

Research Safety Summary - View

RSS No

7728.15

Status

Authorized

Minor Revisions

None.

Last Modified by

Pierce, Eric ([976676](#)) on 11/2/2023 3:39:56 PM

Notice

This information is **current as of 11/16/2023 4:26:53 PM**. The official copy of this Research Safety Summary is the online version. Before using a printed copy, you must verify that it is the most recent version. Any printed copies provided to individuals for the purpose of controlling work must be controlled in accordance with the [Document Control](#) subject area.

Any work for which hazards and controls have not been evaluated is not authorized. Typical examples of unauthorized work would include equipment troubleshooting or changes to experimental conditions or activities outside of limits / boundaries set forth in this RSS and/or its referenced procedures, etc.

Title

ESD Off-Site: Minnesota SPRUCE Experiment--Climate Change Response SFA

Approvals/Authorizations

Date/Time	Name	Role
11/2/2023 3:38:43 PM	Hanson, Paul (29602)	Approver
11/2/2023 3:39:51 PM	Pierce, Eric (976676)	Authorizer

Description Text

[NOTE: The presence of Green Text in this RSS is indicative of substantive changes that have been made to the RSS since the last major version.]

Experimental work under the Response SFA will focus on the identification of critical response functions for terrestrial organisms, communities, and ecosystems. Both direct and indirect effects of these experimental perturbations will be analyzed to develop and refine models needed for full Earth system analyses. Response SFA research will be organized around a climate change manipulation focusing on the combined response of multiple levels of warming at ambient or elevated CO₂ (eCO₂) levels.

A more detailed discussion of the scientific goals/outcomes of the proposed work can be found on the project's website: <https://mnspruce.ornl.gov/>

The experiment will provide a platform for testing mechanisms controlling vulnerability of organisms and ecosystems to important climate change variables (e.g., thresholds for organism decline or mortality, limitations to regeneration, biogeochemical limitations to productivity).

The experiment will evaluate the response of existing biological communities to a range of warming levels from ambient to 9°C. The ambient, +2.25, +4.5 +6.75 and 9°C warming treatments will also be conducted at eCO₂ (in the range of 800 to 900 ppm).

The experiment will be conducted in a *Picea mariana* [black spruce] – *Sphagnum* spp. forest in northern Minnesota. This ecosystem located at the southern extent of the spatially expansive boreal peatland forests is considered to be especially vulnerable to climate change and to have important feedbacks on the atmosphere and climate.

Description File

None.

Division

X042: Environmental Sciences Division

Start Date

9/8/2009

End Date

None.

Authorization Period

One Year

Account

None.

General Notes

Nearly all field work for this RSS will be performed at the Marcell Experiment Station in Minnesota managed by the United States Forest Service (USFS). RSS participants will read and understand Job Hazards Analyses (JHAs) required by the USFS to work at the site as part of the work control package. Nearly all Forest Service JHAs associated with this RSS have been annotated by ORNL Subject Matter Experts (SMEs). The annotations have been made in order to document (1) certain Forest Service requirements that have been waived or (2) where some requirements for the ORNL participants have been clarified or established within this RSS instead.

- [Field Work- Part 1 \(USFS JHA annotated by ORNL\)](#)
- [Field Work- Part 2 \(USFS JHA annotated by ORNL\)](#)
- [Personal Safety \(USFS JHA annotated by ORNL\)](#)
- [Weather \(USFS JHA annotated by ORNL\)](#)
- [Dehydration \(USFS JHA annotated by ORNL\)](#)
- [Soil Sampling \(USFS JHA annotated by ORNL\)](#)
- [Insects \(USFS JHA annotated by ORNL\)](#)
- [Ticks \(USFS JHA annotated by ORNL\)](#)
- [Plants & Animals \(USFS JHA annotated by ORNL\)](#)
- [Ladder Use \(USFS JHA annotated by ORNL\)](#)

Relevant JHAs can also be found under the Additional Reading section of the [Site Access Tab](#) [login required] on the [SPRUCE website](#). The link includes project Required Reading and site access scheduling information which *must* be completed prior to each field campaign. **Note: The Site Access Tab will require some time to update so a TFI was entered (TFI No. 5710) to track the update and ensure it is completed.**

Due to the remote nature of the work, First-Aid, CPR/AED, and Bloodborne Pathogen Training is suggested for all project participants. ESD Line Management encourages ORNL/UT-B Staff members to keep this training active and in their list of training certifications.

Pre-trip meeting

It is BESSD policy for a brief discussion with participants, line management, and members of the Ops team prior to field travel. Details and expectations of these discussion can be found at: https://edrm.ornl.gov/federaldox/#/irl/0902f41f80282622?dataSourceId=ORNL_PRD&versionLabel=CURRENT

Pre-Job briefing

A daily pre-job safety briefing is highly recommended to discuss the goals, tasks, and associated hazards for the day's activities.

A pre-job briefing work aid has been developed for BSD/ESD field activities. While the use of the work aid is not mandatory, it is highly encouraged. Project task leaders may use the following job aid in performing the pre-job brief:

https://ornl.sharepoint.com/sites/eesd/ops_west/RSSDocuments/LinkedPDFs/BESD_START_Job_Safety_Briefing_Card_Rev_0.pdf It is intended to help field teams recognize and identify known or potential hazards posed by their field activities and the mitigating actions required to address the hazards. Situational awareness is emphasized and encouraged. Contact your [Division Safety Officer \(DSO\)](#) for assistance in using this work aid, as needed.

Work at the University of Minnesota: There will be periodic gas exchange work in reach-in growth chambers in Green Hall and in the Plant Growth Facilities Buildings at the University of Minnesota - St. Paul campus. There are minimal hazards associated with this work - hazards include potential excess noise from the growth chambers and use of electric extension cords to power the equipment. Participants working in these non-ORNL labs Work will follow requirements by the onsite laboratory manager, who has provided GFCI outlets for extension cords and ear plugs if desired. Liquid N may also be used and appropriate PPE is available and required. Participants will be proactive to identify other potential hazards and seek guidance from facility staff when needed, and will apply ORNL safety culture rigor if a situation arises that requires it.

General Attachments

[RSS 7728 QEA FINAL 2023.pdf](#)

Point of Contact

Mehlhorn, Tonia (33447)

Authorizer

Pierce, Eric (976676)

Principal Investigator

Hanson, Paul (29602);

PI Delegates

None.

Approvers

Hanson, Paul (29602) - * * PI & Approver;

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(924329); Latimer, John M (3028384); Lowe, Kenneth (34120); Mayes, Melanie (742503); McLennan, Mac (3045874); Neild, Alex (3107291); Norby, Richard (27150); Oleheiser, Keith (3021249); Pearson, Kyle (3071748); Pelletier, Dale (901831); Ruggles, Tom (3086694); Salmon, Verity (3047122); Salvador, Christian (3092622); Schadt, Christopher Warren (902616); Schwaner, Geoff (3068124); Stelling, Jonathan (3108116); Warren, Jeffrey (944146); Weber, Soren (3098798); Weston, David (924106);

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Childs, Steve Evans (34637) - * * * WSR review; Hite, Anthony (3066219) - * * * POC this Version; Pearsall, Bret (3100224) - * QHSP/Laser Safety Officer; Pearson, Kyle (3071748) - * * SPRUCE Site Manager; Walker, Anthony (971699) - * * GL;

Optional Reviewers

Barth, Gerald (712580) - * * * DESO; Childs, Joanne (742253) - * * Lab Space Manager; Cline, Steve (35073) - * * * BESSD COO; Fortner, Allison (902989) - * Participant; Griffiths, Natalie (976981) - * Participant; Gu, Lianhong (901192) - * Participant; Hanson, Paul (29602) - * * * Optional PI & Approver; Iversen, Colleen (905477) - * * * Participant; Krassovski, Misha B (924329) - * * * Participant; Lovelace, Meghan (3097842) - * Quality Review; Lowe, Kenneth (34120) - * * * Participant; McLennan, Mac (3045874) - * * * Participant; Mehlhorn, Tonia (33447) - * * * ESH&Q Coordinator/POC this version; Oleheiser, Keith (3021249) - * Participant; Raby, Keith (616799) - * Transportation Review; Salmon, Verity (3047122) - * Participant; Schadt, Christopher Warren (902616) - * Participant; Schwaner, Geoff (3068124) - * Participant; Thornton, Peter E (939680) - * * Optional SH Reviewer; Warren, Jeffrey (944146) - * * * Participant; Weber, Soren (3098798) - * Participant; Wentzel, Taylor (3100103) - * Pressure System SME; Weston, David (924106) - * * * Participant;

Lab Space Managers

None.

Locations

▲ [Building 102GRAND, Room 01](#) - SPRUCE Project Office (with a small, low hazard lab area); [Field Work](#) - Work in Black Spruce - Sphagnum Bog; [Off-Site Work](#) - S-1 Bog

Nepa Documentation

NEPA Document Number 3627X. Following the preparation and review of an Environmental Assessment on the SPRUCE project, a Finding of No Significant Impact was found and approval to construct the system/experiment was granted.

All the planned lab work here at ORNL falls under the overall umbrella of Categorical Exclusions (CXs) for research and development activities per Division EPO/ECR. This Categorical Exclusion (CX) is currently available online at the NEPA Homepage: [Indoor Small- and Pilot-Scale Research and Development 3767X](#).

