Hazards and Controls
on the Magnetism Reflectometer

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Approved By

Group Leader	Date
Instrument Scientist	Date
NSSD ESH/Operations Manager	Date

Hazards and Controls on the Magnetism Reflectometer

Objective

The objective of this document is to inform personnel working on the magnetism reflectometer of potential hazards and associated controls, as identified in the most recent version of the Research Safety Summary for the magnetism reflectometer. A detailed report of the RSS is appended.

Description

This document describes hazards encountered when working on the Magnetism Reflectometer, and controls to mitigate those hazards, as identified in the Magnetism Reflectometer Research Safety Summary (RSS Number 4211).

References

RSS 4211 current revision

Introduction

The Magnetism Reflectometer Research Safety Summary (RSS number 4211) is the document authorizing all work performed on the Magnetism Reflectometer; and that governs all operations and scientific activities performed on beam line 4A. The RSS identifies hazards present on the beam line and controls to mitigate those hazards. It is important that all staff members and users be aware of all hazards potentially present on the beam line. Some hazards are very much physical (i.e. radiation area), while others are not (i.e. intellectual property). Regardless of the type of hazard, all identified hazards have associated controls, and these controls are to be respected. This document describes all hazards potentially present on the beam line, as indentified in the RSS, and their associated controls. A summary of the RSS for the Magnetism Reflectometer is appended.

Hazards

Chemical: Caustic/Corrosives, Flammable/Combustibles, Toxic

Flammable or combustible materials are possible candidates for neutron measurements and are used for cleaning of instrument components. In addition, the hexapod sample positioner uses 200 liter of hydraulic fluid in its hydraulic system.

Hazard

Exposure to chemicals through contact or inhalation, producing somatic or genetic injury.

Control

Engineering controls, work practices and administrative controls and Personal Protective Equipment (PPE) are used to limit worker exposure to chemical hazards and ensure exposures will be kept to below the personnel exposure limit.

Compressed Gases

Some operations and in-situ sample modification may include the use of gases from compressed gas cylinders with pressures greater than 100 psi.

Hazard

Compressed gas cylinders can release energy suddenly (explosion) causing injury. Gas cylinders can leak, displacing the air inside the instrument cave, causing an oxygen deficiency hazard.

Control

An ODH monitoring system will alarm personnel of a low oxygen condition. Proper methods for procuring, handling, using, storing and disposition of compressed gas cylinders and related equipment will be employed.

Cryogenics

Cryostats and cryo-magnets may be used as sample environment equipment.

Hazard

Boil off from cryogenic liquids can create an oxygen deficiency hazard inside the instrument cave. Cryogenic liquids and gasses can cause injury.

Control

An ODH monitoring system will alarm personnel of a low oxygen condition. Only authorized personnel will handle cryogens, and will follow safe working practices for handling cryogens. Cryogenic systems will be designed so that boil off streams are directed in such a manner as to minimize risk to personnel.

Hazardous Energy, Hydraulic Energy, Unguarded Equipment and Lockout/Tagout

The hexapod sample lift has the potential to release stored energy. Routine maintenance on electrical equipment which may be energized or contained stored energy (capacitors). Neutron detectors require high voltage, low current (approximately 1200 v). Motorized equipment (slits, beam line components, sample and detector tables) is unguarded and may move without warning.

Hazard

Physical injury from a release of stored energy or pinch/crush injuries from unguarded equipment.

Control

All personnel will stay at lease two inches away from hydraulic lines while the Hexapod system is in operation. All routine electrical work will be performed by properly trained and authorized individuals. All personnel performing service on equipment are required to receive training in, and to adhere to, SNS and ORNL Lockout/Tagout policies. As a routine matter, work on energized electrical equipment (Voltages > 50 V) is prohibited. Electrical work will be performed by qualified personnel and testing and verification require specially trained personnel who are familiar with the proper use of special precautionary techniques, personnel protective equipment, shielding and insulating materials, and insulated tools, and follow all applicable SBMS procedures. There is no exposed high voltage at the neutron detectors. All personnel will keep clear of unguarded motorized equipment. Motor power will be shut off where possible prior to motor maintenance.

OSHA Hazard Communication Program (HAZCOM)

Samples are typically thin chemical films on ceramic or crystalline substrates, which may contain hazardous materials.

Hazard

Exposure to hazardous materials.

Control

All samples/experiments are reviewed by the Experiment Safety Committee at the SNS prior to approval. Instrument staff will take ORNL HAZCOM Level I Training.

Hoisting/Rigging

Some sample environment equipment must be lowered into position using the overhead crane located above the sample position.

Hazard

Injury to personnel, damage to equipment

Control

Hoisting and rigging training is required for instrument staff prior to use of the beam line 4A hoist. BL4A hoist is kept locked out when not in use. Users are not permitted to operate hoist. All SMBS rules and regulations regarding Hoisting and Rigging are followed.

