

## 6.0 TECHNICAL APPENDICES

### 6.1 Technical Appendix 1: Risk Matrix

\*Risk matrix is not inclusive of all hazards and serves as a guide. If in doubt about a level of hazard identified or not on the risk matrix, contact your DSO for assistance.

\*See [FESHM Manual](#) for additional guidance relating to each topic below.

<u>Green Low-Risk General Hazard</u> (If your task has TWO or more green general hazards, write a Work Plan/Hazard Analysis or Standard Operating Procedure)	<u>Yellow High-Risk Hazards</u> (If your task has ONE high- level hazard, write a Work Plan/Hazard Analysis or Standard Operating Procedure)
Red – Additional controls or approvals required: DSO, RSO, SME, LSO, AHJ, Permit	
Chemicals, Hazardous or Toxic Substances	
<ul style="list-style-type: none"> <li>Use of chemicals/materials which under a normally controlled work environment do not pose a significant safety or health hazard. (Refer to the SDS).</li> <li>Over the counter chemicals in their original packaging being used for their intended purpose.</li> </ul>	<ul style="list-style-type: none"> <li>Based on the input from Industrial Hygiene Group the use of chemicals/materials which may pose a significant safety or health hazard. (Refer to the SDS).</li> <li>Potential release of hazardous materials (list found in <a href="#">FESHM 8030</a>, 40CFR302, and 40CFR355).</li> <li>Potential release of chemicals, petroleum products, etc. to surface waters (streams or ponds) or drains that lead to surface waters.</li> <li>Potential release, intentional or unintentional, of chemicals, petroleum products, etc. to the sanitary system.</li> </ul>
Contact Industrial Hygiene Group for guidance on identifying the hazard level of chemicals.	
Confined Space Work	
Confined Space Permit or Reclassification form REQUIRED for all confined space work. Additionally contact DSO to determine if a written HA will be needed to supplement.	
Crane, Hoist, & Forklift Use	
<ul style="list-style-type: none"> <li>Any material handling using these types of equipment “standard” crane or forklift operations where a load is being lifted within the rated capacity using approved lifting fixtures and devices.</li> </ul>	<ul style="list-style-type: none"> <li>Load tests at 100% or 125% of rated capacity (<a href="#">FESHM 10100</a>)</li> </ul>
D/S/P Engineering Review Required for:	
<ul style="list-style-type: none"> <li>Below-the-hook lifting devices require engineering note and review</li> <li>Lifts involving prototype or homemade lifting devices and fixtures or attachments</li> <li>Planned engineering lift outside rated load capacity</li> <li>Lifts that meet the definition of critical (<a href="#">FESHM 10200</a>) will require an approved lift</li> </ul>	

plan

DSO Approval & Sign off from FESS crane office required for:

- Use of any crane personnel basket/crane personnel platform ([FESHM 10190](#))

#### Cryogenic Equipment or Systems

- Transporting cryogenic dewar in an elevator ([FESHM 5032.3](#))
- Repair to cryogenic system

- Change in system configuration to cryogenic systems need to be re-evaluated (FESHM 5000s)
- Review applicable safety documentation prior to work on or with cryogenic equipment/system

#### Electrical Work

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| <ul style="list-style-type: none"> <li>• <b>Consult with electrical coordinators to verify low hazard.</b></li> <li>• Work on equipment that has been placed in a verified Electrically Safe Work Condition (ESWC) by personnel working in compliance with FESHM 2100, Fermilab Energy Control Program (Lockout/Tagout) does not pose an electrical hazard.</li> <li>• Work on exposed cables or circuit parts that operate at nominal voltages of 50 volts or less, or the current is limited to less than 5 milliamperes even under fault conditions, or to a nominal 100 volts or less DC or the current is limited to under 40 milliamperes even under fault conditions does not pose an electrical hazard.</li> <li>• Operating electrical utilization equipment (less than 600 volts). Must have no exposed cables, wires, or circuit parts.</li> <li>• Operation of circuit breakers and disconnect switches that are in a normal operating condition (NFPA 70E 130.2(A)(4) energized at 600 volts or less.</li> </ul> | <ul style="list-style-type: none"> <li>• Diagnostic Energized Work (as defined in section 5.2 of FESHM Chapter 9100, Fermilab Electrical Safety Program) on exposed conductors or circuit parts that exceed 50 volts and 5 milliamperes AC or 100 volts and 40 milliamperes DC, including fault conditions, that has not been verified to be in an ESWC.</li> <li>• Verification of an Electrically Safe Work Condition (ESWC), as defined by NFPA 70E Article 120. This must be performed by qualified personnel using required shock and arc flash protection PPE.</li> <li>• Entry into an electrical distribution system manhole in which all cables in the manhole have been verified to be in an ESWC.</li> <li>•</li> </ul> |
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Electrical Hazard Analysis with review by D/S/P Electrical Coordinator Required for:

