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STANDARD OPERATING PROCEDURE
Procedure for Ensuring Worker Health and Safety at the
GSI Land-Based RDTE Facility

Compiled By -

Name: Tyler Schwerdt

Title: GSI Land-Based RDTE Facility Operations Manager

Date: June 16, 2009

Approved By -

Name: Nicole Mays

Title: GSI Senior QAQC Officer

Date: June 26, 2009

Cleared For Issue By -

Name: Allegra Cangelosi

Title: GSI Principal Investigator

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BACKGROUND

The [Great Ships Initiative](#) (GSI) is a collaborative effort to end the problem of ship-mediated invasive species in the Great Lakes-St. Lawrence Seaway System through independent research and demonstration of environmental technology, financial incentives and consistent basin-wide harbor monitoring. To that end, GSI has established research capabilities at three scales—bench, land-based, and shipboard. Each scale is dedicated to addressing specific evaluation objectives, with protocols as consistent with IMO and federal requirements as practicable. Developers of ballast treatment systems apply for GSI research services [online](#), and awards are offered based on an objective review process. GSI incubation/testing will allow meritorious ballast treatment systems to progress as rapidly as possible to an approval-ready and market-ready condition.

The GSI's Land-Based Research, Development and Technology Evaluation (RDTE) Facility in Superior, Wisconsin is used to conduct full-scale biological evaluations of prospective ballast treatments suitable to Seaway-sized vessels. The facility draws raw intake water and entrained organisms from Duluth-Superior Harbor at up to 680 m³/hr. After initial transport through 16 inch HDPE line to the facility, a carefully designed “Y-split” in the intake piping simultaneously channels one half of the flow (up to 340 m³/hr) to a treatment track and one half (up to 340 m³/hr) to a matched control track (figure 1). Water in the treatment track passes through the experimental ballast treatment system and into one of the 200 m³ cylindrical treatment retention tanks (test tank #1 or #2; figure 1). Water in the control track by-passes the treatment system and is channeled directly into a matched control retention tank (control tank #1 or #2; figure 1). After storage (duration dependent on test requirements), the water is discharged sequentially from the treatment and control retention tanks at up to 340 m³/hr. Depending on the test scenario, the water is either discharged to the harbor or sewer system, into an alternate retention tank, or through the treatment system again for discharge or retention.

Treatment and control intake and discharge water is sampled at pressure/flow controlled in-line sample points (SPs). Intake samples are collected concurrently on the control and treatment tracks respectively (using SP2 and SP3, figure 2). Discharge samples are collected from one of two discharge sample points (SP9 or SP10; figure 2), with sequential sampling of control and treatment water. At each of these SPs there are three replicate sample ports with a center-located 3.8 cm internal diameter (ID) elbow-shaped pitot tube (figure 3) connected to a 3.8 cm ID PVC transfer pipe that carries the sample water to one of six collection tubs located at a centralized sampling station (figure 2). Other SPs shown on figure 5, with one port per SP, are used for calibration testing the facility itself and not typically used for sample collection during a

treatment system evaluation.

A mobile field laboratory provides bench-scale facilities to support time-sensitive assays associated with tests conducted at the GSI Land-Based RDTE Facility. The laboratory is located at the facility during testing but may be moved to other sites in the Great Lakes-St. Lawrence Seaway System to support GSI shipboard tests when required. It is climate-controlled, and has enough desk and counter space to allow for simultaneous microscopic and analytical analysis of zooplankton, phytoplankton and bacteria samples. In addition, laboratories of the University of Wisconsin-Superior's Lake Superior Research Institute (LSRI) and the University of Minnesota-Duluth's Natural Resources Research Institute provide non-time sensitive analysis of samples from the land-based tests. Since both facilities are only a few miles from the facility, samples can be easily transported for rapid analysis.

Figure 1. Simplified Schematic of the GSI Land-Based RDTE Facility.