Intellectual Property, Export Controlled Information or Material and Security Considerations

Operation of the Magnetism Reflectometer will involve non-ORNL participants (users), and may involve:

1. Cooperative Research and Development Agreements (CRADAs)
2. Export Controlled information or material
3. Proprietary Information, Protected CRADA Information, and Business Sensitive Information

Hazard

Unauthorized transfer of protected or controlled information or material.

Control

Check with SNS and ORNL staff prior to transferring any information of material.

Lasers: 3a or below

Low-powered lasers (class 3a and lower) will be used while aligning the instrument.

Hazard

Eye injury when viewing laser through focusing optics.

Control

Lock out laser power supply prior to using any focusing optics (theodolite) which may view laser beam.

Lasers: Embedded 3b or 4

A class 4 laser will be used for polarizing 3He gas inside the detector enclosure. These procedures will be carried out by trained SNS personnel.

Hazard

Physical injury from exposure to high power laser beam.

Control

The class 4 laser power supply is locked out with a key that is under control (in a locked cabinet) of BL4A personnel. Operation of this laser is only allowed after all the appropriate controls are in place (to be reviewed by the laser safety officer). Employees who work with or near exposed Class 3b or 4 lasers, or those who install, adjust, maintain, or service a system containing such energy must take 90872: High Power Laser Hazard Awareness SEL training. During normal operation, the class 4 laser will be enclosed (a contact relay coupled to the laser power supply ensures that the enclosure is in place). In this state, the system is rated as class 1 laser.

NEPA (National Environmental Policy Act) Documentation (non-hazard)

The NEPA documentation which grants approval for activities at SNS and beam line 4A is the Final Environmental Impact Statement for Construction and Operation of the Spallation Neutron Source (DOE/EIS-0247), April 1999, and the subsequent Record of Decision for Construction and Operation of the Spallation Neutron Source, issued June 18, 1999.

NIR (Non-ionizing Radiation) Sources

A spin flipper and a resonator will be routinely operated For the incident bench spin flipper: - The incident spin flipper runs at nominal 150 kHz (radio-frequency), and operates between 1 W and 50 W - All magnetic flux densities outside the flipper envelope are under 100 Gauss; all magnetic flux densities in the system are under 400 Gauss. - The RF coil runs at 150 kHz (+/- 30 kHz) with a maximum current of 13 A-rms (18.5 A-peak). - The maximum voltage at the high voltage end of the coil during operation is 121.8 V-rms (173 V-peak) (no exposed terminals). - The maximum RF magnetic flux density achievable with the current RF-amplifier/coil/guide-field/shield setup is 18.6 Gauss-rms (26.4 Gauss-peak). - The maximum RF magnetic field achievable inside the coil is 1480.14 A/m-rms. - The Threshold Level Value (TLV) for 180 kHz is 108.67 A/m-rms (“16.3/f” [A/m] with “f” in MHz); The maximum achievable RF magnetic field is below this level anywhere outside a volume of 34.2 cm x 34.2 cm x 34.2 cm with the RF

coil centered in this volume and parallel to one of the volume's sides; from calculations, the estimated average over an area equivalent to the vertical cross-section of the human body is less than 11.13 A/m-peak (7.84 A/m-rms), for a person standing on the side of the spin flipper with the body in touch with the external wall of the spin flipper. - 12 cm away from the outer envelope of the incident spin flipper, the DC magnetic flux density is under 5 Gauss (still, I recommend posting the whole cave for pacemaker users). - The estimated RF exposure to space and time averaged power density for a person standing 15 cm from the external side wall of the spin flipper is 143 mW/cm^2 (this should be posted on the cover of the incident bench). - The estimated RF exposure to the space and time averaged electric field for a person standing 15 cm from the external side wall of the spin flipper is below 600 V/m (the TLV for this frequency range is 614 V/m). For the resonator: - There will be static magnetic fields above 600 Gauss inside the resonator coils (up. This should be posted in the vicinity of the resonator. - When we first operate the resonator in pulsed mode, we will measure all harmonics and make an evaluation of the components. It is estimated that the band of operation will be below 1 kHz. - The main coil power supplies are limited to 72 Volts peak; RMS voltages at the resonator terminals will be always under 50 Volts. Maximum current is 24 A. - The Foil Current Power Supply is limited to 20 Volts. The maximum current is 20 A.

Hazard

Exposure to non-ionizing radiation

Control

Ensure appropriate engineering and administrative controls. Ensure only qualified individuals work with NIR sources. Use postings to notify instrument cave occupants of the presence and nature of non-ionizing radiation.

Odd Work Hours

The instrument will be operated 24 hours a day during normal SNS beam operations.

Hazard

Reduced support staff

Control

During normal operation of the SNS, a floor coordinator will be present 24 hours/day. Notification of the Instrument Hall coordinator is required if working alone outside of normal working hours (6 am to 7 pm), when the SNS is operating. If the Instrument Hall coordinator is unavailable, the SNS Central Control Room (CCR) should be notified if working alone. If the instrument hall coordinator is unavailable and the SNS CCR is not staffed, the LSS must be notified when conducting hazardous operations.

Pressure greater than 100 psi

The Magnetism Reflectometer is equipped with a 3He position-sensitive gas detector that operates at 120 psi.

