RECEIVED
SEP 0 9 2005
DER/HAZ. WASTE REMED
REGION 8

Work Plan for Phase II (Treatability Testing) of the Draft IRM Work Plan for *In-Situ* SS to Control NAPL Seeps at the East Station Former MGP Site, Rochester, New York

MSVCA Index #B8-0535-98-07
Site # V00358-8

Prepared for:

Rochester Gas & Electric Corporation
89 East Avenue
Rochester, NY 14649

Prepared by:

Ish Inc.
804 Salem Woods Drive, Suite 201B
Raleigh, NC 27615-3313

September 2005

Work Plan for Phase II (Treatability Testing) of the Draft IRM Work Plan for *In-Situ* SS to Control NAPL Seeps at the East Station Former MGP Site, Rochester, New York

WORK PLAN FOR PHASE II (TREATABILITY TESTING)
FOR *IN-SITU* SOLIDIFICATION/STABILIZATION
EAST STATION FORMER MGP SITE
ROCHESTER, NEW YORK

This work plan summarizes the findings of the IRM Phase I remedial design investigation undertaken at the RG&E East Station Former MGP Site in Rochester, New York, and provides detail on laboratory treatability testing to evaluate mixtures for the application of *in-situ* solidification/stabilization (ISS) at the site.

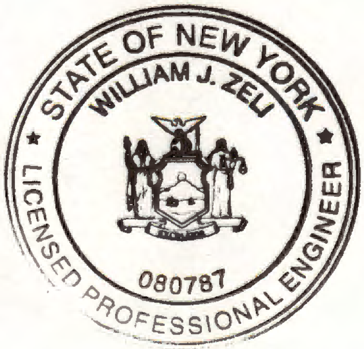
PROFESSIONAL ENGINEER CERTIFICATION

I, William J. Zeli, a Professional Engineer registered in the State of New York, certify that I have reviewed the work plan referenced above and that, to the best of my knowledge and belief, the work plan properly presents the activities to be undertaken to evaluate mixtures for the ISS process.

9/6/05

William J. Zeli, P.E.
New York License No. 080787
MTR Engineering, Inc.

Date



UNAUTHORIZED
ALTERATION
OF THIS ITEM
IS UNLAWFUL

1
INTRODUCTION

This work plan provides the details on the laboratory treatability testing plan for the proposed ISS technology use at the East Station site. This work plan is a supplement to the work plan entitled *Draft IRM Work Plan For In-Situ Solidification/Stabilization (ISS) to Control NAPL Seeps at the Former East Station MGP Site, Rochester, New York,* dated October, 2003 (ISS IRM Work Plan). Specifically, the treatability testing is identified as Phase II in the ISS IRM Work Plan. The remaining portion of this section provides an overview of the ISS IRM Work Plan.

Rochester Gas and Electric Corporation (RG&E) owns property at 86 Smith Street in Rochester, New York that was formerly operated as a manufactured gas plant (MGP) referred to as the former East Station MGP. RG&E initiated and completed three site investigations (SI) between 1992 and 1999. A focused feasibility study (FFS) was subsequently performed in 2001 by Ish Inc. for RG&E. RG&E selected to pursue an Interim Remedial Measure (IRM) to be performed to mitigate NAPL seeps at the riverbank as one of the priority actions for implementation at the East Station site under a multi-site voluntary cleanup agreement executed with NYSDEC in April 2003. RG&E submitted to NYSDEC in October 2003 the draft IRM work plan for In-Situ Solidification/Stabilization (ISS) to control NAPL seeps at the East Station former MGP site. The NYSDEC approved the implementation of Phase I of the ISS IRM Work Plan to carry out Remedial Design Investigation (RDI) to determine the suitability of the physical and chemical conditions of the site for implementing the ISS technology. The field work and the laboratory analyses of the samples for Phase 1 were completed in December 2003 and early January 2004. The report on IRM Phase I RDI entitled *Report on IRM Phase I Remedial Design Investigation to Mitigate NAPL Seeps at the East Station MGP Site, Rochester, New York* (ISS IRM Phase I RDI Report) was submitted to the NYSDEC on February 3, 2004. In August 2005, the NYSDEC approved the commencement of Phase II of the proposed ISS IRM Work Plan to carry out laboratory treatability tests in order to develop the optimum mixture for the ISS process to be implemented at the East Station former MGP site. RG&E retained Ish Inc. to prepare and implement work plans for Phases I and II of the ISS IRM Work Plan.

