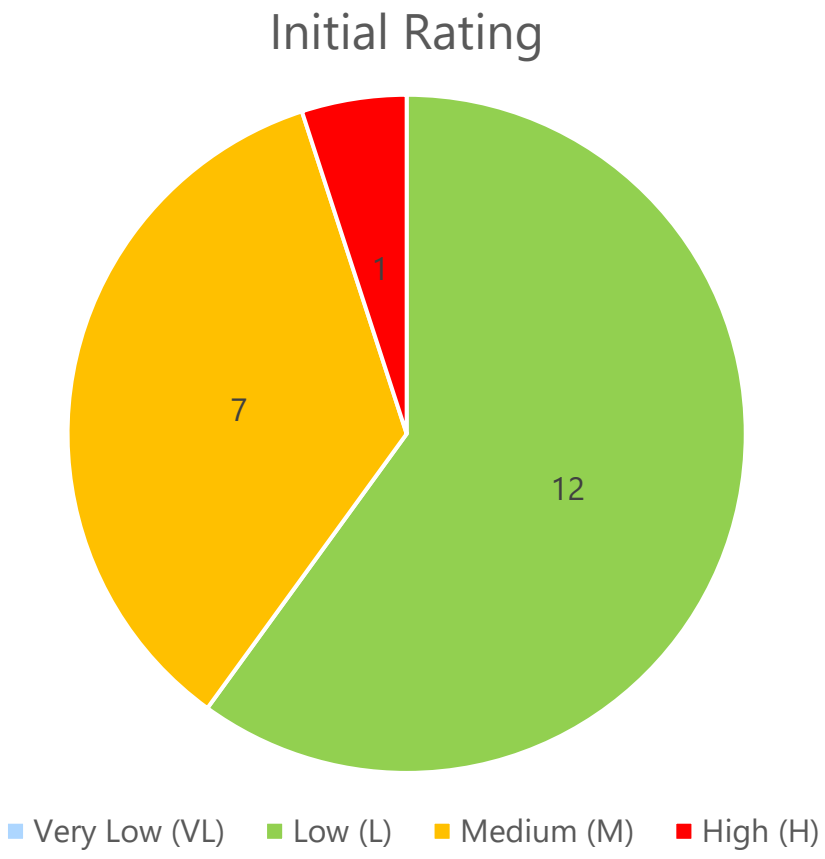
Installation of Sample Holder Auxiliary Equipment in Sample Cave (Operator/LoKI IOE)

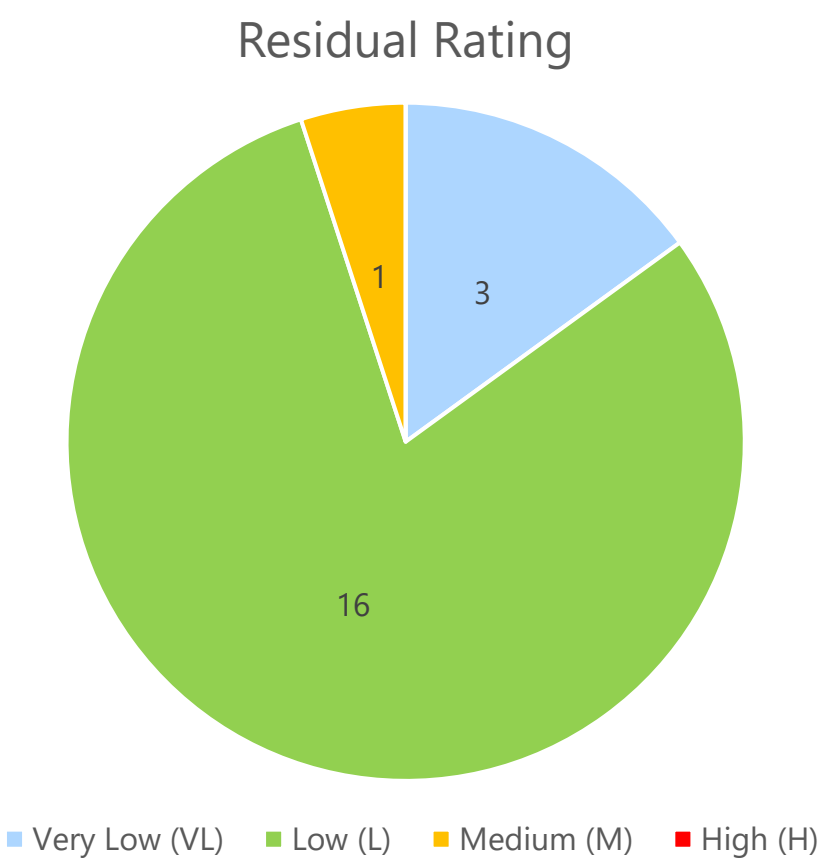
General Use/Operation of Sample Holder (General Users)

