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Secondary Document

Construction Quality Control Plan for the Six-Phase Heating Treatability Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

DEPARTMENT OF ENERGY • UNITED STATES OF AMERICA •

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contributed to the preparation of this document and should not
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Secondary Document

Construction Quality Control Plan for the Six-Phase Heating Treatability Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—August 2001

Prepared for the
U.S. Department of Energy
Office of Environmental Management

Environmental Management Activities at the
Paducah Gaseous Diffusion Plant
Paducah, Kentucky 42001
managed by
Bechtel Jacobs Company LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-98OR22700

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ABBREVIATIONS AND ACRONYMS

ANSI	American National Standards Institute
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
bgs	below ground surface
BJC	Bechtel Jacobs Company LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPVC	chlorinated polyvinyl chloride
CQCP	Construction Quality Control Plan
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
ES&HP	Environmental, Safety, and Health Plan
EPA	U.S. Environmental Protection Agency
FS	feasibility study
GAC	granular activated carbon
gpm	gallons per minute
GWOU	Groundwater Operable Unit
HAZWOPER	Hazardous Waste Operations and Emergency Response
Hg	mercury
kV	kilovolt
kVA	kilovolt-amps, similar to kilowatts
MSDS	Material Safety Data Sheet
NIST	National Institute of Standards and Technology
NSF	NSF International, formerly National Sanitation Foundation
PCU	power control unit
PGDP	Paducah Gaseous Diffusion Plant
PIS	photoacoustic infrared spectroscopy
psi	pounds per square inch
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAAS	Remedial Action Assessment Subcontract
RGA	Regional Gravel Aquifer
RH	relative humidity
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SPH	Six-Phase Heating
TCE	trichloroethene
THERMAL	Thermal Remediation Services, Inc.
TSWP	Treatability Study Work Plan
UCRS	Upper Continental Recharge System
USEC	United States Enrichment Corporation
VOCs	volatile organic compounds
V	volt
VR	vapor recovery
WMP	Waste Management Plan

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EXECUTIVE SUMMARY

This Construction Quality Control Plan (CQCP) has been prepared for the installation of the Six-Phase Heating (SPH) treatability study system at the Paducah Gaseous Diffusion Plant (PGDP) in Paducah, Kentucky. The treatability study is designed to provide quantitative treatment and cost data to assess the feasibility of deploying SPH as part of the remedial action for the Groundwater Operable Unit. The treatability study will be consistent with the *Federal Facility Agreement* among the U.S. Department of Energy, the Environmental Protection Agency (EPA) and the Commonwealth of Kentucky (EPA 1998). The study will be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and will follow the guidance set forth in the EPA's ***Guide for Conducting Treatability Studies under CERCLA*** **(EPA 1992).**

SPH systems operate by applying electricity to electrodes that have been placed at specified depths in the subsurface. As power is applied to the electrodes, the soil matrix resists the flow of electricity between the electrodes causing the subsurface to be heated. Subsurface temperatures are increased to the boiling point of groundwater and targeted contaminants, trichloroethene in this case, are volatilized. Once subsurface temperatures reach the boiling point of groundwater, steam and volatilized contaminants migrate upward to be collected in the vadose zone by vapor recovery wells and routed to vapor and condensate treatment systems.

The treatability study will include the design, installation, and operation of a single SPH array. A single SPH array consists of six power electrodes, a center neutral electrode, an electrical power control unit, a temperature and pressure monitoring system, a vapor recovery system, and vapor and condensate treatment systems. The SPH system design will allow treatment of both the shallow Upper Continental Recharge System (UCRS) and the underlying Regional Gravel Aquifer (RGA) and is intended to test the constructability and effectiveness of this technology at the PGDP. The primary objective of the SPH treatability study is to demonstrate the implementability and cost-effectiveness of the technology to the unsaturated and saturated zones of the UCRS and to the groundwater of the RGA.