To recapitulate, the ISS IRM Work Plan consists of four phases:

- **Phase I** is a Remedial Design Investigation (RDI) to determine if physical characteristics of the target ISS area are suitable for proceeding with the next phases of the IRM effort. The components of this RDI phase involve soil boring/rock coring, test pitting, and collecting soil samples for chemical characterization and treatability testing. **(This phase has been completed)**

- **Phase II** will be implemented if the results from the Phase I RDI indicate the physical characteristics of the East Station site are suitable for the ISS technology, and will consist of designing and carrying out laboratory treatability tests to establish the optimum mixture for the ISS process and to develop the performance measures for stabilized material. **(This ISS treatability testing work plan is for implementation of Phase II)**

- **Phase III** will consist of preparing the engineering design and construction specifications for ISS application to the East Station site if the results of the treatability testing yields a suitable mixture that will meet the desired criteria as identified in this work plan. The design package will be utilized as the bid document to select the construction contractor. **(For future NYSDEC approval and then implementation)**

- **Phase IV** will consist of selecting the construction contractor and then carrying out the in-situ stabilization/solidification construction work and documenting the IRM implementation. **(For future NYSDEC approval and then implementation)**.

1.1 OBJECTIVES

The specific objectives of this Phase II work are:

- To carry out laboratory bench-scale treatability tests using the East Station soil/geological materials collected during the Phase I RDI to develop an optimum blend of cements, clays, water and other reagents for stabilization/solidification of the East Station area NAPL containing soil material; and

- To establish the performance measures for the stabilized material, in particular for permeability, unconfined compressive strength (UCS) and leachability of the NAPL constituents.

2
FINDINGS AND CONCLUSIONS FROM PHASE I REMEDIAL DESIGN INVESTIGATIONS

Based on the findings and conclusions developed during the Phase I RDI field work and from the previous site investigations completed in 1992 and 1998-1999, the physical subsurface conditions in the proposed target ISS area at the East Station site appear suitable for the ISS technology proposed to mitigate/eliminate the potential contribution of NAPL along the river bank of the Genesee River. The Phase I RDI findings and conclusions are summarized in the subsections below.

2.1 SUMMARY OF IRM WORK PLAN PHASE I OBJECTIVES AND FINDINGS

The overall goal for the IRM is to mitigate/eliminate the potential contribution of NAPL seeps along the river bank using a physical-chemical process of in-situ stabilization/solidification to immobilize and halt the potential migration of NAPL towards the river bank. The ISS technology combines the benefits of a physical barrier for containment with treatment of impacted material via solidification/stabilization to eliminate the availability of the contaminants to impact the subsurface.

As indicated in the ISS IRM Work Plan report, the ISS IRM work was structured to be carried out in four distinct phases (These four phases were described above). If during the Phase I activities (RDI) it was determined that design and implementation of site-specific ISS was not feasible because of the site physical conditions, then Phases II through IV would not be carried out and an alternative approach would be pursued. Conversely, if the completed RDI work in Phase I indicated that the physical conditions were conducive to the ISS technology application, then Phases II through IV would be subsequently carried out.

The findings and conclusions from the Phase I RDI recommend that the next phase (Phase II) of the ISS IRM remedy should proceed.

2.2 ISS REMEDY FOR THE MITIGATION OF NAPL SEEPS

In summary, the Phase I RDI work generated the following information as the basis for designing the ISS technology to mitigate the potential for contribution of NAPL to the river bank:

- The general vertical profile of the subsurface is comprised of fill material consisting primarily of reworked silt with lesser amounts of C/D debris, an alluvial layer, shale with a weathered surface (southern area only), and underlain by limestone;
- Depth to groundwater occurs at approximately 10 to 19 feet bgs (deeper toward south), with perched zones present in some areas;
- The subsurface appears to be free of remnants of former structures and large construction/demolition debris with the exception of the foundation of the former light oil plant, which would have to be removed to prepare the site for a stabilization/solidification remedy;
- Purifier box material is present in the northern portion of the ISS target area;
- Limited amount of NAPL is present in the soil in the saturated zone at depths of 10 to 15 feet below grade; and
- Approximately 10 to 15 feet of NAPL-free overburden material (thicker toward south) is present in the target ISS area, above the 10 to 12 feet thick interval targeted for solidification/stabilization.