General Maintenance (Instrument Personnel / LoKI IOE)

Task Risk Assessment for LoKI Sample Holder Operation, Maintenance, Handling, and General Use

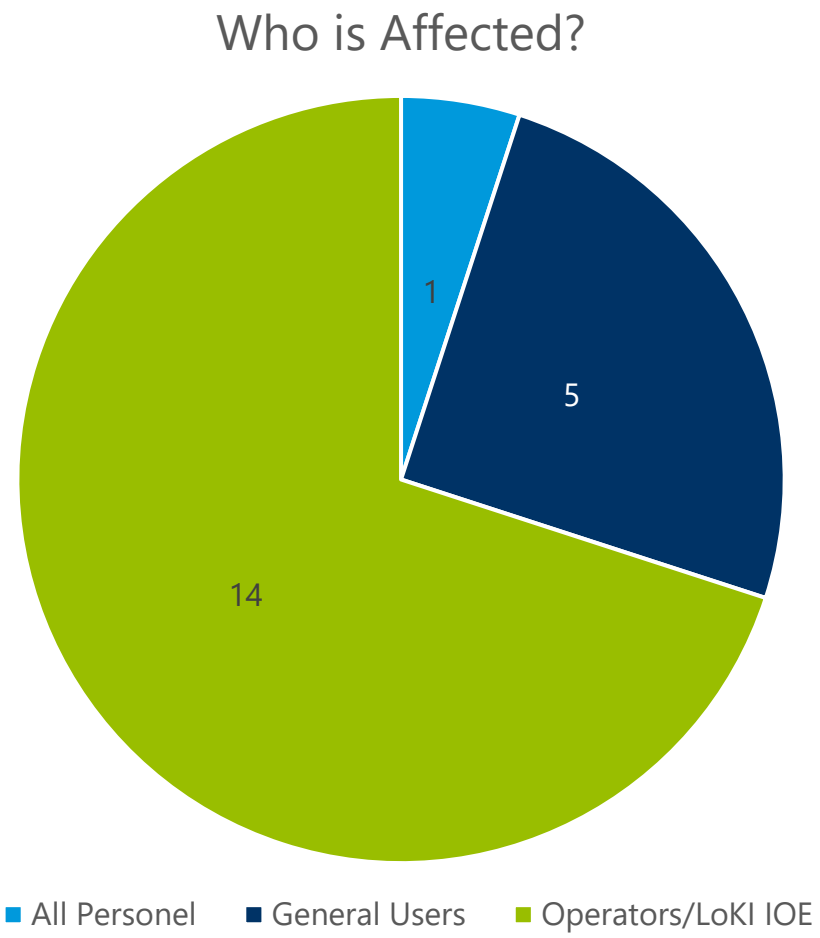
ESS-5939640





Task Risk Assessment for LoKI Sample Holder Operation, Maintenance, Handling, and General Use