Hazard

Potential release of stored energy

Control

Staff will be trained to operate the detector in conformance with safety protocols developed in consultation with the Division Safety Officer.

Radiation Areas

The Magnetism Reflectometer includes an incident flight path that directs a neutron beam generated in the Target Facility to a sample. Direct exposure to this beam at the sample location could result in a dose level as high as 500,000 mrem/hr to an extremity (hand). Whole body dose for a person inside the sample enclosure could be as high as 5000 mrem/hr.

Hazard

Exposure to ionizing radiation

Control

All users given access to the sample enclosure during SNS operation will receive SNS/HFIR specific radiation training for users (note that the sample enclosure can only be accessed when the beam shutter is closed). 1) Shielding - the incident neutron beam is heavily shielded so as to achieve a calculated dose on contact with these shielding pieces of less than 0.25 mrem/hr. Configuration of this shielding is under configuration management. 2) Instrument Personnel Protection System - The IPPS is a certified engineering control which restricts access to areas where personnel can receive radiation dose to conditions where the neutron beam is shut. 3) Training of instrument personnel and users will identify proper operation of the IPPS and the procedures for accessing these areas.

Radioactive Material and Radioactive Sealed Sources

Samples and sample environment equipment will be exposed to a flux of neutrons during normal operation of the instrument. In addition, some equipment associated with the instrument (neutron choppers) will require periodic maintenance and will be activated. Tests of the neutron detector system are planned using a sealed source of neutrons.

Hazard

Injury resulting from exposure to radioactive materials, radioactive contamination.

Control

SNS site specific radiation training for users, as well as beam line specific training, as detailed in SAP Business event group 50276294, will be required for all unsupervised operation of the instrument. In addition to RWI training, chopper maintenance will involve a specific JHA and RWP, including an appropriate ALARA review which involves radiological safety personnel. Radiological hazards associated with irradiated samples will be evaluated as part of the sample proposal to the Experiment Review committee. The sealed neutron source is the responsibility of the SNS Instrument Systems Detector group. Use of the source will be coordinated with this group and be under their control/custodianship.

Thermal

It is possible that custom furnaces will be fabricated as sample environment equipment.

Hazard

Injury as a result of contact with hot components

Control

If such equipment is designed, its operation will be the subject of extensive review and there will be no exposed high temperature surfaces.

Vacuum/Implosion Potential

The neutron guide system has the potential to release shattered glass particles into the sample enclosure.

Hazard

Injury from fragments ejected from guide housing window.

Control

The beam monitor mounted at the guide exit is of sufficient thickness to stop glass fragments that exit the guide housing. If removal of the beam monitor is necessary, a replacement shield, having the same or greater thickness, will be installed in place of the beam monitor.

Other not previously identified hazards

All experiments will be the subject of a review by the SNS Experiment Safety Committee, which will identify hazards. For work not reviewed by the SNS Experimental Safety Committee a Job Hazards Analysis (JHA) will be carried out identifying proper controls and practices prior to beginning work.

RSS Report - Detailed

Report Criteria:

- **Project ID(s):** 6559

RSS Title: Research Safety Summary for the Spallation Neutron Source Magnetism Reflectometer. **Principal Investigator: Richard Goyette, Jr. (925473)** **RSS Number: 4211.2**	
Created By:	Ian Evans (916301) on Thursday May 22, 2008 at 8:23 AM
Last Revised By:	1QG on Thursday May 29, 2008 at 9:29 AM
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Division Work Authority:	Kenneth Herwig (36436)
Division POC:	Ian Evans (916301)
Group Leader(s):	Gregory Smith (652642)
Lab Space Manager(s):	
General Comments:	**No files have been attached to this section**
RSS Description:	This summary tabulates hazards encountered when working on the Magnetism Reflectometer on beam line 4A of the Spallation Neutron Source Target Building (Building #8700). All individual experiments involving measurements on samples will be subject to an Experimental Safety Review - which examines the safety and hazards, including combustibility associated with individual sample materials. This review will be done in accordance with the requirements of the Spallation Neutron Source, Final Safety Analysis Document - Neutron Facilities and applicable ORNL SBMS procedures.
Work Locations:	8700: F-3-1
Hazards:	Accelerators , Chemical: Caustic/Corrosives , Chemical: Flammable/Combustibles , Chemical: Toxic , Compressed Gases ,

	Cryogenics , Hazardous Energy , Hazcom Standard , Hoisting/Rigging , Hydraulics , Intellectual Property , Lasers: 3a or below , Lasers: Embedded 3b or 4 , Lockout/Tagout , NEPA Documentation , NIR Sources , Odd Work Hours , Other , Pressure > 100 psi , Radioactive Material , Radioactive: Sealed Sources , Security Considerations , Thermal , Unguarded Equipment , Vacuum/Implosion Potential

Question: 1.1 Does this operation involve the use of a particle accelerator?
Response: YES
Hazard Category: Accelerators

