

## STANDARD OPERATING PROCEDURE

### Procedure for Collecting Intake and Discharge Water in Sample Collection Tubs via In-Line Sample Ports

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#### RECORD OF AMENDMENTS:

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1	05/20/2011	Changed title. Added text to "Introduction". Replaced Appendix 1 and added Appendix 2. Added text throughout § "Filling the Sample Tubs on Intake" and § "Filling the Sample Tubs on Discharge" to specify that the sample design is specified in the TQAP or test plan.	7		
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## **STANDARD OPERATING PROCEDURE**

### **Procedure for Collecting Intake and Discharge Water in Sample Collection Tubs via In-Line Sample Ports**

#### **BACKGROUND**

The Great Ships Initiative (GSI) is a regional effort devoted to ending the problem of ship-mediated invasive species in the Great Lakes-St. Lawrence Seaway System and globally. In support of that goal, the GSI has established superlative freshwater ballast treatment evaluation capabilities at three scales—bench, land-based, and on board ship. Each scale is dedicated to addressing specific evaluation objectives. These include:

##### *GSI Bench-Scale Tests*

- Range finding for effective treatment dose against diverse freshwater taxa and water quality conditions;
- Generation of freshwater relevant chemical degradation curves; and
- Estimation of residual toxicity given diverse freshwater taxa and water quality conditions.

##### *GSI Land-Based Tests*

- Pre-certification testing, i.e., operational and biological performance (including residual toxicity) status-testing given scale-up and a range of challenge conditions; and
- Certification/verification testing, i.e., formal assessment of performance against international and other discharge standards.

##### *GSI Shipboard Tests*

- Confirmation of biological and operational treatment performance as expected in the ship environment;
- U.S. Coast Guard Shipboard Technology Evaluation Program (STEP) testing;
- Shipboard type approval testing;
- Ship discharge monitoring; and
- Methods development.

GSI awards its independent status-testing services to candidate systems only if technical and programmatic criteria are met. Decisions are based on third party technical assessments as well as GSI Advisory Committee programmatic input. Testing services are currently offered at no cost to the developer with the exception of transportation and system installation/removal costs. Instead, tests are supported by general project funds which derive from federal and state agency grants, Great Lakes port contributions, and in-kind contributions by local governments and universities.

GSI has no involvement, intellectual or financial, in the mechanics, design or market success of the actual treatment systems it tests. To ensure GSI remains completely independent and is uncompromised by any real or perceived individual or project bias, GSI subjects itself to rigorous quality management policies and procedures. In addition, GSI test activities are subject to rigorous QAQC procedures and documentation. This attention to quality management and QAQC assures the high quality and credible evaluation of both GSI and its findings.

## INTRODUCTION

This GSI Standard Operating Procedure (SOP) describes collection of sample water at the GSI Land-Based RDTE Facility as continuous, time integrated samples using in-line sample ports. This SOP must be used in conjunction with *GSI/SOP/LB/G/O/3 – Procedure for Cleaning and Verifying Cleanliness of the Retention Tanks and Piping at the GSI Land-Based RDTE Facility* and *GSI/SOP/LB/G/O/4 – Procedure for Cleaning Sampling Equipment at the GSI Land-Based RDTE Facility* to ensure that the control and treatment retention tanks, sample collection tubs, and all sample collection equipment (e.g., net reservoirs, plankton nets with cod ends, sample bottles, etc.) have been cleaned after the previous sampling event in preparation for the current sampling event.

An appropriate volume of sample water is collected into each 3.8 m<sup>3</sup> sample collection tub, as specified in the Test/Quality Assurance Plan (TQAP) or other planning documentation. The sample water is used for phytoplankton, microbial, and zooplankton sample collection and analysis. It is also used for water quality sample collection and measurement using YSI Multiparameter Water Quality Sondes. The GSI SOPs for each of these routine methods are as follows:

- *GSI/SOP/LB/RA/SC/3 - Procedure for Algae/Small Protozoa Sample Collection*
- *GSI/SOP/LB/RA/SC/4 - Procedure for Microbial Sample Collection*
- *GSI/SOP/LB/RA/SC/2 – Procedure for Collecting Physical/Chemical Data and Samples at the GSI Land-Based RDTE Facility*
- *GSI/SOP/LB/RA/SC/6 - Procedure for Zooplankton Sample Collection*

All phytoplankton, microbial, and water quality samples are collected from the appropriate sample collection tubs (as specified in the TQAP or other planning documentation) immediately after each intake or discharge operation is complete. Following collection of phytoplankton and microbial samples, and collection and measurement of sample collection tub water quality parameters, the first zooplankton sample is collected. Zooplankton samples are collected sequentially, with the first sample collection tub being filtered and, analyzed, followed by the filtering and analysis of the subsequent sample collection tubs as specified in the TQAP.