ESS-5939640

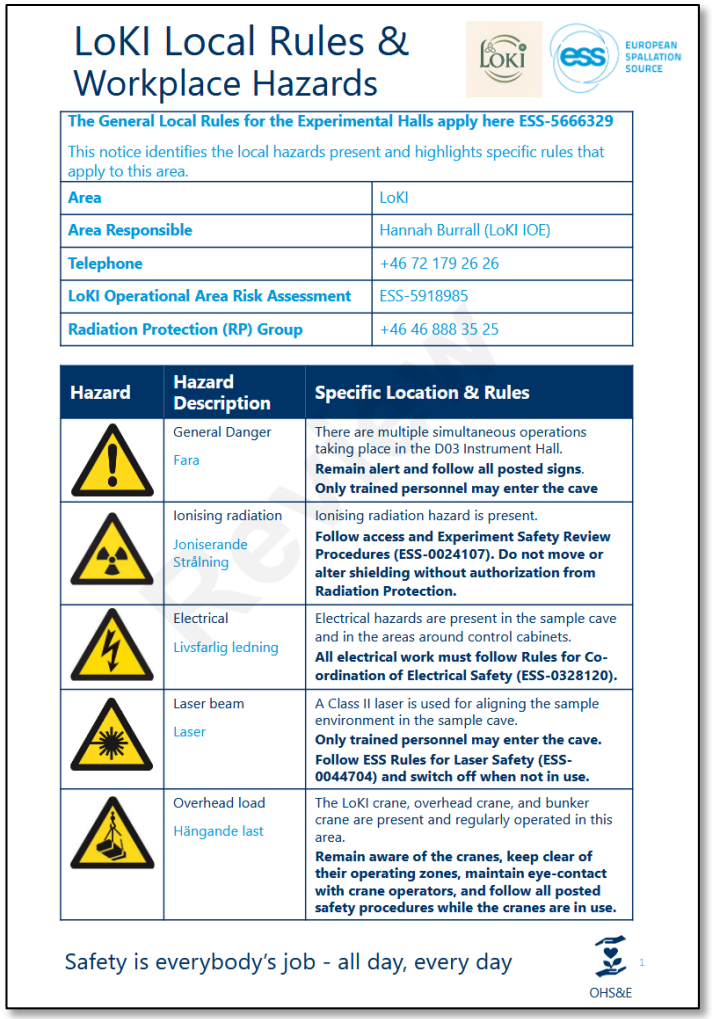


4

Local Rules

LoKI Local Rules for Safety

[ESS-5928878]



LoKI Local Rules & Workplace Hazards

The General Local Rules for the Experimental Halls apply here ESS-5666329

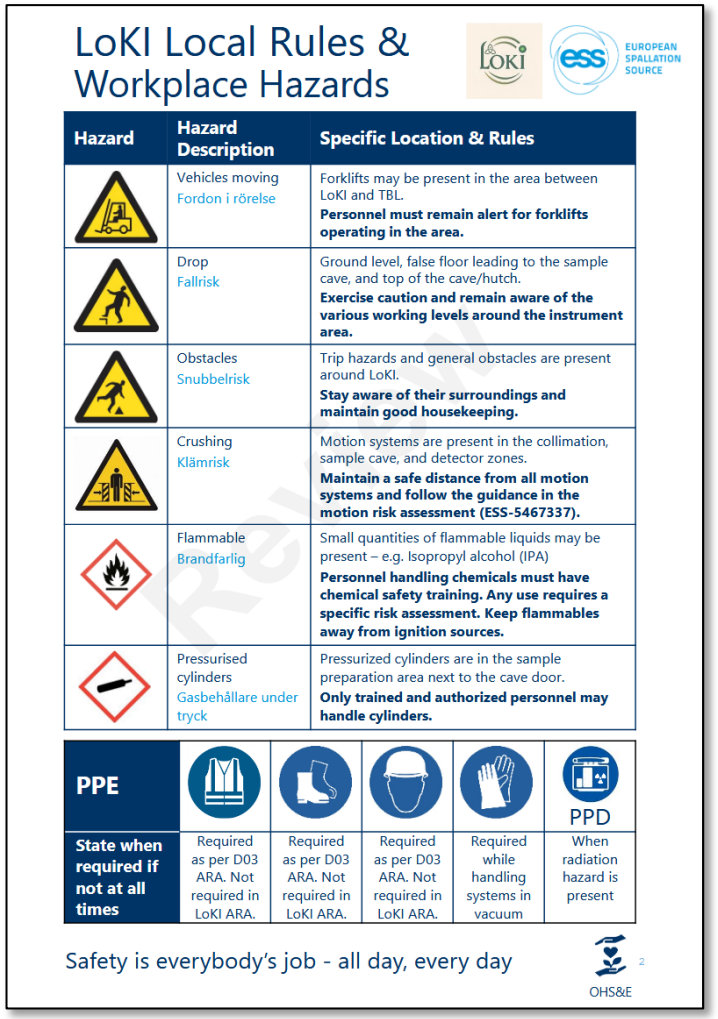
This notice identifies the local hazards present and highlights specific rules that apply to this area.