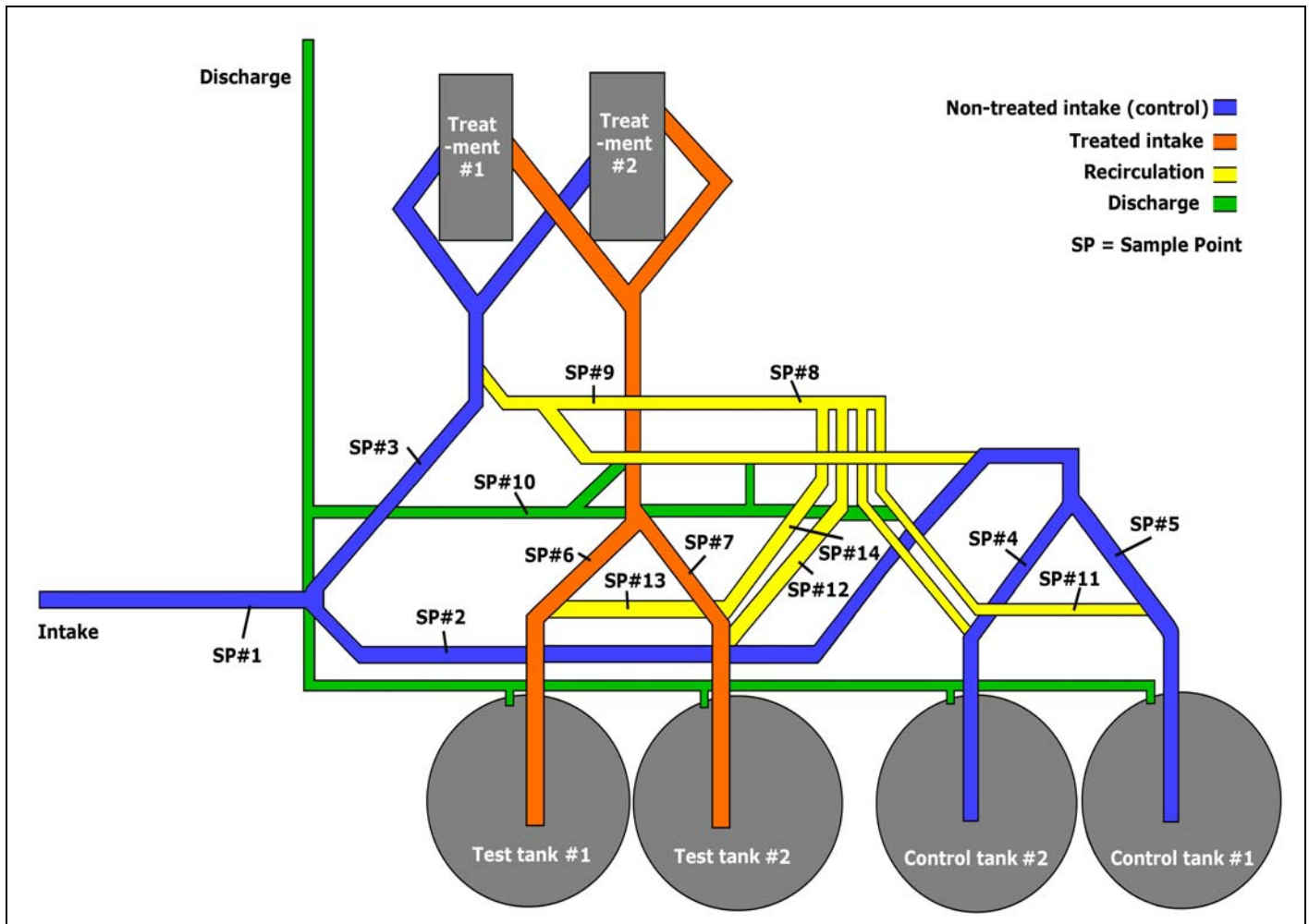


Figure 2. Schematic of the GSI Land-Based RDTE Facility Showing the Location of the Intake and Discharge Sample Points (SPs), Sample Ports, and Corresponding Sample Collection Tubs.