The conclusion from Phase I RDI to proceed with the next phases of the IRM work plan is based on the observations that the overburden soils do not contain significant quantities of C&D fill material and that the underlying shale is highly weathered and conducive to penetration by the ISS mixing augurs to a depth sufficient to mitigate the potential contribution of NAPL to the river bank to the west.

The overburden soils data indicate that NAPL is not generally present in the soils in the unsaturated zone enabling a remedy design involving excavation, stockpiling and reusing the NAPL-free soils. The Phase I RDI effort also indicates and confirms that some NAPL is present in varying amounts in the 1 to 3 feet thick zone in the severely weathered shale bedrock and also in a 1 to 2 feet thick zone of overburden material above the weathered shale. The field investigations during Phase I RDI did not indicate presence of DNAPL "pools".

Conceptually, it is still anticipated that a volume of material about 14 to 27 feet wide, approximately 1,000 feet long and about 10 to 12 feet thick will be stabilized/solidified by the ISS technology to mitigate the potential of NAPL seeps at the East Station site.

3
TREATABILITY TESTING PROGRAM

The treatability testing program will be conducted in phases so that information is accumulated in an organized, step-by-step fashion. By necessity, formulating mixtures with contaminated soils involves iteration in order to produce successful results. Limiting the number of iterations can limit the degree of optimization. A knowledgeable and informed starting point is important in limiting testing time. Using a phased testing program permits allowances for both the construction and technical requirements of the work and any unexpected results obtained during the laboratory work. Each new step builds upon the previous successful step toward a practical solution within what should be a reasonable schedule.

ISS treatment relies on injecting and mixing reagents through a drill rig *in-situ*. Workability is a significant consideration with ISS treatment and mixtures must be sufficiently workable to maximize performance. Workability tests will be performed during each stage of the testing program to ensure that the selected mixture can be implemented using ISS.

The following phases of laboratory testing are planned:

- ***Phase I: Untreated Material Characterization***
  In this phase, all samples collected in the field during the RDI work (including average case, worst case and other cases - if necessary) will be tested and evaluated as described in Section 3.1.

- ***Phase II: Preliminary Solidification Testing***
  In this phase, a number of reagents mixtures will be subjected to simple tests for workability, strength and slake as indicated in Section 3.2.

- ***Phase III: Intermediate Solidification Testing***
  In this phase, Unconfined Compressive Strength (UCS), SPLP, and hydraulic conductivity tests on various mixtures will be performed to refine the reagent mixtures described in Section 3.3.

- ***Phase IV: Optimization Testing***
  In this phase, the reagent mixtures will be tested as described in Section 3.4 so that the optimum mixture of reagents can be selected.

The following subsections describe in detail each phase of the laboratory treatability testing work plan.

3.1 PHASE I: UNTREATED MATERIAL CHARACTERIZATION

During Phase I RDI investigations, composite samples of the target area material were collected for ISS treatability testing, placed in 5-gallon buckets with plastic lids, and were delivered to META Environmental, Inc. for storage. The samples have been maintained in refrigerated storage at a temperature of 4°C. The four (4) composite treatability testing samples were obtained by combining material from the soil borings covering the proposed ISS area. Details of the soil borings and compositing are reported in the Phase I RDI investigation report. Advanced Terra Testing laboratory located in Lakewood, CO has been selected to conduct the treatability testing work. The stored samples were delivered to the laboratory for testing in mid- August 2005. The laboratory will homogenize the untreated soil samples by combining the 5-gallon containers to provide a more uniform composite material for treatability testing. The homogenization will use stainless steel instruments and cool conditions to minimize volatilization loss of organic compounds. To insure the reproducibility of the tests, particles larger than 0.5 inch in diameter will be removed.