Area	LoKI
Area Responsible	Hannah Burrall (LoKI IOE)
Telephone	+46 72 179 26 26
LoKI Operational Area Risk Assessment	ESS-5918985
Radiation Protection (RP) Group	+46 46 888 35 25

Hazard	Hazard Description	Specific Location & Rules
	General Danger Fara	There are multiple simultaneous operations taking place in the D03 Instrument Hall. **Remain alert and follow all posted signs.** **Only trained personnel may enter the cave**
	Ionising radiation Joniserande Strålning	Ionising radiation hazard is present. **Follow access and Experiment Safety Review Procedures (ESS-0024107). Do not move or alter shielding without authorization from Radiation Protection.**
	Electrical Livsfarlig ledning	Electrical hazards are present in the sample cave and in the areas around control cabinets. **All electrical work must follow Rules for Co-ordination of Electrical Safety (ESS-0328120).**
	Laser beam Laser	A Class II laser is used for aligning the sample environment in the sample cave. **Only trained personnel may enter the cave.** **Follow ESS Rules for Laser Safety (ESS-0044704) and switch off when not in use.**
	Overhead load Hängande last	The LoKI crane, overhead crane, and bunker crane are present and regularly operated in this area. **Remain aware of the cranes, keep clear of their operating zones, maintain eye-contact with crane operators, and follow all posted safety procedures while the cranes are in use.**

Safety is everybody's job - all day, every day

OHS&E 1



LoKI Local Rules & Workplace Hazards

Hazard	Hazard Description	Specific Location & Rules
	Vehicles moving Fordon i rörelse	Forklifts may be present in the area between LoKI and TBL. **Personnel must remain alert for forklifts operating in the area.**
	Drop Fallrisk	Ground level, false floor leading to the sample cave, and top of the cave/hutch. **Exercise caution and remain aware of the various working levels around the instrument area.**
	Obstacles Snubbelrisk	Trip hazards and general obstacles are present around LoKI. **Stay aware of their surroundings and maintain good housekeeping.**
	Crushing Klämrisk	Motion systems are present in the collimation, sample cave, and detector zones. **Maintain a safe distance from all motion systems and follow the guidance in the motion risk assessment (ESS-5467337).**
	Flammable Brandfarlig	Small quantities of flammable liquids may be present – e.g. Isopropyl alcohol (IPA) **Personnel handling chemicals must have chemical safety training. Any use requires a specific risk assessment. Keep flammables away from ignition sources.**
	Pressurised cylinders Gasbehållare under tryck	Pressurized cylinders are in the sample preparation area next to the cave door. **Only trained and authorized personnel may handle cylinders.**

PPE					PPD
State when required if not at all times	Required as per D03 ARA. Not required in LoKI ARA.	Required as per D03 ARA. Not required in LoKI ARA.	Required as per D03 ARA. Not required in LoKI ARA.	Required while handling systems in vacuum	When radiation hazard is present

Safety is everybody's job - all day, every day

OHS&E 2

Thank You!

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LoKI Operational Area Risk Assessment (ARA)

Cave & Cave Roof

HazId No.	Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating		
					Severity	Likelihood	Risk H, M , L, A		Severity	Likelihood	Risk H, M , L, A
1	Electrical	X	Electrical hazards are present due to energized instrument racks and control electronics, cable trays and cabling, motors, electrical outlets, and other energized sub-systems in the sample cave and on the roof of the cave/hutch.	Electric shock, burns, or fire on contact with live parts during maintenance, installation or alignment tasks. Faulty or damaged cabling leading to short circuits, sparking, or fire. Accidental activation of motors or other subsystems while personnel are working nearby.	4	3	H	Only qualified personnel handle live circuits, lock-out/tag-out procedures, regular inspection, appropriate protection as needed. Follow ESS electrical self audit scheme.	4	1	M
15	Lifting / Crane Operation	X	The LoKI crane, overhead crane, and bunker crane are present and regularly operated in this area.	Dropped load, crush injury, equipment damage	4	3	H	Crane certified, load limits posted, trained and authorized operators only, taglines used, exclusion zone enforced	4	1	M