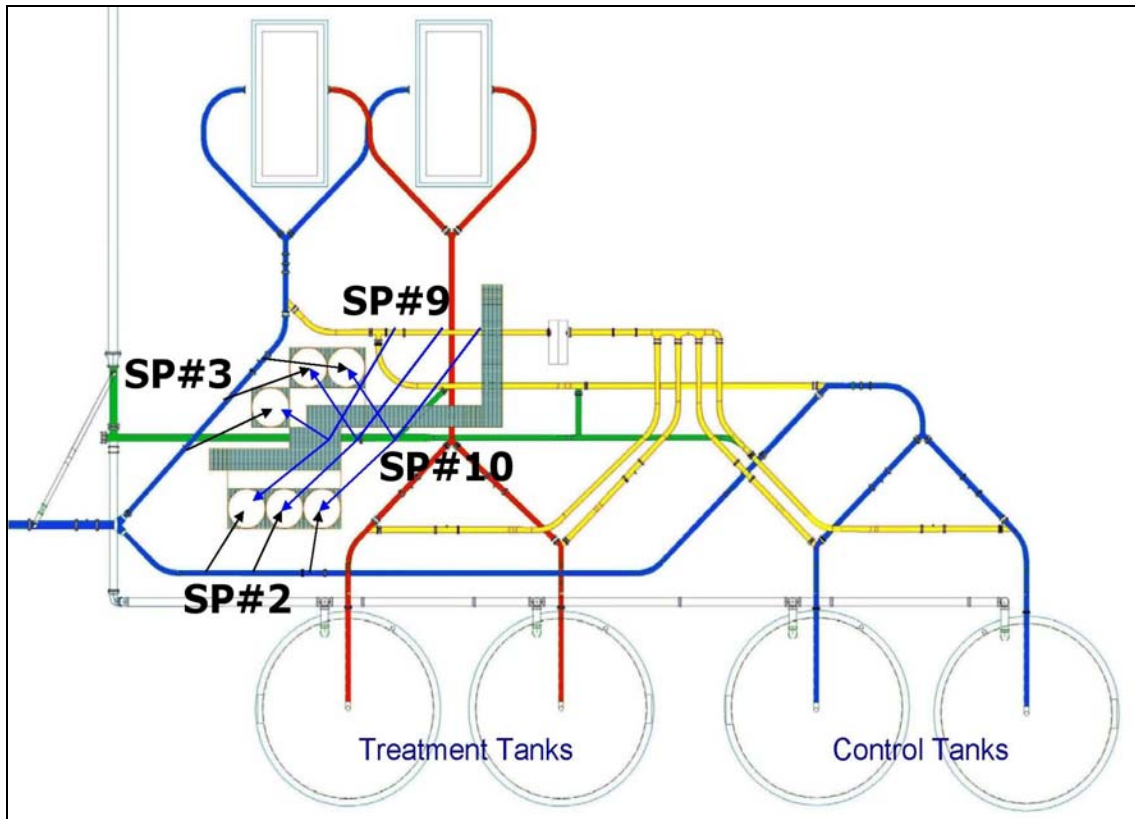
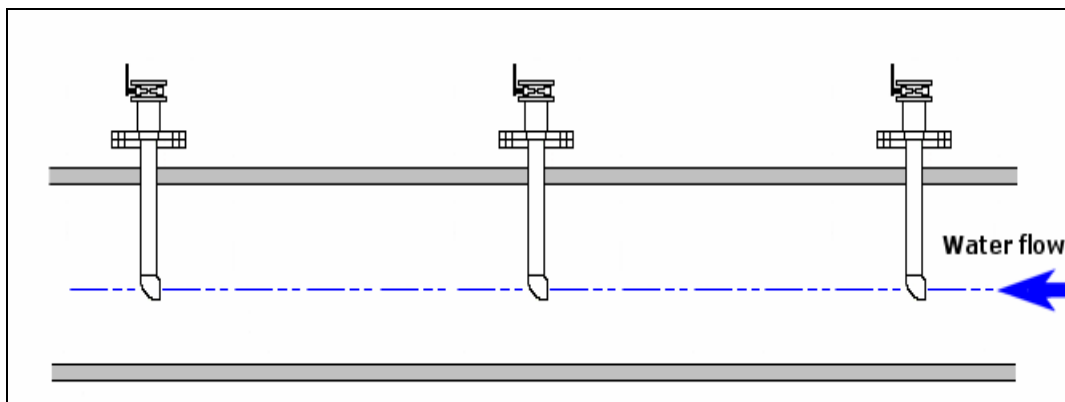


Figure 3. Schematic of a Sample Point (SP) Showing the Design of the Three Sample Port Pitots.



INTRODUCTION

This GSI Standard Operating Procedure (SOP) outlines procedures for ensuring worker health and safety at the GSI Land-Based RDTE Facility located in Superior, Wisconsin. It includes health and safety procedures related to personnel and training; signage; first aid and emergencies; use of protective clothing and equipment; facility visitors; hazardous materials, including chemicals; confined spaces; and equipment and facility operation and maintenance; etc.

DEFINITIONS

GSI Land-Based Facility Operations Manager: Operation of the GSI Land-Based RDTE Facility is carried out by AMI Consulting Engineers P.A. of Duluth, Minnesota. AMI is responsible for providing a suitably qualified and experienced member of its staff to serve as the GSI Land-Based Facility Operations Manager.

