Safety Assessment Document Updates for DOE O 420.2D

SAD Section IV Chapter 06 – MINOS Experimental Areas

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Accelerator Readiness Review

19 March 2023

Outline

- MINOS Experimental Areas Overview
- Hazard Inventory
- Non-Accelerator Specific Hazards
- Accelerator Specific Hazards
- Maximum Credible Incident
- Summary of Credited Controls

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- MINOS Experimental Areas Overview
- Hazard Inventory
- Non-Accelerator Specific Hazards
- ~~Accelerator Specific Hazards~~ - NA
- ~~Maximum Credible Incident~~ - NA
- ~~Summary of Credited Controls~~ - NA

Accelerator-specific hazards
do not apply to this area

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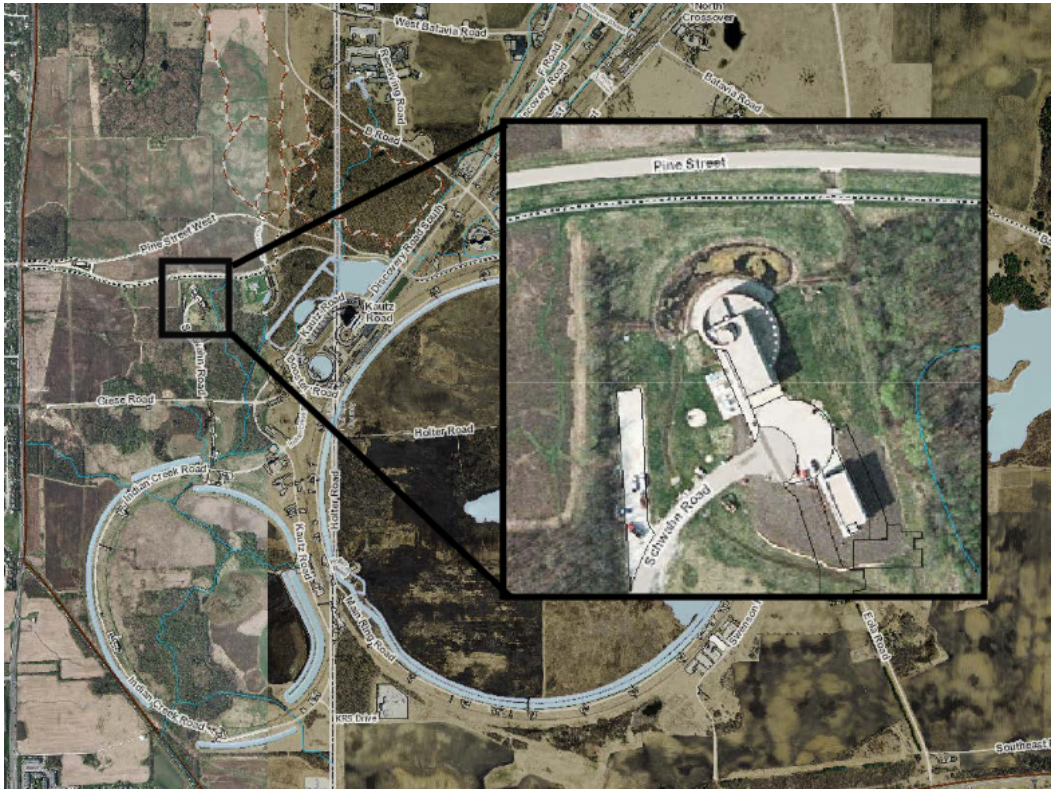
- MINOS Experimental Areas Overview
- Hazard Inventory
- Non-Accelerator Specific Hazards

MINOS Experimental Areas Overview

- Consists of MINOS Service Building on the surface and the underground areas accessible with the elevator
- Positioned along the centerline of the NuMI Neutrino Beamline
- The underground area is about 350ft under ground
- Used by NuMI based neutrino experiments and low cosmic background Dark Matter experiments