The site sampling & data collection activities in the field work currently covered by this RSS falls under the overall umbrella of Categorical Exclusions (CXs) for research and development activities per Division EPO/ECR. This Categorical Exclusion (CX) is currently available online at the NEPA Homepage: [Outdoor, Small- and Pilot-Scale Research and Development 3768X](#)

Consult EPO/ECR or POC if you feel any planned activities might fall outside of the scope of this CX.

Hazards

First

This operation requires specific programmatic controls to protect information (Classified Subject Areas, Export Control, Intellectual Property, or CRADAs).

Requirements:

[Agreements for Commercializing Technology \(ACT\) Projects](#)
[Cooperative Research and Development Agreements \(CRADAs\)](#)
[Export Control Compliance](#)
[Information Protection](#)
[Proprietary Information](#)

Hazard Notes:

Activities performed under this RSS may involve intellectual property. A very large amount of data is generated by this project.

Control Notes:

Participants must be aware of what constitutes intellectual property (IP) and how to handle it according to ORNL SBMS IP requirements, <https://sbms.ornl.gov/sbms/sbmsearch/SubjArea/Info/InfoSA.cfm>.

IP questions/concerns should be directed to the PI of this RSS.

Data management plans may be found on the project's website: <https://mnspruce.ornl.gov/>.

Locations:

All Locations

Attachments:

None.

3.1

This operation involves any of the following [NIR](#) sources:

- permanently installed [microwave/radio-frequency](#) gear (including induction heaters and communications transmitters) 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
- 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)
- static magnetic fields which may exceed 0.5mT (5 gauss)
- sub-radiofrequency (30 kHz and below) magnetic fields exceeding 0.1 mT (1 gauss) or electromagnetic fields exceeding 1842 V/m.
- any equipment that would expose personnel to high levels of Visible Light (400 nm – 770 nm) at >1 candela/cm²; to high levels (>30 J/m²) of Near Infrared (770nm-3000nm) at >10mW/cm²; and/or high levels of Ultraviolet (UV) radiation (180nm-400nm)
- any infrared heat lamp or any near-infrared source where a strong visual stimulus is absent (luminance of less than E-06 candela/cm²)

Requirements:

[Conduct Exposure Assessments](#)
[Work with Nonionizing Radiation](#)

Hazard Notes:

[[New Question October 2023](#)]

The LI-COR 6800 has infrared sources

Control Notes:

[[New Question October 2023](#)]

These sources are contained within the gas analyzers and do not present an exposure hazard to users when used according to manufacturer's recommendations.

Locations:

All Locations

Attachments:

None.

4.3

This operation involves a [class 1](#) laser system with embedded [Class 3b](#) or [4 Lasers](#).

Requirements:

[Lasers](#)

Hazard Notes:

The LI-COR 7700, LGR-ICOS and NanoScan analyzers are class 1 laser systems with an embedded 3B laser.

Control Notes:**Normal Operations:**

Under normal operation laser beams are enclosed, with no emission of laser radiation above the MPE specified by ANSI Z136.1-2014. Beam enclosures are either interlocked or require tools for removal, and have appropriate warning labels. Participants shall not remove enclosures or operate in "open beam mode" without contacting the [Division Laser Safety Officer \(DLSO\)](#) for approval.

Repair and Maintenance:

Repair and maintenance, including inspection and verification of the safety features, will be executed and documented by vendor-trained and authorized service personnel ONLY.

Any service or repair requiring removal of beam enclosures by research staff or service vendors/subcontractors (i.e. gross re-alignment or servicing of the embedded lasers) will not be done before the [DLSO](#) establishes a temporary laser control area and authorizes properly trained and PPE equipped personnel to proceed.

Any significant reconfiguration of an existing setup requires authorization by [DLSO](#) before use.

Locations:

All Locations

Attachments:

[LGR-ICOS analyzer.pdf](#)
[LI-COR 7700 manual.pdf](#)
[Model_3910_NanoScan.pdf](#)

5.4

This operation involves exposure to one or more of the following electrical hazard sources:

- Direct current (DC) sources;
- Batteries, other than household batteries;
- Capacitors;
- Unguarded inductive systems that pose a hazard.

Requirements:

[Electrical Safety](#)

Hazard Notes:

Battery charging will be conducted within the field, at the SPRUCE office in Grand Rapids, and at the bog site workshop.

Control Notes:

Several types of batteries and battery packs (i.e. sealed LI-COR batteries, mini-rhizotron batteries, etc.) will be charged in designated areas. Batteries will not be charged when frozen, as this increases the likelihood of fracturing the battery casing. Batteries that have visible signs of damage will not be connected to the charger and will be taken out of service for proper disposal. Manufacturer's instructions for charging/safety will be followed. **Battery chargers must be NRTL listed and only charged on non-combustible surfaces.**

Note: PPE and other requirements for charging deep cycle batteries are posted at the charging station and can also be found within the following work-aid: https://edrm.ornl.gov/federaldox/#/irl/0902f41f8046d1dc?dataSourceId=ORNL_PRD&versionLabel=CURRENT

Minimum electrical safety training and qualification for persons working on or near unguarded electrical connections to batteries (>1000 watts short circuit available power) requires Electrical Worker (<50 Volts), Direct Current and Batteries. This includes connecting and disconnecting to/from a battery charger. Avoid short-circuiting the battery. Inspect the battery and associated cables/connections prior to servicing or handling the battery. Remove any conductive jewelry or other conductive articles that may come in contact with the battery posts, or exposed connections/conductors.

If question arise please contact the [Division Electrical Safety Officer \(DESO\)](#).

See also Q15.1 for shipping requirements for certain battery types.

Locations:

All Locations

Attachments:

None.

5.5

This operation involves the operation of breakers, disconnects, starters or similar electrical equipment up to 600 volts with doors or covers on.

Requirements:

[Electrical Safety](#)

Hazard Notes:

Electrical breakers and/or disconnects may need to be actuated at the SPRUCE site by participants of this RSS. These breaker operations are only performed as needed for convenience and not to perform maintenance tasks via L/T/V .

Control Notes:

Those participants operating breakers or disconnects must complete the ORNL LRN Breaker & Disconnect Training. Participants shall only operate breakers or disconnects with the doors/covers in place and shall not exceed the voltages outlined within their level of training. **Breaker & Disconnect Training alone does not allow participants to perform L/T/V activities. L/T/V activities may only be performed by the properly trained/qualified individuals who are participants of RSS 11438 or F&O staff working under their own F&O work controls.**

NOTE: Contact the SPRUCE site manager if you have been properly trained to operate breakers or disconnects at the site, but still have questions or concerns (such as identifying systems that may require a higher level of training to operate).

Locations:

All Locations

Attachments:

None.

5.6

This operation involves the potential for electrical shock or the release of other hazardous energy (consider mechanical as well as sources such as pneumatic, hydraulic, thermal, chemical, and pressurized fluids) other than as described elsewhere in this RSS.

Requirements:

[Electrical Safety](#)
[Lock/Tag/Verify](#)
[Occupational Hazard Controls](#)

Hazard Notes:

Static Discharges (Hazard Note): Walking on the decking (glass-reinforced Copolymer polypropylene, manufactured by TRUE DECK) of the boardwalk often results in static buildup. Participants are experiencing static discharge/shock when touching metallic objects.

Temporary Power Cords (Hazard Notes): Flexible power cords (i.e. equipment cords and extension cords) will be used at the site.

Generators may be used

Control Notes:

Static Discharges (Control Notes): Participants are typically familiar with the feeling from static shocks after contact with door knobs, exiting cars, etc. The sensation from a static shock is a "burst" of energy that can be mildly painful, but the feeling dissipates almost instantly. In contrast, a shock from an alternating current (AC) source is identified as an unpleasant tingling or very fast pulsating sensation that persists as long as the person remains in contact with the energized part or until the AC source is turned off.

Participants are to use their own discretion to determine if a received shock is an **expected** static displacement, or **unexpected** contact with energized equipment. Should participants feel that they have contacted **unexpected** electrical energy, they shall stop work, inform others in the work area of the potential hazard, and immediately report the concern to the SPRUCE Principle Investigator, Ops support staff, or the ORNL LSS in order for verification and any follow-up actions or reporting to occur.

Temporary Power Cords (Control Notes): Flexible cords must be used in accordance with applicable requirements. Refer to: [SBMS Exhibit on Corded Equipment](#)

Flexible cords and cables shall be approved for conditions and locations of use (e.g. outdoors, in potentially wet or damp locations, etc.). Although some cords are listed for wet locations, their design does not permit a watertight plug connection. Extension cords and/or power strips will not be daisy-chained; permanent wiring should be installed instead. Flexible cords may be used only in continuous lengths without splice.

Flexible cords must be of sufficient gauge in the American Wire Gauge (AWG) diameter, and be designed to support the amperage and voltage of the equipment being connected.

Ensure that flexible cords and cables are adequately protected if run through doorways, windows, or other pinch points. This can be achieved by using wood blocks to prevent windows or doors closing, schedule 80 UV-resistant PVC to run extension cords through, or protective ramps with cord compartments.

Site Generator Usage:

Electrical cords plugged into portable generators must have a ground plug, be protected from rain and water intrusion, and have ground-fault circuit interrupter (GFCI) protection (many generators have built-in GFCI protection).

Portable generators must be listed by a Nationally Recognized Testing Lab (NRTL) and used in accordance with the manufacturer's instructions. DO NOT OPERATE generator while it is mounted or located on another piece of equipment (e.g., truck or trailer bed.). Generators must be turned off during fueling.

