

ANNEX - HAZID WORKSHEETS – LUNA MV

Guidewords

- Natural disasters

Flooding
Earthquake

- External effects

Dropped object, object dropped during:
Construction
Crane operations

- Structural events

Structural failure due to fatigue, design error, etc.
Foundation failure
Subsidence
Crane collapse
Structural load out transportation and lifting

- Human factors

Occupational accidents
Improper / inadequate training
Inadequate operation of material handling

- Process upsets

Pressure, temperature, flow, level deviations
Improper mixing
Corrosion / erosion
Startup / shutdown
Handling of SF6
Simultaneous operations

- Sulfur hexafluoride

Release, loss

- Composition problems

Moisture

- Decomposition problems of SF6

HF, SO2

- Utility failures

Failure of electrical power
Sliding doors
Cooling water
Instrument air
Nitrogen
Fire water
HVAC system
Ventilation system

- Emergency operations

Escape / egress / rescue
Release from vent

- Loss of containment

Leak from tank
Helium bottles, Ar bottles
Leak from process area
Leak from loading line
Drains
Energy release
Chemical spills
Bottled gas leaks

- Fire

Electrical fire
Hydrogen/deuterium
Control room fire
Heating system fire
Machinery fire
Workshop fire

- Radiation

Radiation (alpha, beta, gamma, neutron)

- Environmental impact

Venting during normal operations
Venting during emergency
Leaks
Oily water treatment
Wastewater treatment /disposal

- Inspection / maintenance issues

Confined space
Machinery / instrument accessibility

- Construction accidents

Accidents occurring construction
Accidents occurring during hook-up & commissioning
Accidents occurring during pipe laying
Accidents occurring during cable laying

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations / comments
Natural disasters	Flooding, release of liquid (water, PC) from Borexino	Damage to accelerator	Liquid recovery and sent to Hall A Sealing of accelerator wall, Door normally closed	1	Install mobile bulkhead at the two entrance to b These bulkhead should be closed during the normal operations
Natural disasters	Earthquake	Damage to structure, damage to accelerator hall (included internal service crane) and control building	Design for seismic event		

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations comments
External effects	Dropped object during construction	Death, injury, damage to equipment	Procedure / caution to lift object, PPE		
External effects	Dropped object during crane operations	Death, injury, damage to equipment	Procedure / caution to lift object, PPE		

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations comments
Structural events	Fatigue	Failure of flexible, hoses, compressor, pump.	Design equipment according to current standards and codes	2	Verify design data for and liquid N2 equipment
Structural events	Design error	Damage to structures, injuries	Detailed design from qualified engineering staff		
Structural events	Foundation failure (N.A.)				
Structural events	Subsidence (N.A.)				
Structural events	Crane collapse	Damage to bunker	Procedure to park crane in safe position when it is not operated		
Structural events	Structural load out transportation and lifting (N.A.)				

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations comments
Human factors	Occupational accidents	Injures/death	Safety emergency procedure and Personal Protective Equipment (PPE)		
Human factors	Improper / inadequate training	Damage to structures injures/death	Safety audit		
Human factors	Inadequate operation of material handling	Injures / death/ damage to structures	Safety Procedure and PPE		

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations / comments
Process upsets	Pressure, temperature , flow, level deviations	Overpressure of vessels/burst, embrittlement due to low temperatures Overfilling of vessels	Pressure Safety Valve (PSV). Alarms. Automatic shutdown systems.	3	a.Hazop Analysis or equivalent analysis after completed design <i>b.SF6 storage tanks in stainless steel</i> <i>c.Install mobile bulkheads by the entrance to bunkers for SF6 containment</i>
Process upsets	Improper mixing, incompatible substances with SF6 (nitric acid, lead dioxide, disilane, sodium peroxide)	Violent reaction		4	Incompatible material stored close SF6 equipment
Process upsets	Corrosion / erosion	Thickness reduction and possible failure	Materials: AISI 316, copper, polymer		
Process upsets	Start up / shutdown	Damage or SF6 degradation from high voltage discharge in accelerator	Procedure and check of SF6 purity		
Process upsets	Handling of SF6 (filling, emptying, cleaning)	Loss of SF6	Bulkhead closing. Emergency procedure. Recovery and compression of SF6.	5	Verify during design
Process upsets	Simultaneous operations (N.A.)				