## EQUIPMENT

- Six 3.8 m<sup>3</sup> sample collection tubs with attached yardsticks, plankton net hooks and drainspouts; each tub also has a drainspout nozzle and flexible drainspout hose connected with quick-connect fittings.
- At least two pairs of 130 L plastic barrels with 3.8 cm ID bottom drains to serve as plankton net support and filtrate collection reservoirs, each pair has their drains fitted with a union fitting allowing the drains to be joined; one pair is used with untreated water samples (Control and Pre-Treatment), the other with treated water samples (Post-Treatment).
- Six plankton nets (30 cm diameter mouth; 90 cm length; 35 µm mesh) with cod ends.

## SUPPLIES

- Protective eyeglasses/goggles and gloves (if a chemical treatment is to be tested).
- Sample collection bottles for chemistry, phytoplankton, and microbial samples.
- Cod ends for zooplankton samples
- Preprinted sample bottle labels.
- One clipboard, preprinted data sheets and pen for each sampling event.

## PROCEDURE

### Preparation

1. Ensure that the retention tanks and facility piping are cleaned prior to sampling operations according to *GSI/SOP/LB/G/O/3 – Procedure for Cleaning the Retention Tanks and Other Equipment at the GSI Land-Based RDTE Facility*. Clean all necessary sampling equipment following the procedure outlined in *GSI/SOP/LB/G/O/4 – Procedure for Cleaning Sampling Equipment at the GSI Land-Based RDTE Facility*.
2. Prepare all data recording sheets and attach to clipboards.
3. Label plankton net cod ends and all chemical, phytoplankton and microbial sample collection bottles with the relevant sample identification nomenclature as directed in *GSI/SOP/G/RA/SC/3 - Procedure for Labeling Samples Collected at the GSI Land-Based RDTE Facility*.
4. Position all collection equipment (net reservoirs, plankton nets with cod ends, coolers with labeled bottles, etc.) by the appropriate sample collection tubs.
5. Ensure that all manual valves in the collection system are properly set for the test scenario as specified in the TQAP or other planning documentation and following the *GSI SOP/GSI/SOP/LB/G/O/1 - Procedure for Operating the GSI Land-Based RDTE Facility*.
6. When preparations are complete, notify the GSI Facility Operations Manager (GSI-FOM) engineer that the system is ready to start the appropriate pump.

### Filling the Sample Tubs on Intake

1. Flush the main intake line for three minutes, as specified in *GSI/SOP/LB/G/O/1 – Procedure for Operating the GSI Land-Based RDTE Facility*.
2. Following initial line flushing, open the control and treatment track diaphragm valves, switching the water flow from the intake bypass to the control and treatment tracks (see *GSI/SOP/LB/G/O/1*).
3. As water begins to flow into the sample collection tubs, record the “start time” on the

data sheet (Appendix 1). Focus on recording the start times for the first and last tub to start filling; record other start times as possible.

4. The sample collection tubs (selected from #1-#6) to be filled on intake are dependent on the ballast treatment technology being tested and will be specified in the TQAP or other test plan. Collection tub fill operations are conducted concurrently and are continuous throughout the entire intake operation until the control and treatment retention tanks are filled to the appropriate volume (maximum of 200 m<sup>3</sup>) and the main intake pump is shut off.
5. A maximum volume of 3.6 m<sup>3</sup> can be collected in each sample collection tub, however, the exact volume of sample water will be dependent upon the treatment technology being tested and will be specified in the TQAP or other planning documentation. Typically at GSI, four sample collection tubs are used during intake as follows:
  - a. Control water directed through SP2A/B fills collection tubs #1 and #2, respectively.
  - b. Water directed from SP3A/B fills treatment track collection tubs #4 and #5, respectively (see Figure 3).
  - c. If required by the TQAP, collection tub #6 can be filled with post-treatment water from SP15.
6. Monitor the sample collection tubs throughout the intake process to ensure that they contain similar volumes of water.
7. When the control and treatment retention tanks are filled to the appropriate volume (as specified in the TQAP), close the sample collection tub diaphragm and manual intake valves and record the “stop time” on the data sheet (Appendix 1).
8. Measure the water depth in each tub using the yardstick attached to the side of the tub and record on the data sheet (Appendix 1). This measurement serves as a backup of the flow meter measurement; however, it is an approximation of the volume in each sample collection tub and is not an accurate measurement.
9. Record the volumes of water collected in each collection tub and the total amount of water in each tank from the auto-logged operational data on the GSI Human-Machine Interface (as measured by flow meters that are accurate to  $\pm 0.5\%$  of reading) and record on the data sheet (Appendix 1).