Locations:

All Locations

Attachments:

None.

7.1

This operation involves work conducted under the [OSHA Laboratory Standard](#).

Requirements:

[Chemical Safety](#)

Hazard Notes:

Work in ORNL Spaces: Some activities occur in laboratories to prepare and process samples before and after field-deployment. At the present time, all of the associated lab activities present no or very low hazards to the participants.

Work at the University of Minnesota: There will be periodic gas exchange work in reach-in growth chambers in Green Hall and in the Plant Growth Facilities Buildings at the University of Minnesota - St. Paul campus. There are minimal hazards associated with this work - hazards include potential excess noise from the growth chambers and use of electric extension cords to power the equipment.

Control Notes:

Work in ORNL Spaces: Work in the auxiliary spaces of at SPRUCE field site and at 102GRAND present no or very low hazards to the participants. Lab activities for some onsite ORNL labs that present more significant ESH hazards are covered by other authorized RSSs such as [RSS 4788](#) and [RSS 2524](#). All staff/guests performing activities covered by such "associated" RSSs must also be a listed participant of and adhere to the requirements of them.

Work at the University of Minnesota: Participants working in these non-ORNL managed lab spaces will follow requirements by the onsite laboratory manager, who has provided GFCI outlets for extension cords and ear plugs if desired. Liquid N may also be used and appropriate PPE is available and required. Participants will be proactive to identify other potential hazards and seek guidance from facility staff when needed, and will apply ORNL safety culture rigor if a situation arises that requires it.

Locations:

Building 102GRAND, Room 01
Off-Site Work

Attachments:

None.

7.2

This operation involves work conducted under the [OSHA Hazard Communication Program \(HAZCOM\)](#).

Requirements:

[Chemical Safety](#)

Hazard Notes:

Some chemicals (e.g. isopropyl alcohol, acetone, ethanol, drierite, magnesium perchlorate) shall be transported to and used within the field location, in non-laboratory settings.

Control Notes:

All participants working with chemicals in the field must be ORNL HAZCOM trained and be familiar with the materials (i.e., have access to and be aware of the product Safety Data Sheets (SDS's)).

To meet HAZCOM labeling requirements, secondary chemical containers (not used/stored in "labs") must be labeled with the identity of the hazardous chemical(s) and appropriate hazard warnings (via words or symbols) which provide at least general information regarding the physical and health hazards. This labeling requirement applies unless: the hazardous chemical(s) is only used by the person transferring the chemical from the primary container; the person that performed the transfer has constant control of the container; AND, the chemical is completely used within the work shift.

Safety glasses with side shields and nitrile gloves will be used when handling and working with these chemicals.

In-line scrubbers containing magnesium perchlorate are used in the Li-Cor instrument. These scrubbers are purchased pre-packaged and require no direct contact with the chemical by the participant.

Locations:

All Locations

Attachments:

None.

7.3

This operation involves any chemicals or wastes that present health hazards ([carcinogens](#), [reproductive hazards](#), [toxics](#), or [toxics with potential for skin absorption](#)).

Requirements:

[Chemical Safety](#)
[Conduct Exposure Assessments](#)
[Personal Protective Equipment](#)
[Radiological Monitoring of Individuals and Areas](#)

Hazard Notes:

Indicating Drierite [Carcinogen] is used.

Control Notes:

Ensure PPE and controls established in Question 7.2 are followed unless otherwise noted. Working concentrations will be kept as low as possible and handling times will be minimized.

This is the only the known carcinogen in use at this time. If others are to be added, each must first be evaluated against the controls/envelope of this RSS to determine if an RSS revision is needed.

Locations:

All Locations

Attachments:

None.

7.7

This operation involves any chemicals or waste that are [flammable liquids](#), [flammable gases](#), [flammable solids](#), [combustible liquids](#), [combustible metals](#), or [combustible dusts](#).

Requirements:

[Chemical Safety](#)
[Compressed Gas Cylinders and Related Systems](#)
[Fire Protection, Prevention & Control](#)
[Personal Protective Equipment](#)

Hazard Notes:

Small amounts of isopropyl alcohol, acetone and ethanol will be transported to and used and for cleaning sampling tubing and instrumentation.

Approximately 100 mLs of isopropyl alcohol is used in the NanoScan instrument and is replenished weekly.

Gasoline will be transported to, stored and used in the field for various uses (i.e. gas powered generator, ATV, etc.)

Propane air heating units are in use to warm the air inside the chambers. These propane heating units are supplied from a large propane tank located near the service road maintained behind a locked, fenced in area. From there, propane is delivered into the individual heating units of the chambers. The heating units themselves are located outside of the chamber and are ducted into the chamber to warm the ambient air.

Control Notes:**General Controls for Flammable & Combustible Liquid Storage:**

Small amounts of flammable and combustible liquid storage (including waste) outside of approved storage devices is permitted in each offsite area that has been properly prepared for this type of work such as 102GRAND and the S-1 site trailer (i.e., up to 4 liters in general area/benchtops can be stored outside of a cabinet or refrigeration unit approved for such flammable/combustible liquid storage). More information and requirements for combustible and flammable storage and handling can be found in SBMS at: <https://sbms.ornl.gov/sbms/SBMSearch/SubjArea/chemsafe/ExhibitFlamCOmbust.cfm>

Control for flammable liquid handling: Safety glasses with side shields shall be worn when fueling equipment from portable containers. In addition, nitrile gloves will be worn when working with acetone, ethanol, etc. Refer to Question 15.1 regarding transportation issues for these items.

Gasoline specific controls:

Gasoline is stored and transported in containers approved for the purpose. Ignition sources are kept at a safe distance (recommend 25 feet) from storage containers and equipment during refueling.

Approved METAL or PLASTIC safety cans may be used for the handling and use of flammable liquids in quantities up to 5 gallons. Safety cans must meet the following conditions:

- Be not more than 5 gallons in capacity.
- Be listed by a national testing lab such as UL, Factory Mutual, etc.
- Have a spring closing lid which closes after filling or pouring.
- Be leak tight.
- Have a flame arrestor screen.
- Have a safety valve to relieve internal pressure.

Controls Related to the Propane Distribution System:

No smoking will be permitted near the propane tank or experimental chambers/enclosures, and the area is posted to reflect this requirement.

See Section 11.1 for details on reporting and responding to potential propane leaks.

Note: Maintenance of the propane and/or heating system will be handled by appropriate ORNL personnel (i.e. the SPRUCE site manager), subcontractors, or the gas company/provider. Project staff will only be involved in setting and monitoring temperature control points.

Locations:

All Locations

Attachments:

None.

8.2

This operation generates [hazardous waste](#).

Requirements:

[Environmental Management](#)
[Manage Waste and Excess Materials](#)

Hazard Notes:

Used magnesium perchlorate from the LiCor will be managed as a hazardous waste (oxidizer).

Control Notes:

Under the memorandum of understanding (MOU) with the USFS, all wastes generated at the field site or office location (102GRAND) will be managed by the USFS along with their hazardous waste products. [USFS is contacted once the material is generated. It is then walked over to the USFS for management and ultimate disposal by USFS.](#)

Locations:

All Locations

Attachments:

None.

8.7

This operation generates [recyclable material](#) (used oil, scrap metal, universal waste, photographic waste).

Requirements:

[Environmental Management](#)
[Manage Waste and Excess Materials](#)
[Prevent Pollution](#)

Hazard Notes:

[\[New Question in October 2023\]](#)

Carbon dioxide cartridges from LI-COR 6800 can be disposed as scrap metal once the cartridge has been punctured and the contents used (i.e., emptied).

Control Notes:

[\[New Question in October 2023\]](#)

Used carbon dioxide cartridges can be disposed as solid waste or scrap metal. The LI-COR 6800 punctures the top of the cartridge which allows it to equalize with atmospheric pressure once it is removed from the equipment.

Locations:

All Locations

Attachments:

None.

8.11

This operation involves the use of quarantined soils, plants, or pests.

Requirements:

[Environmental Management](#)
[Move Soils, Plants or Plant Products, or Other Contaminated Equipment](#)

Hazard Notes:

This question has been marked to raise awareness that USDA or State quarantine restrictions change with time.

Evaluation of local restrictions on the transportation of soils and plant materials to-and-from the research locations must be periodically evaluated.

Note: Precautions should be taken to avoid cross-contamination of "clean" soils with other quarantined soils.

Processing of potentially quarantined plant or soils materials are covered under the authorized versions of [RSS 4788](#) and/or [RSS 2524](#).

Control Notes:

Marcell Experiment Station Soils: The research site north of Grand Rapids, MN. Per Austin Steere of the Itasca County, MN Soil and Water Conservation District, as of 9/17/2021, Itasca County is under no pest quarantines for soils or leaf litter. We may bring back soils and leaf litter, and ultimately dispose of them, with no restrictions.

NOTE: Several NE Midwest states are under quarantine for pine shoot beetles. Contact EPO if project plans to transport pine bark or pine logs containing bark.

Locations:

Field Work
Off-Site Work

Attachments:

None.

8.12

This operation generates excavated soils.

Requirements:

[Environmental Management](#)
[Excavation/Penetration](#)
[Manage Radiological Aspects of Excavated Soil](#)

Hazard Notes:

Manual soil coring/sampling will be performed on this project. Some of these cores into deep peat may be over 1 meter deep.