Work Location(s):	8700: F-3-1
PI Hazard Notes:	While the Spallation Neutron Source is an accelerator facility, operation of the Magnetism Reflectometer does not involve direct use of the accelerator. The only direct interaction the instrument has with the accelerator is via the Instrument Personel Protection System designed to protect operators of the instrument from prompt radiation. The IPPS can initiate a sequence of events that halts operation of the accelerator.
Requirements:	1. Accelerator Safety
PI Control/Rqmt Notes:	Does not directly apply to operation of the Magnetism Reflectometer

No files have been attached to this question

Question: 1.2 Does this operation involve the use of a particle accelerator capable of generating a radiation area?
Response: YES
Hazard Category: Accelerators

Work Location(s):	8700: F-3-1
PI Hazard Notes:	The Magnetism Reflectometer includes an incident flight path that directs a neutron beam generated in the Target Facility to a sample. Direct exposure to this beam at the sample location could result in a dose level as high as 500,000 mrem/hr to an extremity (hand). Whole body dose for a person inside the sample enclosure could be as high as 5000 mrem/hr.
Requirements:	1. Accelerator Safety

PI Control/Rqmt Notes:	All users given access to the sample enclosure during SNS operation will receive SNS/HFIR specific radiation training for users (note that the sample enclosure can only be accessed when the beam shutter is closed). 1) Shielding - the incident neutron beam is heavily shielded so as to achieve a calculated dose on contact with these shielding pieces of less than 0.25 mrem/hr. Configuration of this shielding is under configuration management. 2) Instrument Personnel Protection System - The IPPS is a certified engineering control which restricts access to areas where personnel can receive radiation dose to conditions where the neutron beam is shut. 3) Training of instrument personnel and users will identify proper operation of the IPPS and the procedures for accessing these areas.
No files have been attached to this question	

Question: 2.1 Does this operation involve the generation, handling, processing, use, or storage of radioactive materials (including sealed sources and waste)? Response: YES Hazard Category: Radioactive Material	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	Samples and sample environment equipment will be exposed to a flux of neutrons during normal operation of the instrument. In addition, some equipment associated with the instrument (neutron choppers) will require periodic maintenance and will be activated. Tests of the neutron detector system are planned using a sealed source of neutrons.
Requirements:	1. Facility Hazard Categorization 2. Facility Use Agreements 3. Price Anderson Amendments Act (PAAA) 4. Radiological Design Requirements 5. Radiological Work: Performing Work 6. Radiological Work: Preparing for Work 7. Sealed Radioactive Source Control
PI Control/Rqmt Notes:	1) SNS/HFIR specific radiation training for users, as well as beam line specific training, as detailed in SAP Business event group 50276294, will be required for all unsupervised operation of the instrument. 2) In addition to RWI training, chopper maintenance will involve a specific JHA and RWP, including an appropriate ALARA review which involves radiological safety personnel. 3) Radiological hazards associated with irradiated samples will be evaluated as part of the sample proposal to the Experiment Review committee. 4) The sealed

	neutron source is the responsibility of the SNS Instrument Systems Detector group. Use of the source will be coordinated with this group and be under their control/custodianship.

No files have been attached to this question

Question: 2.2 Does this operation involve any accountable radioactive sealed sources?
Response: YES
Hazard Category: Radioactive: Sealed Sources

Work Location(s):	8700: F-3-1
PI Hazard Notes:	See notes under 2.1
Requirements:	1. Price Anderson Amendments Act (PAAA) 2. Radiation Generating Devices 3. Sealed Radioactive Source Control
PI Control/Rqmt Notes:	See notes under 2.1

No files have been attached to this question

Question: 3.1 Does this operation involve any of the following NIR sources?

- permanently installed microwave/radio-frequency gear, capable of radiating over 1 W into an open area at frequencies between 3 kHz and 300 GHz or of emitting over 100 W if the output is normally completely enclosed by coaxial cables, waveguides, or dummy or real loads
- satellite and permanently installed communications transmitters (not receivers)
- portable walkie-talkie communications sets capable of radiating over 7 W at frequencies between 100 kHz and 450 MHz, and over 7 (450/f) W at frequencies between 450 MHz and 1.0 GHz (f in MHz)
- induction heaters (other than consumer/commercial products being utilized for their originally intended purpose)
- static magnetic fields which may exceed 60 mT (600 gauss)
- sub-radiofrequency (30 kHz - 300 Hz) magnetic fields exceeding 0.2 mT or static electric fields exceeding 625 V/m
- any equipment that would expose personnel to high levels of Visible Light and Near Infrared (400nm-300nm) (>1 candela/cm2), Infrared (770nm-3000nm)

(>10w/cm2, and/or 8h Ultraviolet (UV) radiation (180nm-400nm)
- any infrared heat lamp or any near-frared source where a strong visual stimulus is absent (luminance of less than E-06 candela/cm2)