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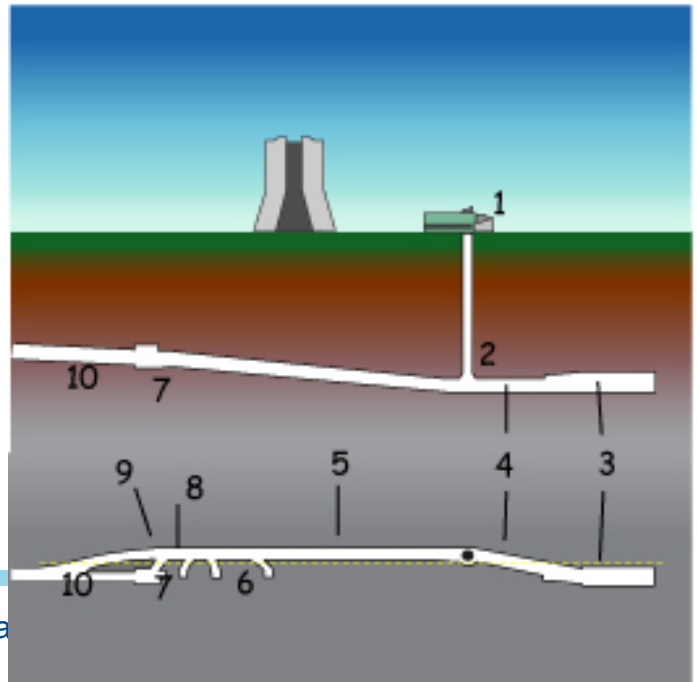
MINOS Experimental Areas Overview

- The experiments are located in
  - Shaft – MAGIS-100
  - Detector Hall – ArgonCube
  - Access Tunnel – NEXUS, QUIET, SENSEI, MOSKITA, SBC
- There are no experiment detectors located in the Absorber Access Tunnel.



Areas accessible from the MINOS Service Building

Described in SAD IV-06
1. MINOS Service Building
2. MINOS Shaft
3. MINOS Detector Hall
4. MINOS Access Tunnel
5. Absorber Access Tunnel

Described in SAD III-08
6. Muon Alcoves 1, 2 & 3
7. Absorber Enclosure, which contains Muon Alcove 0
8. Absorber Entry Passage
9. Absorber Utility Area
10. Decay Pipe Tunnel

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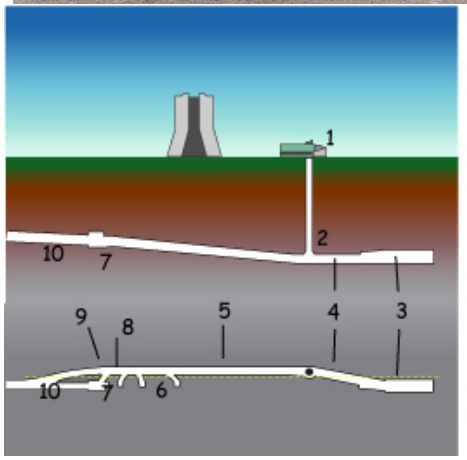
MINOS Experimental Areas Overview

- Access to the MINOS Service Building requires a valid ID card
- Access to the MINOS elevator and underground areas requires a key to the elevator enclosure. The keys are checked out from the Main Control Room
- To obtain a key, personnel must have current General Employee Radiation Training (GERT) and NuMI/MINOS Underground Safety Training.
- In case of emergency the secondary egress path goes from the Absorber Access Tunnel, to the Absorber enclosure, along the decay pipeline to MI-65, to the stairwell that leads to the surface; there is also an elevator at MI-65. Use of the secondary egress path requires breaking the NuMI beam interlock at the entrance to the Absorber Enclosure.