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations / comments
Sulfur hexafluoride	Release, loss	Asphyxia, Greenhouse	Use of appropriate tubes and connections. Emergency transfer of SF6 and recovery. Emergency escape procedure. Breathing masks. SF6 and O2 detectors	6	Periodic leak detection

Composition problems SF6	Moisture	Corrosion	Periodic check of quality of SF6		
Decomposition products of SF6	HF, SO2	Toxicity, Corrosion	Avoid combustible substances close the SF6 equipment	7	Verify during design

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations
Utility failures	Failure of electric power	Stop of: Pump, compressor, accelerator, lighting, HVAC, cooling water,	UPS for lighting, vent pump <i>(nitrogen)</i>	8	a. Verify the possible exhaust nitrogen shielding room b. Verify possibility of bunker doors with independent from supply
Utility failures	<i>Blockage of sliding doors</i>	<i>Experiment stopped</i>	<i>Procedure for closing doors after verification of absence persons</i>	14	<i>Provide man of doors</i>
Utility failures	Cooling water	Increase of temperature/pressure in accelerator. HVAC not available	Automatic stopping of accelerator, possible increase of SF6 temperature/pressure		
Utility failures	Instrument air	Pneumatic valve open or close according to safe position		9	Verify during design
Utility failures	Nitrogen	Possible damage to detectors	Shutdown system for low temperature		
Utility failures	Fire water (N.A.)				
Utility failures	HVAC system	Possible increase of temperature in the bunker and pressure increase of SF6			
Utility failures	Ventilation system in Hall C	Possible small increase of temperature in Hall C			

	Identification Workshop				
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations
Emergency operations	Escape / egress / rescue	Injuries, death	Safety procedure		Verify
Emergency operations	Release from vent for: SF6, N2, Ar, CO2	Asphyxia of operator	Oxygen detectors in bunker and in hall C	10	Perform a study on emergency release

	Identification Workshop				
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations
Loss of containment	Leak/loss from tank: SF6 storage, SF6 accelerator,	Vapour SF6 in bunker	Periodic control of SF6 leakage for vessels and piping. SF6 detectors in bunker. O2 detectors in bunker.		
Loss of containment	<i>Helium bottles, Ar bottles</i>	<i>He in hall C and/or in bunker</i>	<i>Oxygen detectors in bunker and in Hall C</i>		
Loss of containment	Leak from process area (N.A.)				
Loss of containment	Leak from liquid N ₂ loading line	N ₂ in hall C and/or in bunker	Oxygen detectors in bunker and in Hall C		
Loss of containment	Drains (heavy vapour and liquid of SF6, cooling water)	Accumulation in bunker of heavy gas liquid of SF6 or water		11	Perform a study on liquid/heavy vapour by slope and piping
Loss of containment	Energy release (N.A.)				
Loss of containment	Chemical spills			12	Install a box for chemicals
Loss of containment	Bottled gas leak (He, Ar, N2, CO2)	Fall/breaking of bottles	Bottled located in appropriate areas		

	Identification Workshop				
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations
Fire	Electrical fire	Smoke and O2 deficiency	Smoke detectors. Appropriate electrical cable (no PVC). Appropriate fire extinguisher.		
Fire	Control room fire (PC, paper, plastic, ...)	Smoke and O2 deficiency System shutdown	Smoke detector. Appropriate fire extinguisher.		
Fire	<i>Hydrogen (e/o deuterium bottles (1 in accelerator tank, others for experiment)</i>	<i>Flammable mixture in bunker (flash fire/explosion)</i>	<i>Bottle in accelerator in SF6 tank Limited quantities of gas in the bottles (max. total geometric volume 200 l, max pressure 200 bar)</i>	15	<i>Procedure: as the defined limit for hydrogen (max geometric volume containers 200 l, max permitted gas 200 bar when inside the bunker)</i>
Fire	Heating system fire (N.A.)				

Fire	Machinery fire (N.A.)				
Fire	Workshop fire (N.A.)				

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations
Radiation	Radiation (alfa, beta, gamma, neutrons)	Possible effects on people	Authorization from Prefect / Ministry of Industry and qualified expert. Control by fire brigade.	13	Verify during deoperation

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations
Environmental impact	Venting during normal operations	Emission of SF6 to atmosphere	<i>SF6 is contained in bunker. Recovery by specialized company</i>		Environmental a to ISO14001
Environmental impact	Venting during emergency	Emission of SF6 to atmosphere	<i>SF6 is contained in bunker. Recovery by specialized company</i>		Environmental a to ISO14001
Environmental impact	Leaks (N.A.)				
Environmental impact	Oily water treatment (N.A.)				
Environmental impact	Waste water treatment/disposal (N.A.)				

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations

Inspection / maintenance issues	Confined space (N.A.)	Asphyxia of operator	Work permit procedure for confined space. Breathing masks.		
Inspection / maintenance issues	Machinery / instrument accessibility	Injuries	Work permit. Operative instruction		

Identification Workshop					
Guide Words	Hazardous event	Potential consequences	Existing safeguards	N.	Recommendations
Construction accidents	Accidents occurring during construction	Injuries / death damage to the structure	Safety procedure , training , PPE		
Construction accidents	Accidents occurring during hook up and commissioning	Injuries / death damage to the structure	Safety procedure , training , PPE		
Construction accidents	Accidents occurring during: pipe laying	Injuries / death damage to the structure	Safety procedure, training , PPE		
Construction accidents	Accidents occurring during: cable laying	Injuries / death Damage to the structure	Safety procedure, training , PPE		