Response: YES
Hazard Category: NIR Sources

Work Location(s):	8700: F-3-1
PI Hazard Notes:	A spin flipper is routinely operated. A resonator will occasionally be operated. A Helium-3 analyzer will occasionally be operated. Neutron guide fields consisting of permanent magnets magnetizing carbon steel plates are continuously in use. For the spin flipper: - The incident spin flipper runs at nominal 150 kHz (radio-frequency), and operates between 1 W and 50 W - All magnetic flux densities outside the flipper envelope are under 100 Gauss; all magnetic flux densities in the system are under 400 Gauss. - The RF coil runs at 150 kHz (+/- 30 kHz) with a maximum current of 13 A-rms (18.5 A-peak). - The maximum voltage at the high voltage end of the coil during operation is 121.8 V-rms (173 V-peak) (no exposed terminals). - The maximum RF magnetic flux density achievable with the current RF-amplifier/coil/guide-field/shield setup is 18.6 Gauss-rms (26.4 Gauss-peak). - The maximum RF magnetic field achievable inside the coil is 1480.14 A/m-rms. - The Threshold Level Value (TLV) for 180 kHz is 108.67 A/m-rms (“16.3/f” [A/m] with “f” in MHz); The maximum achievable RF magnetic field is below this level anywhere outside a volume of 34.2 cm x 34.2 cm x 34.2 cm with the RF coil centered in this volume and parallel to one of the volume’s sides; from calculations, the estimated average over an area equivalent to the vertical cross-section of the human body is less than 11.13 A/m-peak (7.84 A/m-rms), for a person standing on the side of the spin flipper with the body in touch with the external wall of the spin flipper. - 12 cm away from the outer envelope of the incident spin flipper, the DC magnetic flux density is under 5 Gauss (still, I recommend posting the whole cave for pacemaker users). - The estimated RF exposure to space and time averaged power density for a person standing 15 cm from the external side wall of the spin flipper is 143 mW/cm^2 (this should be posted on the cover of the incident bench). - The estimated RF exposure to the space and time averaged electric field for a person standing 15 cm from the external side wall of the spin flipper is below 600 V/m (the TLV for this frequency range is 614 V/m). For the resonator: - There will be static magnetic fields above 600 Gauss inside the resonator coils (up. This should be posted in the vicinity of the resonator. - When we first operate the resonator in pulsed mode, we will measure all harmonics and make an evaluation of the

	components. It is estimated that the band of operation will be below 1 kHz. - The main coil power supplies are limited to 72 Volts peak; RMS voltages at the resonator terminals will be always under 50 Volts. Maximum current is 24 A. - The Foil Current Power Supply is limited to 20 Volts. The maximum current is 20 A. For the Helium-3 analyzer: The analyzer contains magnetic fields below 2 Gauss. For the guide fields: Guide fields generate static magnetic fields with maximum values below 100 Gauss at the center most field point, dropping to less than 5 Gauss within approximately 10 centimeters of the edge of the steel plate.
Requirements:	1. Occupational Hazard Controls
PI Control/Rqmt Notes:	For static magnetic field levels, two postings will be placed on the instrument cave door and within the instrument cave: the standard posting alerting pacemaker patients and one posting work restrictions in proximity to magnetic fields. For the time varying fields (AC and arbitrary waveforms) in the spin flipper, postings on the instrument cave door and inside the instrument cave list the potential energy stored in the device and work restrictions in proximity to the device.
No files have been attached to this question	

Question: 4.1 Does this operation involve the use of lasers of Class 3a and below?
Response: YES
Hazard Category: Lasers: 3a or below

Work Location(s):	8700: F-3-1
PI Hazard Notes:	Low-powered lasers (class 3a and lower) will be used while aligning the instrument.
PI Control/Rqmt Notes:	The class 3a (or lower) laser does not require particular safety controls but operators are required to take 90125: Low Power Laser Hazard Awareness Training.
No files have been attached to this question	

Question: 4.3 Does this operation involve a class 1 laser system with embedded Class 3b or 4 lasers?
Response: YES
Hazard Category: Lasers: Embedded 3b or 4

Work	8700: F-3-1

Location(s):	
PI Hazard Notes:	A class 4 laser will be used for polarizing 3He gas inside the detector enclosure. These procedures will be carried out by trained SNS personnel.
Requirements:	1. Lasers
PI Control/Rqmt Notes:	The class 4 laser power supply is locked out with a key that is under control (in a locked cabinet) of BL4A personnel. Operation of this laser is only allowed after all the appropriate controls are in place (to be reviewed by the laser safety officer). Employees who work with or near exposed Class 3b or 4 lasers, or those who install, adjust, maintain, or service a system containing such energy must take 90872: High Power Laser Hazard Awareness SEL training. During normal operation, the class 4 laser will be enclosed (a contact relay coupled to the laser power supply ensures that the enclosure is in place). In this state, the system is rated as class 1 laser. It is documented (SNS document number 107050602-EQ0001-R0A) that outside of the metal enclosure box, the potential irradiance is below 0.5 W /cm2, which is not considered a fire hazard.
No files have been attached to this question	

Question: 5. **Does this operation involve the potential for electrical shock or the release of other hazardous energy (mechanical, pressure, steam, etc.)?**
Response: YES
Hazard Category: Hazardous Energy