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- MINOS Experimental Areas Overview
- Hazard Inventory
- Non-Accelerator Specific Hazards

Hazard Inventory for MINOS Experimental Areas

	Radiological
☐	**Prompt Ionizing Radiation**
☐	Residual Activation
☐	Groundwater Activation
☐	Surface Water Activation
☒	Radioactive Water (RAW) Systems
☐	Air Activation
☐	Closed Loop Air Cooling
☐	Soil Interactions
☐	Radioactive Waste
☐	Contamination
☐	Beryllium-7
☒	Radioactive Sources
☐	Nuclear Material
☒	Radiation Generating Devices (RGDs)
☒	Non-Ionizing Radiation Hazards
	Thermal Energy
☒	Bakeouts
☐	Hot Work
☒	Cryogenics
	Potential Energy
☒	Crane Operations
☒	Compressed Gasses
☒	Vacuum/Pressure Vessels/Piping
☒	Vacuum Pumps
☒	Material Handling
	Access & Egress
☒	Life Safety Egress

	Toxic Materials
☒	Lead
☐	Beryllium
☒	Flourinert & Its Byproducts
☐	Liquid Scintillator Oil
☐	Pseudocumene
☐	Ammonia
☐	Nanoparticle Exposures
	Flammables and Combustibles
☒	Combustible Materials (e.g., cables, wood cribbing, etc.)
☒	Flammable Materials (e.g., flammable gas, cleaning materials, etc.)
	Electrical Energy
☐	Stored Energy Exposure
☒	High Voltage Exposure
☒	Low Voltage, High Current Exposure
	Kinetic Energy
☒	Power Tools
☒	Pumps and Motors
☐	Motion Tables
☒	Mobile Shielding
	Magnetic Fields
☐	Fringe Fields
	Other Hazards
☒	Confined Spaces
☒	Noise
☒	Silica
☒	Ergonomics
☐	Asbestos
☒	Working at Heights

- Accelerator specific hazards are bold-purple – **None for MINOS Experimental Areas**
- All MINOS Experimental Areas hazards are evaluated via the common Risk Matrix tables
  - Covered in SAD Section I, Chapter 4
- Hazards evaluated via risk assessment methodology per DOE-HDBK-1163-2020
  - Likelihood (L):
    - Anticipated (A), Unlikely (U), Extremely Unlikely (EU), Beyond Extremely Unlikely (BEU)
  - Consequence (C):
    - High (H), Moderate (M), Low (L), Negligible (N)
  - Risk (R):
    - I , II, III, IV (descending order of concern)

Non-Accelerator Specific Hazards

Risk Tables Description		Baseline Risk	Residual Risk
2,1	Radiological – Onsite-1 Facility Worker	R: I	R: III, IV
2.2	Radiological – Onsite-2 Co-located Worker	R: I	R: III, IV
2.3	Radiological – MOI Offsite	R: IV	R: IV
2.4	Toxic Materials – Onsite 1 Facility Worker	R: *	R: *
2.5	Toxic Materials – Onsite 2 Co-located Worker	R: *	R: *
2.6	Toxic Materials – MOI Offsite	R: *	R: *
2.7	Flammable & Combustible Materials – Onsite-1 Facility Worker	R: *	R: *
2.8	Flammable & Combustible Materials – Onsite-2 Co-located worker	R: *	R: *
2.9	Flammable & Combustible Materials – MOI Offsite	R: *	R: *
2.10	Electrical Energy – Onsite-1 Facility Worker	R: *	R: *
2.11	Electrical Energy – Onsite-2 Co-located Worker	R: *	R: *
2.12	Electrical Energy – MOI Offsite	R: *	R: *
2.13	Thermal Energy – Onsite-1 Facility Worker	R: *	R: *
2.14	Thermal Energy – Onsite-2 Co-located Worker	R: *	R: *
2.15	Thermal Energy – MOI Offsite	R: *	R: *
2.16	Kinetic Energy – Onsite-1 Facility Worker	R: *	R: *
2.17	Kinetic Energy – Onsite-2 Co-located Worker	R: *	R: *
2.18	Kinetic Energy – MOI Offsite	R: *	R: *
2.19	Potential Energy- Onsite-1 Facility Worker	R: *	R: *
2.20	Potential Energy – Onsite-2 Co-located Worker	R: *	R: *
2.21	Potential Energy – MOI Offsite	R: *	R: *
2.25	Access & Egress – Onsite-1 Facility Worker	R: *	R: *
2.26	Access & Egress – Onsite-2 Co-located Worker	R: *	R: *
2.27	Access & Egress – MOI Offsite	R: *	R: *
2.28	Environmental Hazards	R: *	R: *