Equipment and/or utilities within the experimental areas where ORNL research sampling will take place have been installed either by the research staff, or by the direction of the research staff. Therefore, research staff have process knowledge of the underground equipment and utilities at the site.

Ground penetrations will also be made by research staff for the installation of various equipment/materials (i.e. probes, tubes, etc.).

Control Notes:

All of the soil coring/sampling to be performed will be performed off-site. As a result, ORNL's excavation/penetration requirements are not applicable.

It is the responsibility of the PI and RSS participants to ensure that any requirements of the USDA Forest Service facilities be met before any such sampling is performed in order to avoid buried utilities, etc. If ground penetrations are to be made outside of the bog footprint where project knowledge cannot be applied, a Minnesota state required One-Call shall be made (1-800-252-1166) prior to conducting the work.

Locations:

Field Work
Off-Site Work

Attachments:

None.

9.2

This operation involves exposure to moving or rotating parts, such as motors, shafts, pulleys, belts, or any other potential mechanical energy.

Requirements:

[Occupational Hazard Controls](#)

Hazard Notes:

ATUV Use: An all terrain utility vehicle (ATUV) will be used to access certain areas of the site and transport materials.

Tools: Some hand and portable power tools (e.g. drills, bow saws, etc.) may be used during work activities. There is often a need for power tools to be used in non-standard applications for research purposes (e.g. taking large diameter peat cores with extended hole saws and cordless drills).

Automatic soil chambers can present pinch points.

Control Notes:

ATUV Use: Workers riding in government vehicles (trucks and the ATUV) will use seat belts and obey all traffic rules.

A work-aid has been established to allow RSS participants to also use an ESD owned ATUV under this RSS. All required PPE, administrative controls and training documentation needed for this activity are embedded in [the work-aid](#)
at: https://edrm.ornl.gov/federaldox/#/irl/0902f41f8061169d?dataSourceId=ORNL_PRD&versionLabel=CURRENT

Tools: When using hand and portable power tools, users shall ensure that they have donned the proper PPE for the device being used and the task being performed (e.g. safety glasses with side shields where flying particles/debris are being generated or have to potential to be generated). Note: If there is a potential for injury to the face a face shield shall be used in combination with safety glasses.

Workers hands shall not contact any moving or rotating part of the equipment (such as when using a drill, saw, etc.). A safe working distance for the rest of the body shall be maintained from the moving or rotating parts of the equipment to prevent loose fitting clothing from contacting and being drawn into the moving parts. Operations staff should be consulted if uncertainty exists about proper use of any power tools or activities involving them.

ORNL Power Tool Safety Training is **required** for participants using power tools (e.g. cordless drill with hole saw bit) on this RSS. Contact your DTO if you do not possess this training certification.

Be aware that the soil chambers automatically open and close frequently and keep fingers and hands away from operations during set-up/testing and when working in areas where they are deployed.

Locations:

Field Work
Off-Site Work

Attachments:

None.

9.3

This operation involves handling sharp objects that could result in cuts, abrasions, or punctures to the hands and/or arms.

Requirements:

[Personal Protective Equipment](#)

Hazard Notes:

Sharps (Hazard Notes): Syringes with needles will be used to extract water samples from the bog.

Cutting Tools (Hazard Notes): Cutting tools will be used within the field for general use purposes and in association with the PMS instrument.

Control Notes:

Sharps (Control Notes): Needles shall not be directly recapped using two-handed operations. Instead use safer alternative methods (i.e. foam block technique, etc.) to avoid the potential for puncture/ needle sticks. Ensure all needles are recapped prior to walking around on the bog walkways. All sharps will be disposed of in appropriate sharps containers.

Cutting Tools (Control Notes): When using cutting tools with open blades participants must use these tools in a manner that keeps the cutting blade moving in a direction away from fingers, hands, and the body during cuts. A user should not walk with or transport a cutting tool, that is not being actively used, unless the blade is concealed (cut resistant container or blade cover, etc.). Use of ORNL approved "safer" cutting tools (as found within the hyperlink below) are strongly recommended.

Cut resistant gloves should be considered for all activities where cutting tools of any type are used.

For detailed information on cutting tool ratings see, <http://safetyfirst.ornl.gov/cpp/tools.cfm>

For detailed information on cut resistant gloves see, <http://safetyfirst.ornl.gov/cpp/gloves.cfm>

Razor blades, scalpels and other fixed blade or manually retractable blade knives will be disposed of in an approved sharps container. Extreme caution must be employed when changing blades on fixed or manually retractable blade knives.

Locations:

All Locations

Attachments:

None.

11.1

This operation involves the use of a High-Energy [Pressure System\(s\)](#).

Requirements:

[Compressed Gas Cylinders and Related Systems](#)
[Engineering Design](#)
[Pressure System Safety](#)

Hazard Notes:

The propane & CO2 distribution piping and components at SPRUCE field site is considered a "High Energy System" per definitions in the Pressure System Safety Subject Area.

- The propane tank/system supplies propane to the air heating units to warm the air inside the chambers.
- The Large (60 ton) CO2 tanks are used to add pure CO2 into the experimental chambers

System leaks or malfunctions may occur with both distribution systems.

Finally, an additional potential hazard has been identified during CO2 induction operations, where under the certain environmental conditions (i.e. periods of little to no wind/air movement or exchange), there is a possibility for CO2 levels within the enclosures to elevate and potentially reach an unsafe level.

Control Notes:

Details of these Pressure Systems are being collected and maintained [at the following locations](#): <https://webapps.ornl.gov/ServiceRequest/PressureSystemsList.aspx?WCD=7728&category=High-Energy>.

The overall configuration and maintenance of the overall system is the responsibility of the Site Manager Kyle Pearson.

The only requirement/expectation of other project participants is to report potential leaks and/or system abnormalities as discussed below:

Propane Leak Detection and Emergency Response:

Most importantly if participants suspect a leak from the tanks or the piping system supplying the heating units (such as the smell of propane, a hissing sound, etc.) everyone is to immediately evacuate the area, notify the site manager, or the gas company/supplier (if the site manager is unavailable).

Please note that it is not uncommon to detect the odor of propane, or more accurately the odorant added to the propane (which is almost always ethyl mercaptan) when standing close to the make-up air units (MAU). If there is a unit that is not burning efficiently the smell of propane will be detected and the localized odor should be expected. Propane can also be detected in various areas around the site, depending on wind direction, after or during product delivery/tank refilling. In such instances, this will not be a constant odor but rather intermittent as it dissipates into the ambient environment.

If someone detects a consistent odor significant enough to raise a concern, that person must report that to the site manager or the gas company/supplier. An example would be a persistent propane smell that does not seem to be dissipating as normal. This could indicate a failure in the system or issues with the delivery process (i.e. ruptured valves, joints, pipes, blocked or inoperable vaporizers, failed gas valves in the MAUs, etc.).

If this type of situation arises it may be necessary for the site manager, or participants that have been given site specific training by the site manager, to isolate or stop propane gas flow. This will involve closing the proper valve(s) to stop the gas flow to a particular enclosure, an entire dock section, or the entire site (depending upon the situation). If a valve is closed to stop gas flow, an administrative hold tag shall be filled out and placed on that valve to inform others of the purpose of the shut down and to avoid inadvertent reactivation of the system. These tags will be kept in the emergency "go box" kept within the jobsite trailer. Again, the actuation of any valve must immediately be reported to the site manager or the gas company/supplier.

Click [HERE](#) to see photos of the propane shut off locations.

NOTE: During maintenance or repair of the system, the trained site manager and gas company/supplier will use formal lock/tag/verify (L/T/V) procedures. The administrative control tag discussed above is only a temporary measure to be used by participants that actuate a valve during an actual emergency shut down.

CO2 Leak Detection and Emergency Response:

Those present at the site shall leave the area immediately should a known, unexpected release of CO2 from the large tank occur.

Similar to the propane discussion earlier, it may be necessary for the site manager, or participants that have been given site specific training by the site manager to isolate or stop CO2 flow. This will involve closing the proper valve(s) to a particular enclosure, an entire dock section, or the entire site (depending upon the situation). If a valve is closed to stop gas flow, an administrative hold tag shall be filled out and placed on that valve to inform others of the purpose of the shut down and to avoid inadvertent reactivation of the system. These tags will be kept in the emergency "go box" kept within the jobsite trailer. Again, the actuation of any valve must immediately be reported to the site manager or the gas company/supplier.

Click [HERE](#) to see photos of the CO2 shut off locations.

NOTE: Be advised that should the SPRUCE site lose power, pressure could build up within the CO2 tanks resulting in the pressure relief valves operating. This may produce a loud sound and result in a rapid discharge of CO2. Participants should remain away from the tanks should the site lose power.

A monitoring system is in place that measures the amount of CO2 present within each enclosure (this monitoring system is part of the scientific measurements but in this instance will also serve as a safety monitoring system). The system can monitor CO2 levels no higher than 2,000ppm, therefore the set point for alarm activation will be 1,990ppm.