Work Location(s):	8700: F-3-1
PI Hazard Notes:	1) The hexapod sample lift (see procurement document "Beamline 4A Hexapod Sample Positioning System" 107050503-PD001-R00) has the potential to release stored energy. 2) Routine maintenance on electrical equipment. 3) Neutron detectors require high voltage,low current (approximately 1200 v).
PI Control/Rqmt Notes:	1) All personnel will stay at lease two inches away from hydraulic lines while the Hexapod system is in operation. 2) All routine electrical work will be performed by properly trained and authorized individuals. All personnel performing service on equipment are required to receive training in, and to adhere to, SNS and ORNL Lockout/Tagout policies. As a routine matter, work on energized electrical equipment (Voltages > 50 V) is prohibited. Electrical work will be performed by qualified personnel and testing and verification require specially trained

	personnel who are familiar with the proper use of special precautionary techniques, personnel protective equipment, shielding and insulating materials, and insulated tools, and follow all applicable SBMS procedures. 3) There is no exposed high voltage at the neutron detectors.

No files have been attached to this question

Question: 5.2 Does this operation involve work on equipment that requires Lockout/Tagout control procedures (equipment has the potential to release hazardous energy, e.g. electrical, mechanical, pressure, steam)?
Response: YES
Hazard Category: Lockout/Tagout

Work Location(s):	8700: F-3-1
PI Hazard Notes:	See notes above.
Requirements:	1. Electrical Work 2. Lockout/Tagout
PI Control/Rqmt Notes:	See notes above.

No files have been attached to this question

Question: 7.2 Does this operation involve work conducted under the OSHA Hazard Communication Program (HAZCOM)?
Response: YES
Hazard Category: Hazcom Standard

Work Location(s):	8700: F-3-1
PI Hazard Notes:	Samples are typically thin chemical films on ceramic or crystalline substrates.
Requirements:	1. Conducting Qualitative Exposure Assessments - Interim Procedure
PI Control/Rqmt	All samples/experiments are reviewed by the Experiment Safety Committee at the SNS prior to approval. Instrument staff will take

Notes:	ORNL HAZCOM Level I Training.
No files have been attached to this question	

Question: 7.7 Does this operation involve any chemicals or wastes that are flammable or combustible? Response: YES Hazard Category: Chemical: Flammable/Combustibles	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	Flammable or combustible materials are possible candidates for neutron measurements and are used for cleaning of instrument components. The hexapod sample positioner uses 200 liter of hydraulic fluid in its hydraulic system. The oil used is EcoSafe® FR-46 produced by American Chemical Technologies, Inc. The oil is Factory Mutual approved as a less hazardous hydraulic fluid, has a flashpoint is 525°F, and is classified as a Class IIIB combustible liquid. The total quantity of combustible liquids on BL4A are within the limits established in the Target Building Combustible Controls procedure (OPM 7.T-200.5).
Requirements:	1. Storing and Handling Flammable and Combustible Liquids 2. Chemical Safety 3. Conducting Qualitative Exposure Assessments - Interim Procedure 4. Personal Protective Equipment
PI Control/Rqmt Notes:	1) Flammable/combustible samples are identified on the beam time proposal form. 2) Identification should be confirmed during the review by the SNS Experiment Safety Committee. 3) As needed, if such a material is proposed for study, prior to its use, instrument personnel will undergo the appropriate training. Instrument staff and users will use appropriate PPE. The Spallation Neutron Source follows a combustible materials and ignition controls program as described in the Final Safety Analysis Document for Neutron Facilities. 4) The MSDS for the EcoSafe® FR-46 hydraulic oil will be posted and required information will be entered into the ORNL Local Emergency Manual for the Target Building (for example, information on the appropriate fire fighting method and extinguishing media). 5) Hazardous or flammable chemicals will be used at BL4A for cleaning of instrument components or experiment samples. Typical cleaning liquids are Acetone, Ethanol, Methanol and Isopropyl alcohol. These liquids will be stored at the instrument beam line (outside of the instrument enclosure) in an appropriate chemical storage unit. Typical amounts are one liter in

	volume for any individual chemical. The total amount of flammable liquids stored at BL4A shall not exceed 10 liter. The total quantity of flammable liquids on BL4A are within the limits established in the Target Building Combustible Controls procedure (OPM 7.T-200.5). The BL4A life safety features meet the requirements in the National Fire Protection Association (NFPA) 101 “The Life Safety Code”. Automatic fire sprinklers are provided in the sample enclosure (cave) and in the hutch. In addition, spot smoke detectors are provided in the sample enclosure (cave) to provide an additional level of fire safety for the high dollar value equipment located in the enclosure. The hutch materials of construction are noncombustible, including the core material within the prefabricated wall panels. Fire hazards specific to MR can be considered “extremely low” because of the noncombustible construction and the absence of significant combustible shielding material. The overwhelming volume of shielding on BL4A will be concrete and steel (materials which become flammable only at extremely high temperatures). The relatively small quantities of polyethylene used in shielding will typically be encapsulated in steel housings. Fixed and transient combustible materials associated with BL4A will be maintained within the limits established in the Target Building Combustible Materials procedure (OPM 7.T-200.5). BL4A will operate in accordance with the fire safety procedures found in SNS OPM section 2.J, which includes the ORNL SMBS Subject Area “Fire Protection, Prevention, and Control” and the SNS Fire Safety procedure (2.J-2). All waste solutions will be evaluated and characterized. Hazardous and/or mixed wastes will be temporarily staged in Satellite Accumulation Areas pending ultimate treatment and/or diposition. Any radioactive waste will be temporarily staged in an appropriate area awaiting final disposition. All potential wastes will be evaluated by the SNS Environmental Protection Officer and recommendations for proper management of the wastes will be in accordance with State and Federal regulations.
No files have been attached to this question	