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This hazard has been evaluated within the common Risk Matrix table included in SAD Section I Chapter 04 *Safety Analysis*. Work in the specified areas involving this hazard implements the controls specified in the common Risk Matrix table. No unique controls are in use.

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- MINOS Experimental Areas Overview
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Non-Accelerator Specific Hazards - Radiological

- Radioactive Water (RAW)
  - MINOS Sump area has a chance of containing tritiated water due to accelerator operations
  - Fire suppression system uses water from the MINOS sump area

Baseline Qualitative Risk (without controls)	Controls Preventive (P)/Mitigative (M)	Residual Qualitative Risk (with controls)
L: A C: H R: I	P: Postings intended to caution workers of area hazard. P: Radiological Work Permit prevents unauthorized personnel form areas where excessive residual radiation exists. P: Training for workers to identify and respond to the hazard M: Run Conditions to ensure total radiation levels are within expected parameters	L: BEU C: M R: IV

Non-Accelerator Specific Hazards - Radiological

- Radioactive sources
  - SENSEI, NEXUS, QUIET use radioactive sources to test/calibrate detectors

Baseline Qualitative Risk (without controls)	Controls Preventive (P)/Mitigative (M)	Residual Qualitative Risk (with controls)
L: A C: H R: I	P: MINOS Service Building and Underground are posted as "Controlled Area" and "Radioactive Materials." P: Workers must be on access list or have an MCR key to enter the MINOS Surface Building P: Workers must have a permanent key or an MCR key to enter the elevator room to go down to the MINOS Underground P: Workers must have GERT or Rad Worker training AND have Radioactive Source training to be qualified as Source Monitors M: Sources are either used in place with one of more qualified workers or are placed and signed in or out of Source Monitor box located in MINOS electronics room	L: BEU C: M R: IV

Non-Accelerator Specific Hazards - Radiological

- Radiation Generating Devices (RGDs)
  - NEXUS uses d-d neutron generator in their enclosure

Baseline Qualitative Risk (without controls)	Controls Preventive (P)/Mitigative (M)	Residual Qualitative Risk (with controls)
L: A C: H R: I	P: currently, Rad Safety has the key which allows operation of the neutron generator. P: the neutron generator is surrounded by layers of polypropylene, with the intention that nowhere outside the enclosure is considered a radioactive area. The collimated neutron beam hits a target surrounded by lead shielding with the same intention. P: when the neutron generator is first turned on, tests will be made by Rad Safety RCTs and RSOs to ensure that no radioactive area is present that presents a danger. M: Scheduled tests of the radiation field will be made after the neutron generator is brought into operation.	L: BEU C: M R: IV

Non-Accelerator Specific Hazards - Radiological

- Non-Ionizing Radiation – Laser
  - MAGIS uses 3B and 4 lasers

Baseline Qualitative Risk (without controls)	Controls Preventive (P)/Mitigative (M)	Residual Qualitative Risk (with controls)
Class 3B and 4 Laser L: A C: H R: I	P: Class 1 (light tight) enclosures P: ORC and work planning processes P: Locked/Interlocked system P: LOTO procedure or other procedure approved by the laser safety officer (LSO) P: Affected areas are posted M: Use of PPE	L: BEU C: M R: IV

Questions?