During a CO2 Alarm event, the solenoid valve will close stopping flow of CO2 to the chamber. Alarm files have been written in the data and a flashing indicator beacon on the CO2 panel will activate. The Real Time Monitor and Control (RTMC) system will send out emails to make the operators aware of the problem or problems. System operators are select F&O I&C personnel and SPRUCE site manager(s). *NOTE: The data logger system does not look for CO2 alarms during the winter months when the CO2 treatments are turned off.*

There are 4 factors that will cause the CO2 shut off alarm to activate:

- High CO₂ Concentration - 6 minute running average measured inside the chamber is >1990 ppm
- Low sample flow through CO₂ analyzer - 30 second running average of <0.5 lpm
- Loss of Supply Air flow from one or more of the MAU's
- Failed communication between DAC and CO₂ dataloggers - 3 failed attempts

Should the CO2 alarm system activate, an audible alarm and flashing **RED** beacon (installed next to each individual enclosure at the site) will activate, and everyone within the enclosure shall immediately evacuate into open air and no one shall re-enter the enclosure until the alarm condition is cleared. The appropriate directions/information are posted at each beacon **INSIDE** and **OUTSIDE** of the enclosures.

In the case of a CO2 alarm, the operator is required to manually reset the system by pressing the reset button. If there is a power outage, the solenoid shuts automatically but no CO2 alarm is activated. The operator will be notified of the power outage via RTMC.

A preventative maintenance schedule has been developed to periodically (monthly) test/challenge the alarm system and associated controls. *NOTE: The PM schedule will only be called during the months when the CO2 treatment is being done.*

Locations:

Field Work
Off-Site Work

Attachments:

None.

11.2

This operation involves the use of a Moderate-Energy [Pressure System\(s\)](#).

Requirements:

[Compressed Gas Cylinders and Related Systems](#)
[Engineering Design](#)
[Pressure System Safety](#)

Hazard Notes:

Other potential gas cylinder pressure systems used to calibrate a variety of sensors and monitoring points within the SPRUCE infrastructure are considered as "moderate energy" pressure systems.

Control Notes:

A Pressure System Hazard Analysis has been conducted for these calibration set ups. The analysis is documented in the BESSD Pressure System database and the details can be accessed at:

102 Grand Location: <https://webapps.ornl.gov/ServiceRequest/PressureSystemsList.aspx?WCD=7728&category=Moderate-Energy> (System ID PSX-0000508)

S1B0GT Trailer Location: <https://webapps.ornl.gov/ServiceRequest/PressureSystemsList.aspx?WCD=7728&category=Moderate-Energy> (System ID PSX-0000509)

If modifications to any pressure systems are needed, please contact a member of the EESD Operations Support team to ensure that the current hazard analysis is valid.

Locations:

Building 102GRAND, Room 01
Off-Site Work

Attachments:

None.

11.3

This operation involves other processes that might create a pressure hazard not categorized or considered as part of a High or Moderate-Energy system(s).

Requirements:

[Compressed Gas Cylinders and Related Systems](#)
[Engineering Design](#)
[Pressure System Safety](#)

Hazard Notes:

Portable Pressure Chambers will be used to conduct plant moisture stress (PMS) measurements. PMS Instrument, Inc. Model 600D (40 bar), Model 610 (40 bar), Model 615 (40 bar), Model 615D (40 bar), and a Cavitation Chamber Instrument (the 100 bar configuration) will be used. These instruments are categorized as 'exempt' pressure systems but still has hazards/requirements for their proper use/handling. They are pressurized/operated by filling a portable tank with a nurse tank (standard size cylinder).

[A LI-COR 6800 Portable Photosynthesis Unit will be used in the field.](#)

Control Notes:**Portable Pressure Chamber controls:**

All participants using these instruments must be familiar with their use and follow manufacturer guidelines and operating instructions which can all be found at <http://pmsinstrument.com/>.

Pressure chamber safety instructions can be found at <https://www.pmsinstrument.com/maintenance/safety/>

NO tanks or test chambers will ever be pressurized during transport to the field without ORNL Transportation & Packaging Management Organization (TMO) review & approval.

All field portable tanks will be receipt inspected and hydrostatic acceptance tested within the last 5 years.

All cylinders not internal to the instruments, will be stored and used valve end up, with cylinders secured to prevent instability.

Portable tanks (secondary chemical containers) must be properly labeled with identity of the hazardous chemical(s) and appropriate hazard warnings to meet Hazcom requirements UNLESS the following conditions exist:

- The contents will be used by only one person who has constant control over the container, and
- The person transfers the hazardous chemical from a labeled container; and the transferred gas will be immediately used (i.e. during the work shift) by the person performing the transfer.

The PMS test units are self-contained portable pressure systems operated and maintained in accordance with manufacturer's instructions.

Only participants that have been trained by the equipment custodian or designee are authorized to fill the small, portable gas tanks using the transfill procedure available at: https://edrm.ornl.gov/federaldox/#/iri/0902f41f803c7db4?dataSourceId=ORNL_PRD&versionLabel=CURRENT.

The authorized users list is located at: https://ornl.sharepoint.com/sites/eesd/ops_west/lab-equipment-training/Lists/UserData/N2Transfill.aspx

The documentation for exempting the PMS units from Pressure System Safety Subject area requirements can be found in the [Pressure System Database](#) at: <https://webapps.ornl.gov/ServiceRequest/PressureSystemsList.aspx?WCD=7728&category=Exempt> Please contact a member of the Ops Support team if modifications are needed to these systems.

The LI-COR 6800 is a commercially available, consumer product that must be used per manufacturer's instructions.

Locations:

Field Work
Off-Site Work

Attachments:

None.

11.5

This operation involves hazards associated with the physical handling or storage of compressed gas cylinders.

Requirements:

[Compressed Gas Cylinders and Related Systems](#)

Hazard Notes:

Cylinders of compressed nitrogen, CO₂/air mixtures, and non-flammable CH₄ mixtures will be used both within the field and at the 102GRAND lease space.

The Li-Cor 6800 uses 8 gram high pressure carbon dioxide cartridges.

Control Notes:

Labels on compressed gas cylinders will be checked to verify the stated contents prior to use. Cylinders will be secured and stored in an appropriate area until needed. Users will determine to the best of their ability that cylinders are not defective or leaking. Regulators will be placed by trained personnel and used in accordance with the SBMS exhibit [Requirements for Using Compressed Gas Regulators](#).

Movement of full-sized compressed gas cylinders around the research site will be performed by researchers. A compressed gas cylinder hand truck (dolly) must be used to move cylinders around the research site. Any ORNL staff member who uses the compressed gas dolly must complete Common Risk Mechanical Material Handler training. Only use the compressed gas cylinder dolly if you are familiar and comfortable with its operation.

NOTE: All requirements and guidance on compressed gas cylinder hand truck use can be found at: <https://sbms.ornl.gov/sbms/SBMSearch/SubjArea/MatHand/ExhibitHandTruck.cfm>

Calibration gases will be maintained as a mixture containing concentrations within an ambient range (~1,000ppm CO₂; <100ppm CH₄).

NOTE: All requirements and guidance on compressed gas cylinder use can be found at: https://sbms.ornl.gov/sbms/SBMSearch/subjarea/cgc/cgc_sa.cfm.

The 8 gram high pressure carbon dioxide cartridges must be food grade and oil free and be kept out of sunlight and under 50 degrees C. The cartridge may become extremely cold as the carbon dioxide is consumed. The cartridges are considered hazardous materials and cannot be shipped by common carrier. They will be purchased in the field.

Locations:

All Locations

Attachments:

[Gas Calculation RSS 7728 Nitrogen Release Worst Case Scenario - Sep 2021.pdf](#)

12.2

This operation involves [cryogenics](#) or other cold thermal hazards that could cause tissue damage on contact.

Requirements:

[Conduct Exposure Assessments](#)
[Personal Protective Equipment](#)
[Work with Cryogenics](#)

Hazard Notes:

Dry ice may be used during sampling and transporting of samples back to ORNL or other collaborators.

Control Notes:**General Dry Ice Usage Controls**

Never handle dry ice directly. Use tongs, insulated (cryogenic or leather) gloves when handling dry ice; AND wear safety glasses with side shields when breaking blocks of dry ice, when transferring between coolers, or during other activities which could potentially produce flying pieces of dry ice.

See Question 15.1 for dry ice transport controls and requirements.

Further info can be found in the SBMS Procedure: [Work with Cryogenics](#)

Locations:

All Locations

Attachments:

None.

12.3

This operation involves [temperature extreme hazards](#) (heat or cold stress) and/or extreme weather.

Requirements:

[Conduct Exposure Assessments](#)
[Evaluate Temperature Extremes](#)

Hazard Notes:

Field work in hot and especially cold conditions. Work outdoors with potential for inclement and/or severe weather conditions.

Additionally, the potential for build up of snow/ice dams above the SPRUCE enclosures has been observed and is certainly an overhead hazard to consider in the winter months.

Control Notes:

As outlined in several of the JHAs (e.g., "dehydration", "fieldwork", "snowshoe travel", "weather") located at the beginning of this RSS, participants must follow many controls to maximize their safety during severe weather events in northern Minnesota (heavy snow, thunderstorms, etc depending upon the time of year)

Consult your [Division Safety Officer \(DSO\)](#) for assistance in determining the appropriate controls for thermal stress and consult the [Guidelines for Thermal Stress](#) (SBMS excerpt).

The following OSHA publications should be reviewed before starting field activities:

- [OSHA Heat Stress Card](#)
- [OSHA Cold Stress Card](#)

Participants that perform work involving potential exposure to elevated temperatures must have the Heat Stress Training certification. Contact the [Division Training Officer \(DTO\)](#).