Question: 7.8 Does this operation involve any chemicals or wastes that are caustic or corrosive (e.g. acids or bases)? Response: YES Hazard Category: Chemical: Caustic/Corrosives	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	See notes under 7.7

Requirements:	1. Chemical Safety 2. Conducting Qualitative Exposure Assessments - Interim Procedure 3. Personal Protective Equipment
PI Control/Rqmt Notes:	See notes under 7.7
No files have been attached to this question	

Question: 7.9 Does this operation involve any chemicals or wastes that are toxic? Response: YES Hazard Category: Chemical: Toxic	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	See notes under 7.7
Requirements:	1. Chemical Safety 2. Conducting Qualitative Exposure Assessments - Interim Procedure 3. Personal Protective Equipment
PI Control/Rqmt Notes:	See notes under 7.7
No files have been attached to this question	

Question: 8.1 What NEPA (National Environmental Policy Act) documentation grants approval for this project or activity (e.g., CX-1234X, title, etc.)? Response: YES Hazard Category: NEPA Documentation	
Work Location(s):	8700: F-3-1
Requirements:	1. National Environmental Policy Act (NEPA) and Cultural Resources Evaluations
PI	The NEPA documentation which grants approval for this activity is the

Control/Rqmt Notes:	Final Enviromental Impact Statement for Construction and Operation of the Spallation Neutron Source (DOE/EIS-0247), April 1999, and the subsequent Record of Decision for Construction and Operation of the Spallation Neutron Source, issued June 18, 1999.

No files have been attached to this question

Question: 9.1 Does this operation involve any activities requiring the use of mechanically-assisted lifting, rigging or hoisting?
Response: YES
Hazard Category: Hoisting/Rigging

Work Location(s):	8700: F-3-1
PI Hazard Notes:	Some sample environment equipment may be lowered into position using the overhead crane or hoist located above the sample position.
Requirements:	1. Hoisting and Rigging
PI Control/Rqmt Notes:	04795 - Hoisting and rigging training is required for instrument staff prior to use of the beam line 4A hoist. BL4A hoist is kept locked out when not in use. Users are not permitted to operate hoist. All SMBS rules and regulations regarding Hoisting and Rigging are followed.

No files have been attached to this question

Question: 9.2 Does this operation involve any exposure to moving or rotating parts, such as motors, shafts, pulleys, belts, or any other potential mechanical energy?
Response: YES
Hazard Category: Unguarded Equipment

Work Location(s):	8700: F-3-1
PI Hazard Notes:	See notes under 5.
Requirements:	1. Occupational Hazard Controls
PI Control/Rqmt Notes:	See notes under 5.

No files have been attached to this question

Question: 11.2 Does this operation involve a vessel operated at greater than 100 psi? Response: YES Hazard Category: Pressure > 100 psi	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	The Magnetism Reflectometer is equipped with a 3He position-sensitive gas detector that operates at 120 psi.
PI Control/Rqmt Notes:	Staff will be trained to operate the detector in conformance with safety protocols developed in consultation with the Division Safety Officer.
No files have been attached to this question	

Question: 11.3 Does this operation involve exposure to hydraulic systems, jacks, actuators, etc, under load (excluding small lab presses)? Response: YES Hazard Category: Hydraulics	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	See notes under 5.
PI Control/Rqmt Notes:	See notes under 5.
No files have been attached to this question	

Question: 11.4 Does this operation involve exposure to vacuum systems that could implode and injure personnel? Response: YES Hazard Category: Vacuum/Implosion Potential	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	The neutron guide system has the potential to release shattered glass particles into the sample enclosure.