- Operation of equipment, circuit breakers, disconnect switches, and plugging and unplugging connectors that are not in a normal operating condition and have not been verified to be in an ESWC.

- Operation of equipment, other than equipment that has been listed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with the manufacturer's directions, unless the equipment has been approved by a NRTL or AHJ field inspection, or the installation has received an Operational Readiness Clearance (ORC).
- Entry into an electrical distribution system manhole in which not all cables in the manhole have been verified to be in ESWC. (Confined Space requirements must be separately considered).
- Coring or cutting into concrete, masonry, and walls, floors and ceilings of any type of material where it cannot be proven in advance that there are no electrical circuits or equipment embedded in or located on the side of the concrete or building surface opposite the worker. FESHM 7040.
- Manipulative Energized Work (as defined in section 5.2 of FESHM Chapter 9100, Fermilab Electrical Safety Program) on exposed conductors or circuit parts that have not been verified to be in an ESWC requires approval from the D/S/P Electrical Coordinator, D/S/P Head, and the Fermilab Directorate.

#### Excavation and Digging

Excavation EJULIE Permit required for all excavation and digging work.

Environmental Review Form required for excavation and digging work.

*NOTE: All excavation must be overseen by excavation competent person.*

#### Fall Exposure

- Work from a ladder at 6 feet or more above the floor.
- Work from a scissors lift or articulating boom lift.

- Fall potential is >4 ft. when performing operation and maintenance work, and >6 ft. when performing construction work. *NOTE: HA also requires rescue plan when using fall protection equipment ([FESHM 7060](#))*
- Any use of scaffolding, including erection of the scaffolding. *NOTE: Any erection or dismantling of scaffolding must be overseen by scaffolding competent person. ([FESHM 7070](#))*

Competent Person required for:

- Erection or Dismantling of scaffolding
- Inspection of Scaffolding prior to use

#### "First time use" of new or unfamiliar equipment

- First time use of mechanical or electrical equipment. The task is outside the normal duties and responsibilities or being performed in a location unfamiliar to the work group.

- First time production work following ORC on Fermilab designed or modified equipment
- Critical multi-step activity without existing SOP
- Unfamiliar hazards to employees

#### Hand Tools

<ul style="list-style-type: none"> <li>Using commercially available tools with a sharp blade or edge</li> </ul>	<ul style="list-style-type: none"> <li>Using a tool that is modified, homemade, or fabricated non-commercial.</li> </ul>
DSO approval required for bypassing guards on hand tools.	
Hydraulic and Pneumatic Systems ("Fluids such as oil, water, air, etc.")	
<ul style="list-style-type: none"> <li>Connecting hoses or lines to pressurized oil, water, or air systems.</li> <li>Pressure washing operations or power sprayers.</li> </ul>	<ul style="list-style-type: none"> <li>Any work where a sudden uncontrolled release (failure) of pressure or fluids could result in injury (e.g. people working around a heavy object supported hydraulically could get "caught between") or impact to the environment (air, land, or water).</li> <li>Operating hydraulic cutters.</li> <li>Transporting compressed gasses in elevators (FESHM)</li> </ul>
<ul style="list-style-type: none"> <li>Modifying or reconfiguring hydraulic or pneumatic systems needs to be re-evaluated</li> </ul>	
Lasers	
	Work with a Class 3R (3a), 3b or 4 shall be identified as a potential hazard within the Work Plan/Hazard Analysis. See "Red" section below for additional requirements when working with Class 3b or 4 lasers.
Laser Safety Officer approval required for: <ul style="list-style-type: none"> <li>Work with a Class 3b or 4 laser (<a href="#">FESHM 4260</a>)</li> </ul> Note: Work with a class 3b or 4 laser requires Laser Safety Officer approval, eye examination and training.	
Machining	
	<ul style="list-style-type: none"> <li>Machining hazardous materials such as lead, uranium, etc.</li> </ul>
DSO or Shop Supervisor approval required : Operating machinery without appropriate guards.	
Grinding/Welding/Brazing and Flame Cutting	
<ul style="list-style-type: none"> <li>Welding work in an area where passers-by can see the arc.</li> </ul>	<ul style="list-style-type: none"> <li>Grinding/Welding/Brazing hazardous materials such as lead, uranium, etc.</li> <li>Work requiring an unusual or awkward position (e.g. overhead grinding, etc.)</li> <li></li> </ul>
Grinding/Welding/Brazing and Flame Cutting require Hot Work Permit Structural AHJ approval required for removal of structural welds.	