The CQCP presents the quality assurance (QA) and quality control (QC) requirements and procedures to be followed during installation of the SPH treatability study system. The objective of the CQCP is to assure that the finished system adheres to the technical specifications for the SPH treatability study. QA activities include all those actions that provide confidence that quality is achieved. The overall QA program for the treatability study establishes responsibilities and authorities, defines polices and requirements, and provides for the performance and assessment of the work. Quality Control activities include those actions that involve the use of the appropriate policies and procedures in the performance of the work scope.

The CQCP identifies the procedures to be followed during installation of the SPH system to assure that construction materials are of suitable quality, that system components are capable of meeting the SPH Design Package operating criteria, that proper installation methods and techniques are followed, and that installation quality checks have been performed and approvals obtained before the system is operated. The CQCP identifies the installation QA/QC team members and outlines their responsibilities; it also describes or references the frequency of quality control activities, standards for documentation, and methods for resolving deficiencies and exceptions.

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1. TECHNOLOGY DESCRIPTION

Six-Phase Heating **(SPH)** is a remediation technology that uses electrical resistive heating in saturated or unsaturated soil to raise subsurface temperatures. Subsurface heating may be used for several remedial purposes, including contaminant volatilization, ***in situ*** steam stripping, enhancing soil vapor extraction rates, and increasing biological degradation rates. Subsurface heating also increases the rates of the chemical reactions that destroy chlorinated hydrocarbons, in accordance with the Arrhenius Law.

To implement the SPH technology, an array of six power electrodes is placed into the ground so that the electrodes surround a targeted contaminated region. Each electrode then is connected to a separate power supply transformer to provide it with a unique phase of electrical current. A typical **SPH** array is hexagonal in shape, and a seventh neutral electrode is located in the center.

The SPH power electrodes conduct electrical energy to the subsurface and are designed to input that energy only at selected subsurface depth intervals. In the resistively heated intervals, the electrode construction materials are uninsulated and the electrode borehole annulus is packed with a conductive material to increase the effective diameter of the electrode. In those portions of the subsurface where electrical resistive heating is not desired, the electrode construction materials are insulated and the borehole annulus is filled with nonconductive materials such as sand, bentonite, or cement. At strategic depths in the electrode borings, sand filters are installed to assist the vapor recovery (VR) process, or impermeable seals are installed to prevent heated fluids or vapors from migrating up the borehole.

A SPH power control unit (PCU) is used to convert standard three-phase electrical power to six separate electrical phases. Each power electrode in an array is connected to one of the six electrical phases and, thus, will conduct current to the other five out-of-phase power electrodes comprising that array. When multiple arrays ***are*** used simultaneously at a site, they are configured **so** that electrodes in adjoining arrays are out-of-phase with each other and current can flow from array to array. Resistance by the subsurface environment to this flow of electrical current uniformly heats the soil and groundwater between the electrodes. Because electrically conductive intervals can be installed at multiple depth intervals, it is possible to heat separate subsurface depths either independently or in unison.

As the subsurface is resistively heated, contaminants are volatilized and soil moisture and groundwater are converted to steam. The production of steam during SPH operations effectively provides ***in situ*** steam stripping of volatile organic compounds (VOCs) from the soil matrix. By raising subsurface temperatures above the boiling point of the mixture of targeted contaminants and groundwater, SPH significantly enhances the speed and effectiveness of physical contaminant removal. On its **own,** the **SPH** technology does not necessarily remove contaminants from the subsurface. Rather, it provides the physical conditions necessary to release the contaminants from groundwater and the soil matrix, allowing them to migrate up toward the surface where they are collected by a VR system.

The **SPH** process is self-correcting with regard to overheating. As the soil between the electrodes is heated to boiling, water is removed from the soil matrix. Once the residual water content reaches about 5%, the resistivity of the soil matrix increases rapidly and electrical current no longer will flow through that portion of the treatment volume. Because of this phenomena, only soil immediately adjacent (within inches) to the electrodes can be heated beyond the boiling point of groundwater at depth.