EQUIPMENT

- Relevant health and safety documents.
- Health and safety signage.
- Personnel training logbook.
- List of emergency contacts and phone numbers.
- First aid kit.
- Three self-contained eyewash stations.
- Emergency drench shower.
- Fire extinguishers, floating life rings, alarms, and other relevant emergency equipment.
- Personal protective equipment and clothing, including gloves, eyeglasses, face-shields, helmets, hearing protectors, etc.
- Visitor log book.
- Reference materials, including Material Safety Data Sheets, for all hazardous materials stored on-site.
- Confined space entry permit log book.
- Confined space testing and monitoring equipment.
- Ventilating equipment.
- Communications equipment.
- Lighting equipment.
- Barriers and shields.
- Ladders.
- Rescue equipment.
- Equipment manuals and service procedure documents.

PROCEDURE

General

1. Ensure that on-site personnel have available to them and understand the health and safety procedures outlined in this document, and any other GSI documents relevant to performing their work (i.e., *Spill Prevention Control and Countermeasure Plan*, *Confined Space Policy*, and *Lock Out, Tag Out Policy*). The GSI Land-Based RDTE Facility Operations Manager is responsible for making copies of all relevant documents available on-site.
2. Conduct a site health and safety inspection every day prior to the start of operations. The GSI Land-Based RDTE Facility Operations Manager is responsible for ensuring that the *GSI Land-Based Facility Daily Safety Check List* is correctly filled out following each inspection (see appendix A).
3. Follow all health and safety signage displayed at the site. This includes warnings signs for hazardous and risky areas, storage of chemicals, and the location of emergency and safety equipment, etc. The GSI Land-Based RDTE Facility Operations Manager is responsible for ensuring that all signage is properly positioned and maintained.

Training

1. Provide GSI personnel with adequate health and safety training prior to their commencing a new task at the facility and prior to testing of a new treatment system. The GSI Land-Based RDTE Facility Operations Manager and/or GSI QAQC Officer is responsible for conducting the training sessions with information provided on materials, equipment, and tools found at the site; known hazards and how they are controlled; potential risks to health and safety; precautions to prevent exposure; wearing and use of personal protective equipment and clothing; and appropriate responses to emergencies, incidents and accidents.
2. Ensure that all equipment operators are sufficiently qualified and/or certified, and have received adequate training. This includes, but is not limited to, "Confined Space Certification" for those personnel charged with entering the retention tanks.
3. Record personnel training information in a logbook. Records must be made immediately following completion of the training. Information must include: date, name, title, company/organization, and GSI responsibility. The logbook must be stored at the facility in a common and easily accessible area when the facility is in use (i.e., in the facility control room or mobile laboratory), and off-site at the University of Wisconsin-Superior during facility lay-up.

Cleaning

1. Keep workspaces clean and orderly and free from any avoidable hazards at all times.
2. Keep walkways and platforms clear of all unnecessary equipment at all times. The GSI Land-Based RDTE Facility Operations Manager is responsible for placing warning signs near those hazards that cannot be removed.
3. Ensure that all waste and spills are cleaned up at the time they occur, taking appropriate health and safety precautions.

First Aid and Emergencies

1. Display a list of emergency contacts and phone numbers at the facility in highly visible, safe and secure areas. The GSI Land-Based RDTE Facility Operations Manager is responsible for ensuring that the lists are properly maintained and up to date.
2. Ensure that on-site personnel know the whereabouts of the facility's first aid kits. The GSI Land-Based RDTE Facility Operations Manager and GSI QAQC Officer are jointly responsible for maintaining and adequately stocking the first aid kits.
3. Ensure that on-site personnel know the whereabouts of the facility's eye-wash stations and emergency drench shower. The GSI Land-Based RDTE Facility Operations Manager is responsible for maintaining this equipment and ensuring it remains easily accessible.
4. Ensure on-site personnel are aware of the location of facility fire extinguishers, floating life rings, emergency shut-off buttons, alarms and any other equipment that could be used in an emergency. The GSI Land-Based RDTE Facility Operations Manager is responsible for maintaining this equipment and ensuring it remains accessible and in sound working order. He/she is also responsible for ensuring emergency equipment adequately reflects the scale and potential uses of the facility.