LoKI Operational Area Risk Assessment (ARA)

Sample Preparation Area

HazId No.	Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating		
					Severity	Likelihood	Risk H, M , L, A		Severity	Likelihood	Risk H, M , L, A
1	Electrical	X	Energized equipment	Electric shock, burns, or fire	4	3	H	Only qualified personnel handle live circuits, lock-out/tag-out procedures, regular inspection, appropriate protection as needed. Follow ESS electrical self audit scheme.	4	1	M
6	Radiation (Supervised Area)	X	Activation of materials	Exposure to ionizing radiation	5	2	H	Area classified, regular surveying of area, personal dosimeter required	5	1	M
11	Lifting / Crane Operation	X	Use of overhead instrument crane for lifting or positioning components	Dropped load, crush injury, equipment damage	4	3	H	Crane certified, 2 ton load limits posted, trained and authorized operators only, taglines used, exclusion zone enforced	4	1	M

LoKI Operational Area Risk Assessment (ARA)

Control Hutch

HazId No.	Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating		
					Severity	Likelihood	Risk H, M , L, A		Severity	Likelihood	Risk H, M , L, A
3	Use of electrical equipment - space heater	X	Space Heater Use	Fire risk or burns if misused or left unattended	4	3	H	Use only CE marked heaters; place on stable surfaces away from flammables; switch off when unattended or use a timer.	4	2	M
7	Fire or Evacuation Scenario	X	Emergency Evacuation	Personnel may not respond appropriately	4	3	H	Display emergency procedures clearly; ensure clear access to exits; conduct drills where applicable	4	1	M
10	Radiation (Controlled Area Context)	X	Activation of materials	Exposure to ionizing radiation	5	2	H	Area classified, regular surveying of area, personal dosimeter required	5	1	M

LoKI Operational Area Risk Assessment (ARA)

Work & Maintenance Area

HazId No.	Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating		
					Severity	Likelihood	Risk H, M , L, A		Severity	Likelihood	Risk H, M , L, A
14	Radiation (Supervised Area)	X	Activation of materials	Exposure to ionizing radiation	5	2	H	Area classified, regular surveying of area, personal dosimeter required	5	1	M

Task Risk Assessment for LoKI General Activities

ESS-5939666

HazId No.		Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating		
						Severity	Likelihood	Risk H, M , L, A		Severity	Likelihood	Risk H, M , L, A
18	D03 LoKI	Use of LoKI instrument crane for lifting and moving equipment	Dropped load, swing of suspended load, pinch points, collision with structures, failure of slings/rigging	Crush injuries, severe injury, equipment damage	LoKI IOE, Rigging Team	5	2	H	Only trained and authorized crane operators may use the crane; inspect the crane, hook, and all lifting accessories before use; confirm the safe working load of both the crane and slings; attach the load securely and lift slowly; maintain clear communication with nearby personnel; coordinate with D03 Overhead Crane and In-Bunker Crane operators before lifting; establish a clearly marked exclusion zone—no personnel under a suspended load; ensure the travel path is clear; avoid sudden movements; perform a Pre-Job Safety Check; follow the ESS Rigging Handbook and the applicable Lifting Plan; stop immediately if instability or unsafe conditions occur.	5	1	M

Task Risk Assessment for LoKI Sample Holder Operation, Maintenance, Handling, and General Use

ESS-5939640

HazId No.		Hazard Type	Is hazard present in the area?	Hazard description	What are the possible Consequence?	Initial rating			Existing mitigations to control risk	Residual rating		
						Severity	Likelihood	Risk H, M , L, A		Severity	Likelihood	Risk H, M , L, A
1	D03 LoKI	Lifting and installing sample holder via LoKI Instrument Crane	Dropped load / lifting failure, collision with nearby equipment or instruments, pinch points, crushing.	Severe injury, fatality, equipment damage	Authorized Crane Operators (LoKI IOE & Rigging Team), nearby personnel	5	2	H	Refer to lifting plan TRA (ESS-5940991). Use certified lifting equipment; trained & authorized operators and spotters; check load weight and rigging; establish exclusion zones during lifts; follow Rigging Handbook guidelines; consult Rigging Team for infrequent lifts.	5	1	M