Once steam and volatile Contaminants have been collected by the VR system, steam is condensed to water and the volatile vapors are treated before release to the atmosphere. As the treatment area is cleaned, contaminant concentrations in the recovered soil vapors decrease. In a typical SPH remedial cleanup, the results of interim soil vapor and groundwater sampling are used to track remediation progress. The concentrations of VOCs in the recovered soil vapors are used to establish the interim groundwater-sampling schedule. Once interim groundwater sampling indicates that the groundwater cleanup goals established for a specific project have been met or exceeded, confirmatory groundwater and/or soil samples are collected.

The critical components required to implement SPH include the following:

- electrodes;
- VR wells;
- groundwater monitoring wells;
- a subsurface temperature monitoring system;
- vadose zone vacuum monitoring piezometers;
- a SPH power control unit to condition three-phase power for application to the subsurface;
- an above grade steam and vapor collection system, including piping, a blower, and a condenser;
- a vapor treatment system;
- vapor sampling systems to measure VOC removal from the subsurface, determine the efficiency of the vapor treatment system, and measure the VOC concentration in the final system discharge;
- data acquisition systems; and
- a computer control system for continuous remote control of power.

2. PROJECT AND PLAN DESCRIPTION

2.1 PROJECT DESCRIPTION

In August **1988,** VOCs and radionuclides were detected in residential wells near the U.S. Department of Energy's (DOE's) Paducah Gaseous Diffusion Plant (PGDP). The D2 version of the Groundwater Operable Unit (GWOU) Feasibility Study (FS) was issued August **2001** (DOE **2001a). As** part of this FS, it is necessary to understand the effectiveness of certain treatment technologies that are being considered for full-scale use based upon their applicability to specific site conditions. The SPH treatability study will provide quantitative treatment and cost data for evaluating the constructability, applicability, and performance of the SPH technology in remediating trichloroethene (TCE) source areas at PGDP.

The treatability study will be conducted near the southeast comer of the C-400 Building, and the lithology at this location is extremely variable. The main hydrogeologic units beneath the treatability study area consist of the Upper Continental Recharge System (UCRS), the Regional Gravel Aquifer (RGA), and the McNairy Formation. In the study area, the RGA and the McNairy Formation are separated by an approximate 2.7 m- **(9** ft)-thick lens of interbedded silts, sands, and clay that act as an aquitard. Approximately **17.1** m **(56** ft) of silt and clay, with horizons of sand and gravel lenses, covers the RGA. The groundwater flow system developed in these shallow sediments is called the UCRS. Groundwater is typically encountered in the UCRS at approximately **11.9** m (39 ft) below ground surface (bgs). The RGA potentiometric surface is encountered at a depth of approximately 17.1 m (56 ft) bgs. The RGA is saturated throughout and recharged primarily by vertical groundwater flow from the UCRS. Hydraulic gradients direct groundwater flow in the RGA laterally to the north where groundwater discharges into the Ohio River.

Previous site investigations have identified three groundwater contaminant plumes resulting from past activities at PGDP. All three of the plumes are located in the RGA. Two of these plumes, currently identified as the Northwest Plume and the Northeast Plume, receive considerable contaminant loading from the C-400 Building area. Current site data suggests that the southeast comer C-400 dense nonaqueous-phase liquid (DNAPL) zones account for the majority of the mass of residual and pooled DNAPL. To assist in developing the information needed to determine if full-scale implementation of SPH will be effective at PGDP, the SPH treatability study will be located near the southeast comer of the C-400 Building and centered on the area that current site characterization data indicates as having the highest levels of UCRS soil contamination.

A single SPH treatability study array will be installed at the C-400 Building, as indicated in the ***Design Drawings and Technical Specifications Package for Six-Phase Heating Treatability Study*** (SPH Design Package) (DOE 2001b). The array will consist of six power electrodes placed in a hexagonal pattern, measuring 9.1 m (30 ft) in diameter, with a seventh neutral electrode placed in the center of the hexagon. Each electrode boring also will contain steam collection and soil vapor recovery points.