Consider the following controls for cold stress:

- Engineering controls that provide an increase in clothing insulation, reduce air velocities with wind breaks, provide sources of radiant heat, provide opportunities for changes into dry clothing, among others.
- Administrative controls that set acceptable exposure times, reschedule work in warmer temperatures, allow sufficient recovery in warm environments, establish stations for warm fluids, among others.
- Personal protective equipment such as clothing that increases insulation, outer clothing that minimizes airflow across the skin, head covering, and additional protection for extremities, anti-contact gloves, among others.

Additional information on cold stress can be found at the following link: <http://www.cdc.gov/niosh/topics/coldstress/>

During inclement weather, if you can hear thunder or see lightning you are within the strike distance of the lightning. Stop your activities, evacuate the site and seek safe shelter immediately. Safe shelter may be obtained in a permanent structure or in a vehicle with windows closed. If there is not time to get to such protected areas, find a low-lying, open place that is a safe distance from trees, poles, or metal objects, or standing water that can conduct electricity. Get into and stay in a tucked position.

Additional ORNL Controls to supplement USFS JHAs:

- [Wait thirty minutes after the last lightning strike before resuming field activities.](#)
- [Travel to and from hotel/lodging areas to the Marcell Experiment Station via rental vehicles or government vehicles may require winter driver skills and practices that rarely needed in east Tennessee. Participants should keep heavy blankets and emergency supplies in vehicles during the winter periods.](#)

Enclosure Snow/Ice Discussion: Since an engineered solution to the issue is not readily available, participants working at the site in the winter months need to remain vigilant to the presence of snow/ice overhead before entering/exiting enclosure doorways and are encouraged to remove it with proper tools or report it to Site Manager personnel.

Locations:

Field Work
Off-Site Work

Attachments:

None.

13.1

This operation involves any sources of [excessive noise](#) (e.g., such that you would have to raise your voice to talk to a co-worker standing 3 feet from you).

Requirements:

[Conduct Exposure Assessments](#)
[Hearing Conservation](#)

Hazard Notes:

Hearing protection may be required during the use of some types of equipment associated with this project (e.g. some hand/portable power tools; within close proximity of gas powered generators; while using some air driven/pneumatic/electric equipment such as the Bosch Hammer, etc.).

Control Notes:

Hearing protection is required for exposures in excess of 85 dBA. Hearing protection devices (HPDs) (i.e., earplugs or earmuffs) with a proper noise reduction rating (NRR) are required for the operator of the equipment that exceeds 85 dBA (e.g. chainsaws, weed eaters, snow blowers, etc.) during use.

Equipment with the potential to exceed 85 dBA should be evaluated by Safety Service Division using calibrated sound level meters. However, this may not be possible for all equipment due to their distance from ORNL, so it is recommended that participants err on the side of caution and use hearing protection when exposed to loud noises. While they cannot replace a calibrated sound level meter, smartphone-based sound level meter applications (apps), such as the [NIOSH sound level meter](#) for the iOS platform, can serve as a screening tool to determine if hearing protection should be worn. It is recommended that hearing protection be worn when the sound level meets or exceeds 82 decibels on the smartphone-based sound level meter app.

Participants of this RSS that use HPDs (either on a mandatory or voluntary basis) must understand their proper use and fit. Guidance is available at:

https://ornl.sharepoint.com/sites/eesd/ops_west/RSSDocuments/LinkedPDFs/BSD_ESD_HPD_GUIDE.pdf

Personnel identified as having known or potential noise exposures exceeding the Occupational Exposure Limit of 85 dBA, 8-hour time-weighted average must be enrolled in the Hearing Conservation Program (HCP) and receive HCP training (initial and refresher as required). It is the supervisor's responsibility to enroll the worker in the HCP using the ORNL Medical Services Division Mandatory Enrollment Form (<https://ornl.sharepoint.com/sites/forms/ornl/ORNL-1064.pdf>). Consult your DSO for assistance.

Locations:

Field Work
Off-Site Work

Attachments:

None.

13.3

This operation involves [ergonomic hazards](#) (e.g., lifting, pulling/pushing, vibration, posture, repetitive motion, excessive force, awkward positions, long duration, etc.).

Requirements:

[Apply Ergonomics Controls](#)
[Conduct Exposure Assessments](#)

Hazard Notes:

Potential Ergonomic Hazards Include:

- Carrying field equipment and sampling gear (tools, batteries, etc.) can present ergonomic hazards if loads are not carried properly, etc.
- Lifting the air driven and/or electric hammering devices (i.e. Bosch Hammer).
- Ergonomic hazards also exist due to tower climbing activities.
- Traveling on bog boardwalks when wet represents a plausible slipping and/or twisting hazard.

A particular ergonomic hazard unique to this site is lowering and raising of the extension platforms to access the center of the experimental plots. These platforms are fairly large and awkward to handle which presents a lifting, bending, and twisting concern (see attached photo).

Control Notes:

As outlined in several of the JHAs in the attached USFS package, participants should avoid awkward positions and should follow proper lifting and carrying techniques. Under extended field sampling situations, personnel should rotate job tasks to limit continuous actions, or take breaks as needed.

Tips for Lifting Heavy Items:

For material handling, use of mechanical devices such as hand trucks, dollies or carts is preferred and should be used whenever possible.

Manual material handling and lifting is strenuous; use of proper bending and lifting techniques are essential for injury prevention. When lifting, bend at the knees instead of at the waist and use the large, strong muscles of the legs instead of the small muscles of the back to lift items.

Participants should use proper lifting techniques when lifting any load, especially those approaching 30 lbs. and should seek assistance, even for lesser weights, depending on their personal capabilities and shape and size of the item to be lifted.

Refer to the "Manual Lifting Guideline: 30/50/30" which identifies key points for safe lifting:

<https://sbms.ornl.gov/sbms/sbmsearch/subjarea/MatHand/GuidelineManualLift.cfm>

In addition, a video review of safe lifting practices is available at:

<http://safetyfirst.ornl.gov/mmh.cfm>

Bog boardwalks are elevated above the surrounding saturated conditions to keep them dry. The installed boardwalks are textured to further limit the potential for slips, trips, twists, and falls when the boardwalks may be wet from precipitation. When the boardwalks are covered with snow in winter, special care including shoveling off the boardwalks should be taken to ensure their safe use.

A device known as a "kneeler" (see attached photos) allows participants to access equipment within the center of the enclosure without having to use the large platforms at all (elimination of the hazard).

When the platforms will have to be used, a new and updated design of the stands that hold the platforms in place have been developed that prevents the platform from sliding out of the stand during ascent and descent, even when standing at an angle.

These controls have reduced the ergonomic hazards associated with use of the platforms, but if any person feels uncomfortable deploying the platforms by themselves, assistance by others should be requested.

Locations:

Field Work
Off-Site Work

Attachments:

[Kneeler Photo 1.jpg](#)
[Kneeler Photo 2.jpg](#)
[SPRUCE Enclosure Platform Photo.jpg](#)

13.7

This operation involves the use of ladders or [elevated work areas or platforms](#) with an [unprotected edge](#).

Requirements:

[Fall Protection](#)
[Ladders](#)
[Scaffolding and Aerial Lifts](#)

Hazard Notes:

To access instrumentation and trees it may be necessary to occasionally use a step ladder and/or extension ladder. The spongy surface of the bog may make the safe use of a ladder difficult.

Ladders may also be used (by ORNL staff and collaborators) within the plot enclosures to access instruments or equipment.

Articulated ladders will be used at the site to access trees, obtain samples, conduct measurements, etc. These ladders can be configured for use like a standard step or extension ladder, or can be positioned to span across the boardwalks and/or the drop down planks.

Each experimental plot/ring at the SPRUCE site has a tower in the center which is outfitted with environmental monitoring equipment. It will be necessary for certain participants to periodically climb the towers to install, repair, and/or replace these instruments.

Note: Controls for tower climbing activity were transferred to the authorized version of [RSS 11438](#) during the 2021 annual review of that RSS. Any participant of RSS 7728 needing to climb the tower must be a participant of RSS 11438 and read the Fall Protection Plan referenced in Q13.7.

Control Notes:

Ladder use in bogs must be supported by a solid surface and include a spotting individual to ensure that the ladder does not shift from its position on the solid board or walkway. Ladder users shall be familiar with the SBMS [Using Ladders Safety](#) procedure and the US Forest Service Ladder Use JHA provided previously.

Ladder users must also successfully complete the ORNL LRN Ladder Training before use.

All ORNL staff and project collaborators (non-ORNL staff) accessing instruments or equipment secured to the 18 foot structural member of the plot enclosures must follow the instructions listed within this work-aid: https://edrm.ornl.gov/federaldox/#/irl/0902f41f803e7015?dataSourceId=ORNL_PRD&versionLabel=CURRENT

Use of the articulated ladders must be done in accordance with the associated work-aid found here: https://edrm.ornl.gov/federaldox/#/irl/0902f41f803e71b8?dataSourceId=ORNL_PRD&versionLabel=CURRENT

ORNL Users of these ladders must have the ORNL LRN ladder training (just as with any other ladder) and must also receive hands-on/site specific training (as specified within the work-aid) by the PI and/or the PI delegate(s).

Locations:

Field Work
Off-Site Work

Attachments:

None.

14.2

This operation involves work performed outside normal working hours (6am to 7pm, Monday-Friday).

Hazard Notes:

After hours work will be performed at both the SPRUCE field site and the 102GRAND office area.

Control Notes:

The following controls have been established for work that occurs outside of normal business hours (normal business hours are 6 am to 7 pm Monday through Friday, excluding holidays).