Magnetic Fields	
<ul style="list-style-type: none"> <li>Working in or creating accessible magnetic fields of &gt; 5.0 gauss (<a href="#">FESHM 4270</a>).</li> </ul>	<ul style="list-style-type: none"> <li>Any situation where ferrous objects can be subject to magnetic forces causing sudden or unexpected movement into the magnetic field. If uncertain, contact your DSO.</li> </ul>
Noise Hazard	
<ul style="list-style-type: none"> <li>Eight hours of work in an environment where you must raise your voice (but not shout) to be heard from a distance of 3 feet or sound pressure levels in excess 85 dBa.</li> <li>Communication is difficult due to noise</li> </ul>	<ul style="list-style-type: none"> <li>Work where it is necessary to shout in order to be heard from a distance of 3 feet. (<a href="#">FESHM 4140</a>)</li> </ul>
Contact Industrial Hygiene Group for work activities where double hearing protection is required. Contact Industrial Hygiene Group for actual sound level readings and guidance.	
Other Work Environments	
<ul style="list-style-type: none"> <li>Nuisance dust from general cleaning, sweeping, or windy conditions.</li> <li>Work in areas above 86 degrees F or below 25 degrees F</li> </ul>	<ul style="list-style-type: none"> <li>Exposure to animal feces during clean-up operations (birds, rodents, raccoons, etc.)</li> <li>Prolonged work in temperatures above 86 degrees F or below 25 degrees F. (<a href="#">FESHM 4250</a>)</li> </ul>
Contact Industrial Hygiene Group for guidance	
Radiation	
<ul style="list-style-type: none"> <li>Work on Class 1 (&lt; 1mR/hr) or Class 2 (&lt; 10mR/hr) radioactive items outside of beamline enclosures.</li> <li>Using radioactive sources.</li> <li>Work in posted Radiological Areas.</li> </ul>	<ul style="list-style-type: none"> <li>When a Radiation Work Permit is required and not all hazards can be incorporated into the RWP. (See <a href="#">FRCM Article 322</a>)</li> </ul> Bringing hazardous material into Radiological Areas or other work that will generate a mixed (radioactive + regulated) waste. Bringing hazardous material into Radiological Areas.
Radiation Safety Officer approval & RWP required for: <ul style="list-style-type: none"> <li>Work in a High Radiation Area, on or with Class 3-5 objects, with activated liquids, depleted uranium (DU), or contaminated objects, requires a Rad Work Permit (RWP).</li> <li>Work in posted Radiological Areas or work with radiological material/sources requiring HA</li> <li>Work with Radiation Generating Devices/neutron generators.</li> <li>Pressure (vacuum/water) or stress testing of activated components.</li> <li>Work on/with water systems. exhaust systems, absorbers, targets, and other beamline components.</li> </ul>	

**Stored Energy**

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| <ul style="list-style-type: none"><li>• Work near equipment that has the potential to release stored energy through falling, rotating, or other unplanned movement NOT covered by a LOTO procedure.</li><li>• Work on or near computer actuated mechanical equipment.</li></ul> | <ul style="list-style-type: none"><li>• Any unusual arrangement of heavy objects. Other mechanical stored energy hazards (e.g. springs).</li><li>• Work on equipment where there is potential for unexpected release of energy (hydraulic, pneumatic, thermal, potential, etc.) where LOTO is required.</li></ul> |
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