To provide for the collection of operational data, the treatability study system will include 15 vadose zone vacuum monitoring piezometers, 4 multi-port groundwater monitoring wells, and approximately 59 subsurface thermocouples. Pre-test soil and groundwater samples will be collected during system installation, as described in the Treatability Study Work Plan (TSWP) Sampling and Analysis Plan (SAP), to document existing (baseline) contaminant concentrations in the vicinity of the test array (DOE 2001b).

The treatability study is designed to test the effectiveness of the SPH technology in the complex lithology at the C-400 Building. Electrodes will be constructed to a depth of 2.4 m (8 ft) below the bottom of the RGA and will consist of six discrete resistive heating intervals. The use of discrete heating intervals will allow the system to independently treat various portions of the UCRS, the RGA, and the upper interbedded sand and clay layer of the McNairy Formation. It is expected that resistive heating will continue for about 130 days. However, the actual period of resistive heating will depend upon how rapidly the system purges the test cell of contamination. Operations monitoring, described in the SPH Design Package (DOE 2001b), will produce the data needed to determine the actual resistive heating time.

Within two weeks of stopping electrical resistance heating, new UCRS soil borings will be completed adjacent to the pre-test sampling borings, and soil and groundwater samples will be collected and analyzed as described in the TSWP SAP. The post-test data then will be compared to the pre-test (baseline) data to determine the remedial effectiveness of the treatability study.

2.2 PROJECT GOALS

The goals of the treatability study are to determine the constructability, remedial capabilities, and cost effectiveness of a SPH system at the PGDP. Of particular interest will be the cost effectiveness of the technology in removing TCE from the RGA. Successful implementation of the SPH technology will include a precise installation of the system's subsurface and surface components and a clear demonstration that the system can heat the treatment volume, recover steam and contaminant vapors from the subsurface, and treat the recovered contaminant vapors in a cost-effective manner. Because the treatability study will be conducted in the center of a larger TCE-contaminated area, diffusion and fluid mixing will introduce additional TCE into the treatment region during operation. This TCE influx makes it impractical to establish a specific clean-up goal for this treatability study. The system remedial effectiveness will be measured by comparing soil and groundwater analytical data collected before and after the treatability study. In addition to measuring the system's remedial effectiveness, the following operational parameters will be evaluated during the treatability study:

- energy consumption rate;
- steam, VR, and temperature decay rates;
- temperature gradients throughout the test cell;
- TCE removal rates as a function of operational time and energy consumption;
- construction and operation costs as a function of TCE mass both removed or destroyed;
- constructability of the system in the C-400 Building area;
- the effect of the SPH system on adjacent utilities and facilities; and
- operational impacts experienced by United States Enrichment Corporation (USEC).

Critical parameters for the SPH treatability study are those operational parameters of the system and the physical and chemical parameters of the media being treated that have the greatest impact on the ability of the technology to meet the treatability study goals. These critical parameters include the following.

- **Soil and Groundwater Temperature.** For the **SPH** technology to be effective, the temperature of soil and groundwater throughout the treated volume must be raised sufficiently to drive groundwater and targeted contaminants to their vapor phases. For the treatability study, soil and groundwater temperatures must be 100°C (or slightly less due to the applied vacuum from the VR system) at the top of the heated volume and approximately 125°C at the bottom of the heated volume, which is at 29.6 m (97 A) bfgs (Weast et al. 1976).

- **Treatment Time.** The treatability study is planned for 130 days of resistive heating, but the duration of electrical resistance heating may be shortened or lengthened depending upon the rate at which the system removes TCE from the treatment volume.

- **Soil Moisture Content.** Because subsurface heating is accomplished by the flow of electricity through soil moisture, efficient heating over the course of the treatability study is dependent upon the amount of moisture in the subsurface. The moisture content of soil adjacent to the electrodes must be maintained at levels that prevent it from drying out and insulating the electrodes. At present, the vadose zone at PGDP contains approximately 25 volume percent water. During the treatability study, the soil moisture is expected to decrease to approximately 19 volume percent, well above the **5** volume percent required for effective electrical conduction.