### **Filling the Sample Tub on Discharge or Recirculation**

1. See **Preparation** Section above.
2. Open the treatment (or control) tank discharge valve and start the discharge/recirculation pump (see *GSI/SOP/LB/G/O/1*).
3. Drain treatment tank and control tank in sequence (typically the treatment retention tank

is sampled first). Time the second tank drain to synchronize the second tank's zooplankton sample collection with completion of first tank's zooplankton sample analyses, preferably within 2 hours.

4. Upon commencement of the discharge process from either the treatment or the control tank and as water begins to flow into the sample collection tubs, record the "start time" on the data sheet (Appendix 2). Focus on recording the start times for the first and last tub to start filling; record other start times as possible.

The sample collection tubs (#1-#3 for control discharge and #4-#6 for treatment discharge) to be filled on discharge are dependent on the ballast treatment technology being tested and will be specified in the TQAP or other test plan. A maximum volume of 3.6 m<sup>3</sup> can be collected in each sample collection tub, however, the exact volume of sample water will be dependent upon the treatment technology being tested and will be specified in the TQAP or other planning documentation. Typically at GSI, six sample collection tubs are used during treatment and control discharge as follows:

- a. Fill sample collection tubs #4, #5 and #6 during treatment discharge (or #1, #2, and #3 for the control tank) with water directed from SP9A/B/C, collecting water throughout the entire discharge/recirculation process.
5. Monitor the sample collection tubs throughout the discharge process to ensure that they contain similar volumes of water.
  6. When the main tank has completed draining, and the collection tub diaphragm and manual valves have been closed, record the "stop time" on the data sheet (Appendix 2).
  10. Measure the water depth in each tub using the yardstick attached to the side of the tub and record on the data sheet (Appendix 2). This measurement serves as a backup of the flow meter measurement; however, it is an approximation of the volume in each sample collection tub and is not an accurate measurement.
  7. Record the volume of water collected in each collection tub and the total amount of water drained from each tank from the auto-logged operational data on the GSI Human-Machine Interface (as measured by flow meters that are accurate to  $\pm 0.5\%$ ) and record on the data sheet (Appendix 2).

### **Collecting Samples from the Filled Tubs**

1. Once the tubs have been filled, water for chemical, microbial, phytoplankton and zooplankton samples can be taken following procedures in *GSI/SOP/LB/RA/SC/2 – Procedure for Collecting Physical/Chemical Data and Samples at the GSI Land-Based RDTE Facility*, *GSI/SOP/LB/RA/SC/3 - Procedure for Algae/Small Protozoa Sample Collection*, *GSI/SOP/LB/RA/SC/4 - Procedure for Microbial Sample Collection*, and *GSI/SOP/LB/RA/SC/6 - Procedure for Zooplankton Sample Collection*. Note that all chemical, phytoplankton and microbial samples are collected immediately. When water for more than one zooplankton sample has been collected (e.g., on fill) in a single event,

the first zooplankton sample is collected immediately after the chemical, phytoplankton and microbial samples and after the water quality parameters have been measured by the YSI Multiparameter Water Quality Sonde. The collection of subsequent zooplankton samples is timed to match the completion of the analysis of the previous zooplankton sample. Record the time that each sample is collected on the data sheet (Appendix 1 and 2).

2. After sample collection, clean the sample collection tubs and all sample collection equipment (net reservoirs, plankton nets with cod ends, sample bottles, etc.) in preparation for the next sampling event as directed in *GSI/SOP/LB/G/O/4 - Procedure for Cleaning Sampling Equipment at the GSI Land-Based RDTE Facility*.
3. Drain all system piping downstream of the main intake line after the sampling event.

### **QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)**

1. Conduct all quality assurance/quality control procedures according to *GSI/QAQC/QAPP/LB/1 - Quality Assurance Project Plan (QAPP) for Great Ships Initiative Land-Based Tests (2011)*.
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. Ensure that a second individual checks the log books and data sheets for completeness following each collection event.
4. Ensure that the volume of water in each replicate collection tub is within 10 % of the mean for that sampling event. If volumes vary greatly, this indicates a likely mechanical problem with the flow meters that would require maintenance.

### **DATA STORAGE AND ARCHIVING**

1. Store and archive data according to *GSI/QAQC/QAPP/LB/1 - Quality Assurance Project Plan (QAPP) for Great Ships Initiative Land-Based Tests (2011)*.
2. Archive all hard- and electronic-copies of data and records generated for a period of at least seven years.