SPRUCE Site Staff

Division Director pre-approval is required for all high risk/high consequence work performed outside of normal business hours. Participants must submit the approval request at least 24hrs in advance using the [BESSD request form](#). A list of work tasks and conditions considered high risk/high consequence work are available on the BESSD request form.

Research Teams

The pre-trip meeting described in General Notes serves as authorization for off-site field work activities in lieu of the LSS Notification and BESSD High Risk / High Consequence request form.

Locations:

All Locations

Attachments:

None.

15.1

This operation involves packaging or transporting of DOT hazardous materials (chemicals, biological materials, samples/specimens, RCRA waste, etc.) or DOT radioactive materials that have an off-site destination or originate off-site.

Requirements:

[Commercial Motor Vehicle](#)
[Export Control Compliance](#)
[Off-Site Transportation](#)
[Package/Transport Nonhazardous, Hazardous, and Radioactive Materials Off-Site](#)

Hazard Notes:

Participants will have need to transport gasoline, compressed gas cylinders, ethanol & other DOT hazardous items to the off-site field locations.

At times, dry ice or samples packaged in dry ice may need to be transported or shipped while in Minnesota. Special controls apply when dry ice is transported or shipped **other than by vehicle**.

Participants often have need to ship batteries from the field sites and regulations/requirements for (a) taking batteries on airliners (checked or carry-on) or (b) officially shipping them change fairly frequently.

Control Notes:

Only project participants who have completed DOT Materials of Trade (MOT) training are permitted to transport hazardous chemicals by vehicle. The controlling subject area requires that such transport shall only occur in **government** vehicles and if material(s) being transported meet the MOT exception (applicable Packing group, volume limits, packed securely, properly labeled, etc), but an approved [ESD variance](#) exists to allow rental vehicles to be used as needed. Gross Weight of all hazardous materials must be less than 440 lbs.

If you have not previously ascertained whether a particular chemical/volume fall within MOT limits, you must first verify with [Transportation Management \(TM\)](#).

Specifics Regarding Gasoline Transport:

The volume limits per container for Gasoline (DOT Class 3 flammable liquid, Packing Group II) is further reduced by other OSHA requirements such that the it must be transported in safety cans with capacities of 5 gallons or less. [See Q7.7 for gasoline container requirements](#).

Specifics Regarding Gas Cylinder Transport:

In addition to the MOT weight limits and training, all cylinders must be transported upright, properly secured with valve protection cap in place (i.e., not with regulators attached).

Movement of full-sized compressed gas cylinders to the research site will be performed by researchers. A compressed gas cylinder hand truck (dolly) must be used to move cylinders. Any ORNL staff member who uses the compressed gas dolly must complete Common Risk Mechanical Material Handler training. Only use the compressed gas cylinder dolly if you are familiar and comfortable with its operation.

NOTE: All requirements and guidance on compressed gas cylinder hand truck use can be found at: <https://sbms.ornl.gov/sbms/SBMSearch/SubjArea/MatHand/ExhibitHandTruck.cfm>

DRY ICE TRANSPORT

If participants must prepare and ship samples and/or materials on dry ice for air transport from offsite locations, additional DOT function-specific training certifications are required in order to properly declare and label the package(s).

Authorized individuals must possess the **IATA Dry Ice by Air Shipper** role in Success Factors. Contact the [Transportation Safety Compliance Officer](#) for more information.

NOTE: Transport of dry ice by vehicle is not DOT regulated but be cautious if transporting dry ice inside vehicles compartments. The preferred method of motorized transport of cryogenic material is in the bed of a truck to prevent potential asphyxiation to the vehicle occupant(s). However, if necessary to transport in a vehicle compartment, provide adequate ventilation and do not recirculate the air inside the vehicle. Dry ice should be in closed but vented coolers.

See [Package/Transport Nonhazardous, Hazardous, and Radioactive Materials Off-Site](#) in the SBMS Subject Area [Off-Site Transportation](#) for further requirements and guidelines.

Battery Shipping Controls:

For transport to offsite locations, participants need to refer to the following FAA links that described and provides a summary of rules for transporting batteries (and other hazardous materials as carry-on or checked baggage):

Lithium Batteries in Baggage Fact Sheet: https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=23054

FAA Pack Safe link: <https://www.faa.gov/hazmat/packsafe/>

With the exception of the small quantities allowed and discussed in the FAA links, participants must coordinate all other shipments of batteries via ORNL Transportation Management to ensure IATA regulations are met.

Participants are prohibited from shipping LiPo and lithium ion batteries back to ORNL (i.e., not part of their travel baggage) without further training requirements.

Locations:

Field Work
Off-Site Work

Attachments:

None.

15.3

This operation involves the use of watercraft, aircraft or unmanned aerial vehicles.

Requirements:

[Aviation Safety](#)

Hazard Notes:

Drone Use: Drones (an unmanned aircraft System-UAS) may be operated by project staff for aerial photo activities, etc.

Control Notes:

Drone Use (Control Notes): Only select persons will be authorized to operate drones in accordance with the authorized version of [RSS 17044](#). Project personnel, collaborators, or site visitors present should be alert of the overhead hazard associated with such UAS flights in case of an unplanned landing or equipment failure occurs.

Paraphrasing the COA: Overhead UAS flights are not authorized over uninformed, unsheltered humans. If a UAS is spotted overhead, this is cause for concern and should be treated as UAS malfunction; participants are to immediately seek shelter and report the incident.

Locations:

Field Work

Attachments:

None.

16.0

This operation involves offsite work which potentially includes hazardous operations or activities in hazardous environments/locations.

Hazard Notes:

Most field work will be performed in northern Minnesota on the Marcell Experimental Forest operated and maintained by the USDA Forest Service.

Hazards - unexpected emergency requiring outside assistance in a field situation and ensuring all parties understand the responsibility of the others.

Control Notes:

When working off-site, staff ensure they consider any special precautions that may be needed in unusual environments. Local work control processes and health and safety requirements are followed when working at other facilities. (e.g. the SME-annotated JHAs attached in the general comments section)

At the off-site location, work conditions may be different from what was expected. If necessary, the resources of the Laboratory will still be available to you, e.g., your supervisor, subject matter experts (SME), ES&H support staff, and the Lab Shift Superintendent (LSS).

Participants should familiarize themselves with ORNL guidance related to offsite work available at: <https://sbms.ornl.gov/sbms/sbmsearch/subjarea/wppc/GuideOffsite.cfm>

Emergency Communication Requirements:

A) When in the field, a person will have access to (and know how to operate) some means (ie., operable phone, satellite phone, radio and contact #) for getting timely emergency help.

B) When an individual is doing field work alone, he or she will have created the situation that someone will:

- know where the field worker is;
- know when the fieldworker should return from the field; and
- take appropriate search actions if the fieldworker does not return in a timely fashion.

First Aid and Injury Reporting:

A first aid kit and AED (automated external defibrillator) will be maintained at both the S-1 Bog Field Trailer and SPRUCE Office in Grand Rapids (102Grand). Note however, that use of an AED by participants is completely voluntary.

When working off-site, personnel must have the emergency services phone numbers for the location and the numbers for the site point of contact immediately available. When in remote locations, personnel should be aware of the route from the worksite to the nearest medical facility and/or method to summon emergency services to the site. While off-site, employees with an injury or illness report to the nearest medical facility for treatment.

- See attachment for directions to nearest medical facilities to the Marcell Experimental Forest.
- Participants should also become familiar enough with these directions so that they can adequately describe where they are located in the event that an accident/injury is severe enough to require the assistance of emergency service providers to respond.

An individual involved in a work-related injury or illness will immediately seek the appropriate level of medical care as required by the event. Within 2 hours of the event, occurrence inform the supervisor for proper follow-up and reporting.

Employees with an injury or illness while on-site at ORNL report to the Health Services Division between the hours of 7:30 AM and 4:30 PM. After hours medical assistance is available by calling 911 on a land-line or the Laboratory Shift Superintendent (LSS) office at 865-574-6606.

Special Note: Due to the remote location, specialty clothing, PPE, drinking water, dry ice, shipping charges, etc. may also need to be procured via non-standard ORNL procurement Methods. Personal reimbursement may be possible if participants make purchases covered/discussed in the linked SBMS variance: <https://sbms.ornl.gov/sbms/variance/Related.cfm?VarianceID=1108>.

Locations:

All Locations

Attachments:

[Driving directions from BOG to Grand Rapids Hospital.pdf](#)

17.1

This work requires the project staff to prepare or modify engineering calculations, drawings or specifications that are to be traceable and on record. Engineering calculations, drawings or specifications must be traceable and on record if used for construction, fabrication, modification, installation, or acquisition of [engineered systems, structures, or components](#) and meet any of the following criteria:

- Have the potential to adversely affect the health and safety of staff, workers, the public, or the environment
- Failure could unacceptably impact program objectives
- Are currently recorded in the ORNL Engineering Files or Records
- Are or will be installed as an integral operating system in a new or existing UT-Battelle controlled facility

Requirements:

[Engineering Design](#)

Hazard Notes:

Engineered structures are present at the site (i.e. bog board walks, chamber structures, electrical and data infrastructure, gas lines, etc.).

Control Notes:

Research staff (i.e. RSS participants) **ARE NOT** responsible for the engineering designs and modifications of the structures associated with the SPRUCE project. All engineering designs, calculations, drawings, specifications, etc. have been and shall be conducted and maintained by the ORNL engineering department.