- **VOC Vapor Extraction Rate.** The rate **of** air extraction from the vadose zone must be greater than the production of contaminant vapors to prevent vaporized contaminants from escaping to the atmosphere or from condensing in the vadose zone.

- **Impact to Surrounding Structures, Utilities, and Operations.** It must be possible to install the system at the C-400 Building site and to operate it with limited interference to site personnel and operations. A successful application of the technology will demonstrate that site operations could proceed adjacent to, or even directly over, an operating electrode field.

- **Vapor Treatment Criteria.** Emissions from the granular activated carbon (GAC) vapor treatment unit will be in accordance with criteria with which DOE and the Commonwealth of Kentucky air quality control boards have agreed.

2.3 INSTALLATION PHASES

Installation of the system will commence only when the notice to proceed is given by Bechtel Jacobs Company **LLC (BJC), DOE,** and the Remedial Action Assessment Subcontract (RAAS) Subcontractor. General site preparation will be performed by USEC, while the **RAAS** and **SPH** Subcontractors will **perform** system installation. The RAAS Subcontractor will be responsible for the overall management of the system installation, including **QA, QC,** and health and safety activities. While there will be some overlap of phases during system installation, the process will proceed through the following major phases.

- **BJC** will coordinate general site preparation activities. The area chosen for the **SPH** treatability study includes a fence; an unused, empty aboveground storage tank (AST); and unused, aboveground pipelines and pump associated with the AST. In order to install the treatability system in the area of highest contamination, the fence, as well as the aboveground piping and associated airline connecting the pump system with the AST, must be removed. The fence will be reinstalled after system installation is complete.

- An electrical power pole will be installed in the area adjacent to the **SPH** treatability study site. Electricity will be obtained from a nearby 13.8-kV electrical line.

- Staging locations for the larger system equipment components will be prepared.

- Specialty materials for constructing the electrodes and the **SPH** portions of the treatability study system will be procured and mobilized to the site.

- The multi-port groundwater sampling systems will be procured and mobilized to the site.

- Drilling services will be procured and the drilling subcontractor will mobilize standard drilling materials and equipment to the site. Standard dnlling materials will include well casing, bentonite, grout, and sand.

- The drilling subcontractor will perform the installation of the electrodes, VR wells, groundwater monitoring wells, and vacuum monitoring piezometers under the supervision of the **SPH** Subcontractor and the RAAS Subcontractor.

- The **SPH** PCU and condenser will be procured, mobilized to the site, and placed on the previously prepared staging locations.

- The VR system components will be procured and mobilized to the site. The above-grade VR piping system will be constructed and connected to the VR wells.

- The vapor treatment system components will be procured, mobilized to the site, and placed on the previously prepared staging locations.

- The **SPH** PCU will be connected to the electrodes, the VR piping system to the condenser, and the condenser to the vapor treatment system.

- The electrical connections to the system components will be completed and the interlock control wiring between the components will be installed.

- Shakedown testing of the **SPH PCU,** the condenser, the VR system, and the vapor treatment system will be performed. Appropriate testing work guides and worker training will control these testing activities. These guides will be included as part of the operations and maintenance plan to be developed as part of the field installation task.

- Shakedown testing of the complete SPH treatability study system will be performed. Appropriate testing work guides and worker ***training*** will control these testing activities. These guides will be included as part of the operations and maintenance plan to be developed as part of the field installation task.

- The SPH treatability study system will only be placed into operation once the notice to proceed is given by DOE, BJC, and RAAS Subcontractor.

2.4 PLAN DESCRIPTION

The Construction Quality Control Plan (CQCP) presents the quality assurance (QA) and quality control (QC) requirements and procedures to be followed during installation of the SPH treatability study system. QA activities include all those actions that provide confidence that quality is achieved. The overall QA program for the treatability study establishes responsibilities and authorities, defines polices **and** requirements, and provides for the performance and assessment of the work. QC activities include those actions that involve the use of the appropriate policies and procedures in the performance of the work scope.