### **REFERENCES AND RELATED DOCUMENTS**

Great Ships Initiative website: [www.greatshipsinitiative.org](http://www.greatshipsinitiative.org).

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

GSI/QAQC/QAPP/LB/1 - Quality Assurance Project Plan (QAPP) for Great Ships Initiative Land-Based Tests (2011).

GSI/SOP/LB/G/O/3 - Procedure for Cleaning and Verifying Cleanliness of the Retention Tanks and Piping at the GSI Land-Based RDTE Facility

GSI/SOP/LB/G/O/1 – Procedure for Operating the GSI Land-Based RDTE Facility.

GSI/SOP/G/RA/SC/3 - Procedure for Labeling Samples Collected at the GSI Land-Based RDTE Facility

GSI/SOP/LB/RA/SC/3 - Procedure for Algae/Small Protozoa Sample Collection.

GSI/SOP/LB/RA/SC/4 - Procedure for Microbial Sample Collection.

GSI/SOP/LB/RA/SC/6 - Procedure for Zooplankton Sample Collection.

GSI/SOP/LB/RA/SC/2 – Procedure for Collecting Physical/Chemical Data and Samples at the GSI Land-Based RDTE Facility.

# **APPENDIX 1**

**GSI/FORM/LB/C/1: Sample Collection Form for Intake Samples Collected  
from the Sample Collection Tubs**

Ballast Treatment System Test Sample Collection Form (GSI/FORM/LB/C/1)							
Sample Collection Tub Intake (F) Samples				System Name: _____			
Date				Test #			
Duration	Days			Hours			
Collection Team							
Sample Collection Scenario - Fill Control and Treatment Tanks at same time							
Note which tanks are being filled	C1 T1			C2 T2			
Collect water in up to 6 tubs							Harbor ZP Pre-Trial
Sample Point and Port	SP3A	SP3B	SP3C	SP2A	SP2B	SP2C	
Tub #	4	5	6	1	2	3	
Time start line flush		Time valves operated manually		Time end fill	12456	3	
Time Tubs start fill							
Total amount of water in tank (US Gal)	Treatment			Control			
Height of water placed in Sampling Tub	SP3A	SP3B	SP3C	SP2A	SP2B	SP2C	
	4 (PT)	5 (PT)	6 (T)	1	2	3	
Total amount of water placed in Sampling Tub (US Gal)							
Collect phytoplankton, microbial, chemistry and zooplankton samples as directed by workplan; record sonde data on Sonde Datasheet							
Time phytoplankton (PP) collected							
Phyto discard/sample volume (l)							
Time microbes (MA) collected							
Microbial sample volume (l)							
Time zooplankton (ZP) collected							
Weather:	Time:			Sky:			
	Air Temp:			Wind:	@	kts.	
	Water Temp:			Water Level:	in. Above LWD		
Notes:							

## **APPENDIX 2**

**GSI/FORM/LB/C/2: Sample Collection Form for Discharge Samples  
Collected from the Sample Collection Tubs**

<b>Ballast Treatment System Test Sample Collection Form (GSI/FORM/LB/C/2)</b>								
<b>Sample Collection Tub Discharge (D) Samples</b>				<b>System Name:</b> _____				
Date				<b>Test #</b>				
Collection Team								
Sample Collection Scenario - Drain <b>Treatment</b> and then <b>Control</b> Tank								
Note which tanks are being used		C1 T1			C2 T2			
		Collect <b>Treatment (T)</b> water in up to 3 tubs			City Water		Collect <b>Control (C)</b> water in up to 3 tubs	
Sample Point and Port	SP10C	SP10B	SP10A	SP10B	SP10C	SP10B	SP10A	
TUB #	4	5	6	5	1	2	3	
Time pump started								
Time Tubs start filling								
Time pump stopped								
		<b>Treatment</b>			<b>Control</b>			
Total volume discharged from Tank (US Gal)								
Height of water placed in Sampling Tub	SP10C	SP10B	SP10A	SP10B	SP10C	SP10B	SP10A	
	4 (T)	5 (T)	6 (T)	5 (W)	1	2	3	
Total volume of water placed in Sampling Tub (US Gal)								
Collect phytoplankton, microbial, chemistry and zooplankton samples as directed by workplan; record sonde data on Sonde Darasheet								
	4	5	6	5	1	2	3	
Time phytoplankton (PP) collected								
Phyto discard/sample volume (l)								
Time microbes (MA) collected								
Microbial sample volume (l)								
Time zooplankton (ZP) collected								
Time 2nd cod end collected								
Notes:								