Personal Protective Clothing and Equipment

1. Require on-site personnel to wear protective clothing and equipment when appropriate. This may include gloves, eyeglasses, hearing protectors, face-shields, helmets, etc. The GSI Land-Based RDTE Facility Operations Manager is responsible for providing and maintaining this equipment on-site.
2. Require on-site personnel to wear hearing protection in marked areas where noise may cause hearing damage and/or is uncomfortably loud. Personnel are also required to wear eye protection when using chemicals, when operating machinery, or when other

situations require them. On-site personnel are also prohibited from wearing open-toed footwear.

Visitors

1. Ensure visitors to the GSI Land-Based RDTE Facility are accompanied by a GSI representative at all times.
2. Record visitor information in a logbook. Records must be made at the time of the visit of the following information: date, name, company/organization, time of entry to the site, and time of departure. The visitor logbook must be stored on-site in a common and easily accessible area when the facility is in use (i.e., in the mobile laboratory), and off-site at the University of Wisconsin-Superior during facility lay-up.
3. Provide visitors to the site with relevant health and safety information at the time of entry. The GSI representative accompanying the visitor(s) is responsible for monitoring visitor compliance with site health and safety requirements.
4. Require and issue visitors with personal protective clothing and equipment when necessary.

Hazardous Materials, Including Chemicals

1. Correctly label and store all hazardous materials, including chemicals in designated storage areas.
2. Provide relevant personnel with copies of reference material, including Material Safety Data Sheets, on all hazardous materials including chemicals found at the site. Ensure copies are located in an easily accessible area and all personnel are made aware of their location. The GSI Land-Based RDTE Facility Operations Manager is responsible for ensuring that all procedures outlined in the reference material are followed, including those for labeling, handling, storage and disposal of hazardous materials used by the treatment systems or facility; scientific staff are responsible for hazardous materials used in the mobile laboratory.
3. Ensure all GSI personnel that come into contact with hazardous materials have available to them and understand the GSI's *Spill Prevention Control and Countermeasure (SPCC) Plan*, and know what actions to take in the event of minor and/or major chemical spills. The GSI Land-Based RDTE Facility Operations Manager is responsible for making copies of this document available on-site.

Confined Spaces

1. Authorize only those personnel who have received “Confined Space Training” to act as confined space entrants and attendants.
2. Ensure that confined space entrants and attendants have available to them and understand the GSI’s *Confined Space Policy*. The GSI Land-Based RDTE Facility Operations Manager is responsible for making copies of this document available on-site.
3. Require confined space personnel to obtain a permit signed by the GSI Land-Based RDTE Facility Operations Manager prior to entry into all confined spaces. Record confined space entry information in a logbook. Records must be made at the time of the confined space exercise and include the following information: date, name and signature of confined space entrant, name and signature of confined space attendant, name and signature of GSI Land-Based RDTE Facility Operations Manager, reason for confined space entry, time of confined space entry and exit, and any other relevant information. The GSI Land-Based RDTE Facility Operations Manager is responsible for storing the confined space entry logbook at the facility in a common and easily accessible area when the facility is in use (i.e., in the mobile laboratory or facility control room), and off-site at the University of Wisconsin-Superior during facility lay-up.
4. Verify that conditions are acceptable for confined space entry prior to entry.
5. Provide adequate equipment to confined space entrants and attendants, including testing and monitoring equipment; ventilating equipment, communications equipment, personal protective equipment, lighting equipment, barriers and shields, ladders, rescue equipment, and any other equipment deemed necessary for safe confined space entry and exit. The GSI Land-Based RDTE Facility Operations Manager is responsible for providing, maintaining and ensuring proper storage of the equipment.

Operation and Maintenance

1. Ensure that all personnel responsible for performing maintenance operations on GSI land-based facility equipment have available to them and understand the service procedures for that specific piece of equipment prior to initiating the maintenance. The GSI Land-Based RDTE Facility Operations Manager is responsible for providing copies of all service documents on-site.
2. Ensure that all pumps are turned off prior to any service procedures being undertaken.
3. Maintain all equipment in proper working order. Keep equipment free from improper modifications that may result in impaired function, unsafe conditions, shortened machine

life, and/or voided warranties.

4. Ensure that all personnel involved with energy isolating devices at the facility have available to them and understand the GSI's *Lock Out, Tag Out Policy*. The GSI Land-Based RDTE Facility Operations Manager is responsible for making copies of this document available on-site.
5. Ensure that all relevant connections and equipment are secured before operating and/or servicing facility equipment.
6. Consult the GSI Land-Based RDTE Facility Operations Manager before unbolting any tank hatches, pitots or blanks. Tank hatches, pitots and blanks must never be loosened or opened when under pressure.
7. Avoid welding, soldering, or using a torch near pressurized fluid lines or tanks.