After homogenization, representative aliquots of the soils will be collected for characterization prior to the treatability testing work. One untreated sample will be tested for selected chemicals, leaching potential, and physical properties. These properties are necessary to provide the basis for the selection of solidification reagents:

Untreated Material Characterization	Test Methods
Total VOCs and SVOCs	EPA 8260B/8270C
SPLP[(1)] for VOCs and SVOCs	EPA 1312/8260B/8270C
Soil pH	ASTM D4972
Grain size and plasticity	ASTM D422/D4318
Moisture content	ASTM D2216
Loss On Ignition	ASTM D2974

(1) Synthetic Precipitation Leaching Procedure

3.2 PHASE II: PRELIMINARY SOLIDIFICATION/STABILIZATION TESTING

The treatability testing program will use varying combinations and amounts of reagents to create solidified/stabilized materials that meet or exceed the project criteria. We are striving to achieve 10^{-6} cm/sec permeability and a UCS of 50 psi at 28 days curing time. It is expected that Portland cement in the amounts from 1.4% to 16% on a dry weight basis will be tested. Table 1 provides a preliminary list of the various reagent mixes that may be considered and their relative proportions for testing. Most of the mixtures will be based on similar mixtures used on previous successful projects at other MGP sites in the U.S.

Table 1: Preliminary List of Treatability Mixes

Reagents	Treatability Sample Number					
	1	2	3	4	5	6
Water (approximately)	30%	30%	30%	30%	30%	30%
Portland Cement	8%	1.4%	12%	2.2%	16%	2.9%
Blast Furnace Slag	0%	5.8%	0%	8.6%	0%	11.5%
Other (Bentonite Clay)	0%	0.35%	1%	0.35%	1%	0.35%

Reagents (i.e., Portland cement and blast furnace slag) will be selected based on local availability, suitability for solidification, and cost. Cement and slag are known to be readily available in the Rochester area, based on past experience, and have been used successfully on past MGP ISS projects elsewhere. Other additives, such as clays, dispersants, and thinners may be incorporated into the mixtures to improve workability, set time, impermeability, and chemical stabilization. Tap water will be used for mixing with reagents to create a grout. The use of a fluid grout for construction will minimize dust and vapor concerns, improve mixing efficiency, and ensure cement hydration.

The laboratory blending process has been developed to mimic the full-scale solidification process on a laboratory scale. First, a fluid grout is created by blending pre-weighed proportions of water and reagent in a high-speed mixer. This high speed mixing for blending of water and reagents is intended to simulate the preparation of the grout mix in the field plant setup. Viscosity and density of the grout may be measured to gauge workability. Next, the fluid grout is added to a measured proportion of the untreated materials in a lower-speed mixer and blended together for 60 to 120 seconds or until homogeneous. The lower speed mixing simulates the field scale augur mixing. The "wet" treated material is next placed into plastic molds that measure 2" in diameter by 4" long. Air voids in the specimens are minimized by tamping, rodding and/or vibrating. The specimens are covered and cured in a temperature and moisture controlled room until tested. Usually, about 6 to 10 specimens are made of each mixture in each phase to provide sufficient samples for testing plus reserves.

The preliminary solidification testing will begin by formulating about 6 reagent mixtures to test a range of reagents and percent application rates. During this testing, the workability of the grout (viscosity and density) and the grout/soil mixture (slump and density) will be evaluated. If excessive heat is generated during mixing, temperature (or vapors as measured by PID) will be monitored. As the samples harden, simple penetration tests will be conducted (at 1, 3, 5 and 7 days) to see if the local reagents satisfy basic solidification criteria (i.e., strength). In addition, the solidified samples will be subjected to visual observations for NAPL. Solidified samples will be immersed in water after 7 days of curing to observe for any sheen or disintegration of the sample (i.e., slaking). These tests are useful in narrowing the range of percent application rates of the reagents. This round of tests will usually require about two weeks. A list of tests to be completed on the stabilized/solidified material in Phase II is as follows:

Preliminary Solidification Testing	Test Methods
Temperature	Standard Thermometer
Grout Viscosity & Density	API RP 13B-1
Slump & Wet Density	ASTM C143/D4380
Visual Observations and Slake	ASTM D4644(mod)
Pocket Penetration Resistance	ASTM D1558(mod)
UCS (7 days)	ASTM D1633

3.3 PHASE III: INTERMEDIATE SOLIDIFICATION TESTING

A second round of testing is used to refine the reagent mixtures, make additional samples, and measure strength, leaching potential (via SPLP) and hydraulic conductivity of the solidified materials. About 6 reagent mixtures will be formulated in this phase. During this round, testing will concentrate on reducing the permeability and leaching properties of the treated materials while controlling the strength.

Testing will begin after 7 days of curing, as long as the samples have gained sufficient strength. Hydraulic conductivity tests will be performed using the flexible wall permeameter to model the effects of overburden pressures on the solidified materials. The hydraulic conductivity tests will model *in-situ* conditions of the solidified materials by imposing pressures on the specimen that are similar to the stresses the solidified materials will experience when buried in a treated monolith. The specimens will be permeated with standard laboratory water (alternatively groundwater from the site can be used) until steady state values are obtained. The goal is to achieve a permeability of 10^{-6} cm/sec.

Unconfined compressive strength (UCS) tests will also be performed during this round after curing for 7 and 28 days. A desirable UCS is in the range of 50 psi. SPLP leaching tests for semi-volatiles will also be carried out to evaluate reductions in leaching potential. A calculation will be made, based on mass balance, of the volume increase or swell resulting from treatment. The tests to be performed in Phase III are as follows:

Intermediate Solidification Testing	Test Methods
Grout Viscosity & Density	API RP 13B-1
Slump & Wet Density	ASTM C143/ D4380
SPLP VOCs and SVOCs (7 days)	EPA Method 1312/8270C
Hydraulic Conductivity (7 days)	ASTM D5084
UCS (7 & 28 days)	ASTM D1633
Volumetric Swell	Mass Balance Calculations

3.4 PHASE IV: OPTIMIZATION TESTING

This round of testing will focus on about 3 reagent mixtures that are the most promising. The goal will be to develop at least one and preferably two different mixtures that can be used for successful solidification/stabilization. The reason for developing two mixtures is to provide an alternate in case the source for one reagent becomes unavailable during construction. The purpose of this round of trial mixtures is to 1) better refine the cost of the materials, 2) optimize performance, and 3) provide some redundancy for evaluating test results. New batches will be made, tested and cured as before. These mixtures will be put through the physical tests and chemical tests listed below.

Optimization Testing	Test Methods
Grout Viscosity & Density	API RP 13B-1
Slump & Wet Density	ASTM C143/D4380
SPLP VOCs & SVOCs (28 days)	EPA Method 1312/8270C
Hydraulic Conductivity (28 days)	ASTM D5084
UCS (7 & 28 days)	ASTM D1633
Volumetric Swell	Mass Balance Calculations

Hydraulic conductivity and SPLP tests will begin after a 28-day curing period. Generally, SPLP and hydraulic conductivity test results improve as the samples harden. UCS tests will be performed at both 7 and 28 days to gauge the improvement in mixture physical properties with time.

After this round of tests, we expect to have two optimized mixtures that will successfully treat the coal tar impacted subsurface materials at the East Station site to mitigate/control NAPL seeps.

3.5 REPORTING

Following the four phases of the treatability testing, a report will be prepared to summarize the test procedures and present the findings and conclusions of the work.

3.6 TARGET DURATION SCHEDULE

Following is the target schedule for the implementation of the Phase II treatability studies to develop optimal mixes for the ISS remedy.

Testing Laboratory Selected	August 10, 2005
Carry out chemical characterization of samples (3.1)	September 6, 2005
Laboratory Mixing Tests & Measurements (3.2)	September 30, 2005
Laboratory Testing & Measurements (3.3)	October 30, 2005
Final Tests & Measurements (3.4)	November 30, 2005
Data Analysis & Report Preparation (3.6)	December 21, 2005