If there is an issue or concern identified by RSS participants at the site, relating to the engineered structures, research staff listed as participants will not attempt to correct these issues, but will refer back to Project Management to address the issue with ORNL engineering and/or the subcontractors maintaining the structures.

Locations:

Field Work
Off-Site Work

Attachments:

None.

18.6

This operation requires specific programmatic controls to ensure integrity of information and processes such as project-specific calibrations, Quality Assurance Plans or Software Quality Assurance Plans.

Requirements:

[Calibration](#)
[Records Management](#)
[Software Quality Assurance and Other Software Requirements](#)

Hazard Notes:

Li-Cor gas analyzer calibration procedures are used for this project.

Additional lab & field equipment calibration schedules have been defined to ensure data collection integrity. Calibration reports are maintained at the field site and ORNL campus.

Control Notes:

Li-Cor gas analyzer calibration procedure can be found at: https://edrm.ornl.gov/federaldox/#/irl/0902f41f803e728b?dataSourceId=ORNL_PRD&versionLabel=CURRENT

Locations:

All Locations

Attachments:

None.

19.0

This work involves planned modifications/alterations of experimental equipment or planned maintenance of equipment.

Requirements:

[Configuration Management](#)
[Electrical Safety](#)
[Select, Use and Modify Laboratory Equipment](#)

Hazard Notes:

Routine maintenance and repair may be performed.

Control Notes:

Standard maintenance and regularly planned repairs that are listed in the equipment operating manual are authorized when energy is not present, not stored, or appropriately guarded. These hazards must be analyzed in some way. Examples include equipment manual, equipment troubleshooting guide, and SOP developed by staff and approved by SMEs. Manuals do not need to be attached if they are readily available when work is being performed.

Participants must ensure equipment is in the safest state reasonable. Participants must be mindful of older equipment that may not have the same touch-safe NRTL requirements and engage the appropriate SMEs before work.

Work that is not covered by this RSS and would require additional review includes but is not limited to:

- Any activities requiring panels to be removed while the instrument is energized without knowing if hazardous energy is accessible.
- Participants acting as vendors' hands in electronic, virtual, or telephone step-by-step instructions.
- Planned maintenance and repairs that are not going as planned.
- Vendor subcontracts (which will be covered by the procurement system)

These activities will require a pre-job brief and all hazards are evaluated. Work approval will be documented and attached to this RSS.

Locations:

All Locations

Attachments:

None.

Last

This operation involves hazards or risks not previously identified above. Questions to consider:

- What can go wrong (what keeps you up at night?)
- What measures or controls are in place to prevent that from happening?

- Consider how do (or which of) the most important controls depend on human actions or behavior. Where might an error or omission impair the effectiveness of an important control?
- Consider any change that has been made (process, equipment, etc) which could inadvertently increase risk in another area.
- Error precursors are conditions or attitudes that increase the chances of an error during the performance of a specific task by a particular individual. Are there precursors that, if reduced or eliminated, would make the controls more likely to be effective?

Hazard Notes:

The field work presents many hazards that are not included in the standard RSS question.

- Potential for methane emissions.
- Possible head injury from instrumentation positioned near the ground.
- Slips/trips/falls
- Poisonous plants
- Wildlife Hazards
- Hunting season and construction activities
- Fatigue

Smoke from local and regional wildfires may be present when working at SPRUCE. Dust masks can be worn voluntarily by participants when wildfire smoke is present.

Many of the field tasks embedded in the JHA package require or suggest use of dust masks, and some lab related activities (e.g soil grinding, etc) may present the need or desire for dust mask usage by participants.

Control Notes:

General Controls:

- Participants that work outside and off the roads will wear appropriate clothing and additional PPE as discussed and prescribed in the USFS JHAs (unless annotated otherwise in the JHAs and discussed in this RSS).
- Safety glasses with side shields shall be mandatory where the potential for eye injury exists (i.e. Dry/dusty conditions, low lying vegetation and/or tree limbs, etc.) and shall be left to the discretion of the individual in all other circumstances. Use tinted lenses/sunglasses as need to reduce glare/eyestrain in bright conditions or when snow is on the ground.
- High top rubber work boots shall be utilized by research staff members needing to enter directly into the bog itself; otherwise, sturdy, closed-toed shoes or work boots are sufficient. When work involves the potential for damage to the foot or toes (i.e. working with heavy equipment that could be dropped onto the foot) a safety-toed boot is required.
- Long pants shall be mandatory. Long sleeve shirts are optional and will be left to the discretion of the individual where the potential for insect bites, contact with poisonous plants, and cuts/scrapes exists.

Methane emissions:

High concentration methane emissions from stored, subsurface pockets of naturally generated methane represent a low probability, but possible combustion danger if released. The open nature of the field environment would adequately disperse such releases if they happen, but staff should avoid ignition sources that may potentially spark methane gas should adequate ambient levels occur.

Head Injury:

While working in and around environmental instrumentation installed in the bog, staff should be aware of elevated hard and sharp surfaces or corners that might represent a possible source of head injuries. These circumstances are not common, but should be considered while working at the bog surface level in their vicinity.

Slips/Trips/Falls:

- Workers should remain alert while walking in the field since slippery and uneven surfaces could cause slips, trips and falls.
- Always be aware of where your co-workers are and other activities going on around you.
- Plan route carefully to avoid most uneven ground and ensure you can see where you are putting your feet before walking. Avoid working in poor light conditions.
- Do not jump over or off anything. If there is a drop or ditch that has to be negotiated, lower yourself slowly or use existing bridges, steps, or paths etc. When walking down hill, walk across the slope and not down the steepest path, keeping your weight on the back foot as much as possible - if you slip you should try to fall backwards, not forwards!
- Take special care on slippery rocks.

Poisonous Plants: RSS participants should be cognizant of potentially poisonous plant species (i.e. Poison Ivy, Poison Oak, or Poison Sumac) at the various field sites. For additional information concerning the identification of poisonous plants please refer to the following website: <https://www.cdc.gov/niosh/docs/2010-118/pdfs/2010-118.pdf>.

All participants conducting field work are strongly encouraged to utilize extra precautions (i.e. barrier creams, post-wash soap such as ivy-wash, exposed skin coverings, etc.) even if the individual does not have a known sensitivity/allergy to poisonous plants.

Wildlife hazards:

- Insects: As discussed and supplemented in the JHAs, biting and stinging insects (ticks, mosquitos, hornets, bees, etc.) may be encountered in the field. Participants can use insect repellents with DEET on their skin and clothes or Permethrin on their clothes only, following the product instructions. As field conditions warrant (seasonal), participants will inspect themselves for tick and mosquito bites after field activities and subsequent showering.
- If you do encounter wildlife of any kind: do not block the animals path of travel, never come between mothers and their young, do not run or move suddenly - this may cause predators to attack. You are instructed stay at least 100 yards (91 m) away from bears and at least 25 yards (23 m) away from all other large animals.
- Snakes: Poisonous snakes are unlikely to be present at the site. If snakes are encountered, minimize contact with them. Do not attempt to handle the snake unless absolutely necessary to remove from the work area. Use remote handling devices when possible to remove the snake.

Hunting Season and Construction Activities:

It is recommended that during large game hunting seasons, and certain construction activities participants wear a high visibility vest (i.e. blaze orange, high visibility green, etc.) to reduce the potential for being mistaken for an animal. Remember that the Marcell experiment site is public land.

Fatigue: Non-traditional shifts and extended work hours lead to increased fatigue, stress, and lack of concentration and amplify the risk of operator error, injuries and/or accidents. When possible, limit the use of extended shifts and increase the number of days worked. Take frequent breaks and rotate tasks. Tasks that require heavy physical labor or intense concentration should be performed at the beginning of the shift if possible. Monitor coworkers for signs of fatigue. See additional guidance from OSHA on [Extended Unusual Work Shifts](#).

Wildfire Air Quality:

Participants may encounter poor air quality when working in the field with local and regional wildfires. The following websites provide real-time air quality information in relation to wildfires. These websites should be reviewed in the morning prior to work. Participants are prohibited from working when the air quality index (AQI) is >250.

<https://fire.airnow.gov/>

https://tools.airfire.org/monitoring/v4#!/?category=PM2.5_nowcast¢erlat=42¢erlon=-95&zoom=4

The California Air Resources Board provides guidance on the use of this data to determine if field work can be conducted safely. Refer to: <https://ww2.arb.ca.gov/protecting-yourself-wildfire-smoke#:~:text=Stay%20Indoors%20and%20Keep%20Indoor,with%20windows%20and%20doors%20closed>

The leader of the field team or participant, if working alone, will decide whether to continue with field activities for the day based on the information from the websites above. However, participants must use individual discretion when deciding to work in the field near wildfires, or other challenging conditions depending on their individual health, wellness, and comfort level. Each individual may decide to not participate in any work activity at any time without fear of repercussion if they feel unsafe.

Dust Masks (Control Notes): N-95 respirators/dust masks are available and may be voluntarily worn by participants; however, these masks must be ORNL-issued and only used by participants properly trained on the limitations of their use. Refer to the SBMS subject area on the Requirements for Voluntary Dust Mask Use at <https://sbms.ornl.gov/sbms/SBMSearch/SubjArea/RP/RPprocedure8.cfm>. The training module titled "Voluntary Use Dust Mask" must be completed before N-95 dust masks can be issued.

Locations:

All Locations

Attachments:

None.