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

1. Conduct all quality assurance/quality control procedures according to the GSI/QAPP/1 - Quality Assurance Project Plan (QAPP) for Great Ships Initiative Bench-Scale and Land-Based Biological Tests (2009).
2. Follow all procedures outlined in this SOP. Any deviations known ahead of time must be approved by the GSI Principal Investigator or one of the two Lead On-Site Investigators. Any deviations made during the experiment must be recorded and also approved by the GSI Principal Investigator or one of the two Lead On-Site Investigators as soon as practicable.
3. The GSI Land-Based RDTE Facility Operations Manager is responsible for ensuring that all forms, documents, logbooks and records associated with this SOP (i.e., confined space entry permit and logbook, daily safety checklist, visitor logbook, and training logbooks) are correctly filled out. He/she is also responsible for maintaining the forms, documents, logbooks and records at the facility and on file; and creating electronic copies and posting to the GSI Sharepoint website for storage, when relevant. QAQC spot-checks of these documents and the processes used to complete and maintain them will be undertaken periodically by GSI QAQC Officers. Problems identified by the spot-checks will be documented and included in a corrective action report.

DATA STORAGE AND ARCHIVING

1. Store and archive data according to GSI/QAPP/1 - Quality Assurance Project Plan (QAPP) for Great Ships Initiative Bench-Scale and Land-Based Biological Tests (2009).

2. Archive all hard- and electronic-copies of data and records generated for a period of five years.

REFERENCES AND RELATED DOCUMENTS

Cangelosi AA (2006). RDTE Facility for the Great Ships Initiative (GSI) (OAR-SG-2006-20000364). Project Proposal to the National Oceanic and Atmospheric Administration (NOAA).

Confined Space Policy for the Great Ships Initiative Land-Based Research, Development, Testing and Evaluation Facility, Superior, Wisconsin.

Great Ships Initiative website: www.greatshipsinitiative.org.

Great Ships Initiative Standard Operating Procedures: <http://www.nemw.org/GSI/protocols.htm>.

GSI/QAPP/1 - Quality Assurance Project Plan for Great Ships Initiative (GSI) Bench-Scale and Land-Based Biological Tests (2009).

Lock Out, Tag Out Policy for the Great Ships Initiative Land-Based Research, Development, Testing and Evaluation Facility, Superior, Wisconsin.

Spill Prevention, Control, and Countermeasure (SPCC) Plan for the Great Ships Initiative Land-Based Research, Development, Testing and Evaluation Facility, Superior, Wisconsin.

APPENDIX A - GSI Land-Based Facility Daily Safety Check List

- Relevant health and safety documents (i.e., *Spill Prevention Control and Countermeasure Plan*, *Confined Space Policy*, and *Lock Out, Tag Out Policy*) and logbooks (i.e., personnel training logbook, visitor logbook, confined space entry logbook) are current and available on-site.
- Health and safety signage is properly positioned and in good working order.
- On-site personnel have received adequate health and safety training.
- On-site equipment/facility operators are adequately qualified and/or certified.
- Workspaces, walkways and platforms are clear of all unnecessary equipment; warning signs have been placed near those hazards that cannot be removed.
- Lists of emergency contacts and phone numbers are current and properly positioned; all on-site personnel are aware of their location.
- First aid kits are well-stocked and all on-site personnel are aware of their location.
- Eyewash stations are full and all on-site personnel are aware of their location and proper use.
- The emergency shower water supply is on and all on-site personnel are aware of its location and proper use.
- On-site personnel are aware of the location of fire extinguishers, floating life rings, emergency shut-off buttons, alarms and any other emergency equipment.
- On-site personnel are correctly attired and have been provided with personal protective clothing and equipment.
- All hazardous materials, including chemicals, are stored in appropriate containers within properly designated areas and in accordance with the manufacturer's recommendations.
- Relevant on-site personnel are aware of the location of hazardous material reference documents, including MSDSs.
- Relevant on-site personnel are aware of emergency procedures in the event of a chemical spill as outlined in the facility's *Spill Prevention Control and Countermeasure (SPCC) Plan*.
- All piping, valves and pumps are secure, tank hatches are properly closed, tanks bolts are secure, and pitot ports are closed and secure.

GSI Land-Based RDTE Facility Operations Manager:

Name _____

Signature _____ Date _____