PI Control/Rqmt Notes:	The only permanent equipment maintained and operated under vacuum at the MR will be the neutron guide and the choppers. These components, especially the beam windows, are carefully designed to withstand the involved mechanical stress. Implosion of any vacuum component is highly unlikely. However, a possible accident scenario is that a delamination of the chopper coating may rupture a guide window leading to a destruction of the glass neutron guides. The triggered air shock wave may send debris (e.g. glass particles) downstream the guide housing into the instrument enclosure. Although this accident scenario is very unlikely, calculations indicate that the window thickness of the beam monitor currently installed at end of the guide, and immediately upstream of beam aperture slits, is sufficient protection against debris resulting from this scenario (107030400-DA0005-R00, “Beam-line 2, 4a and 4b Disk Chopper / Neutron Guide Failure Analysis”). In the event that the beam monitor needs to be removed, an aluminum shield, which has the same (or larger) thickness as the beam monitor window, will immediately be placed at the neutron guide exit. The shield piece will be chained to the wall such that it cannot be removed unintentionally. The following sign will be posted: “If the beam monitor needs to be removed, this metal plate must be inserted at the beam monitor position to mitigate hazards due to a guide implosion.” This process is covered in OPM document 7.U-4A.16.1 Magnetism Reflectometer Beam Monitor Maintenance Procedure.
No files have been attached to this question	

Question: 11.5 Does this operation involve compressed gases at greater than 100 psi? Response: YES Hazard Category: Compressed Gases	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	Some operations and in-situ sample modification will include the use of gases from compressed gas cylinders.
Requirements:	1. Compressed Gas Cylinders and Related Systems
No files have been attached to this question	

Question: 12.1 Does this operation involve sources of thermal hazards greater than 200 degrees C, other than commercially available units or materials, such as soldering irons, hot plates, small ovens or furnaces?

Response: YES Hazard Category: Thermal	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	It is possible that custom furnaces will be fabricated as sample environment equipment.
Requirements:	1. Occupational Hazard Controls 2. Personal Protective Equipment
PI Control/Rqmt Notes:	If such equipment is designed,its operation will be the subject of extensive review and there will be no exposed high temperature surfaces.
No files have been attached to this question	

Question: 12.2 Does this operation involve cryogenics in quantities greater than 1 gallon? Response: YES Hazard Category: Cryogenics	
Work Location(s):	8700: F-3-1
PI Hazard Notes:	The impact of releasing cryogens inside the instrument enclosure has been analyzed in the document "BL4A Hazard Analysis for Superconducting Magnet Cryogens" Cryostats and cryomagnets may be used as sample environment equipment on this instrument.
Requirements:	1. Working with Cryogens 2. Personal Protective Equipment
PI Control/Rqmt Notes:	1) SNS has a cryogenic safety policy 2) Appropriate PPE will be used.
No files have been attached to this question	

Question: 14.2 Does this operation involve work performed outside normal working hours (6am to 7pm)? Response: YES Hazard Category: Odd Work Hours	
Work	8700: F-3-1

Location(s):	
PI Hazard Notes:	The instrument will be operated 24 hours a day during normal SNS beam operations.
PI Control/Rqmt Notes:	1) During normal operation of the SNS, a floor coordinator will be present 24 hours/day. 2) Notification of the Instrument Hall coordinator is required if working alone outside of normal working hours (6 am to 7 pm), when the SNS is operating. If the Instrument Hall coordinator is unavailable, the SNS Central Control Room (CCR) should be notified if working alone. 3) If the instrument hall coordinator is unavailable and the SNS CCR is not staffed, the LSS must be notified when conducting hazardous operations.
No files have been attached to this question	

Question: 17. **Does this operation involve any safety hazards not previously identified above? Examples might include:**

- **Equipment or facility modifications**
- **Changes in research that might affect the Facility Use Agreement, e.g. change in chemical inventories, introduction of new hazards, fire safety issues**

Response: YES
Hazard Category: Other

Work Location(s):	8700: F-3-1
PI Hazard Notes:	Experiments brought by users will each be reviewed by an SNS committee and assessed for relevant hazards.
PI Control/Rqmt Notes:	1) All experiments will be the subject of a review by the SNS Experiment Safety Committee, which will identify hazards. 2) For work not reviewed by the SNS Experimental Safety Committee a Job Hazards Analysis (JHA) will be carried out identifying proper controls and practices prior to beginning work.
No files have been attached to this question	

Question: 18.1 Does this operation involve intellectual property or export controlled information or materials?
Response: YES
Hazard Category: Intellectual Property

Work Location(s):	8700: F-3-1

PI Hazard Notes:	Operation of the Magnetism Reflectometer will involve non-ORNL participants (users).
Requirements:	1. Cooperative Research and Development Agreements (CRADAs) 2. Export Control 3. Proprietary Information, Protected CRADA Information, and Business Sensitive Information
No files have been attached to this question	

Question: 18.4 Does this operation require safeguards and security considerations or special controls? Review the ISSM checklist.
Note: If any of the questions on the ISSM checklist are answered "yes," question 18.4 must also be answered yes.
Response: YES
Hazard Category: Security Considerations

Work Location(s):	8700: F-3-1
PI Hazard Notes:	see notes under 18.1
Requirements:	1. Classified Matter Protection and Control Program 2. Event Reporting and Follow-Up 3. Export Control
No files have been attached to this question	

Unless superseded by another document, this Research Safety Summary, once authorized, serves as the certification of hazard assessment for the specification of personal protective equipment for research activities at Oak Ridge National Laboratory.

Location:	Facility(s) and lab/room(s) in which RSS/work will be conducted.
Requirements:	Laboratory-level documents/procedures that direct work at ORNL.