The entire treatability study is described in the TSWP (DOE 2001b), which includes a SAP, a Quality Assurance Project Plan (QAPP), an Environmental, Safety, and Health Plan (ES&HP), and a Waste Management Plan (WMP). Design specifications are contained in a separate SPH Design Package (DOE 2001c). The CQCP is being developed concurrently with the SPH Design Package to maintain consistency among the documents. Quality issues are covered in various components of the TSWP, the SPH Design Package, and the CQCP. These documents contain the 16 QA elements in the EPA Interim Guidelines and Specifications for Preparing QA Plans, QAMS-005/80 (EPA 1983) and the 10 QA elements discussed in 10 CFR 830.120. A crosswalk to these documents is contained in the TSWP QAPP.

The objective of the CQCP is to assure that the finished system adheres to the SPH Design Package (DOE 2001c) for the SPH treatability study. The CQCP identifies the procedures to be followed during installation of the SPH system to assure that construction materials are of suitable quality, that system components are capable of meeting the SPH Design Package operating criteria, that proper installation methods and techniques are followed, and that installation quality checks have been performed before the system is operated. The CQCP identifies the installation QA/QC team members and outlines their responsibilities; it also describes or references the frequency of quality control activities, standards for documentation, and methods for resolving deficiencies and exceptions.

The TSWP ***SAP*** and TSWP QAPP provide procedural guidance for the SPH treatability study and the contents of these documents are summarized in Tables 1 and 2, respectively. The field operating procedures that will be controlling documents for the CQCP plan are presented in Table 3.

3. QUALITY ASSURANCE TEAM

The implementation of quality control systems during the installation phase of the treatability study will include the involvement of personnel from BJC, the RAAS Subcontractor project team [Science Applications International Corporation (SAIC) team], and the SPH Subcontractor [Thermal Remediation Services, Inc. (THERMAL)]. The QA team members represent qualified individuals with strong professional

Table 1. TSWP SAP procedure locations

Reference location	Reference title
TSWP SAP (Sect. 1.2)	Sampling Strategy
TSWP SAP (Sect. 1.2.1)	Soil and Groundwater Sampling
TSWP SAP (Sect. 1.2.2)	Operational Sampling
TSWP SAP (Sect. 1.2.3)	Health and Safety Sampling
TSWP SAP (Sect. 1.2.4)	Waste Management Sampling
TSWP SAP (Sect. 1.2.5)	Analytical Requirements
TSWP SAP (Sect. 1.2.6)	Sampling Schedule
TSWP SAP (Sect. 1.3)	Sampling Procedures
TSWP SAP (Sect. 1.3.1)	Monitoring Well Installation and Development
TSWP SAP (Sect. 1.3.2)	Groundwater Sampling
TSWP SAP (Sect. 1.3.3)	Subsurface Soil Sampling
TSWP SAP (Sect. 1.4)	Documentation
TSWP SAP (Sect. 1.4.1)	Field Logbooks
TSWP SAP (Sect. 1.4.2)	Sample Log Sheets
TSWP SAP (Sect. 1.4.3)	Field Data Sheets
TSWP SAP (Sect. 1.4.4)	Sample Identification, Numbering, and Labeling
TSWP SAP (Sect. 1.4.5)	Sample Chain of Custody
TSWP SAP (Sect. 1.4.6)	Sample Shipment
TSWP SAP (Sect. 1.4.7)	Field Planning Meeting
TSWP SAP (Sect. 1.4.8)	Readiness Checklist
TSWP SAP (Sect. 1.5)	Decontamination Procedures
TSWP SAP (Sect. 1.6)	Waste Management Procedures
TSWP SAP (Sect. 1.7)	Procedures for Sample Analyses
TSWP SAP (Sect. 1.7.1)	Radiological Analysis Procedures
TSWP SAP (Sect. 1.8)	Sample Location Surveying

Table 2. TSWP QAPP procedure locations

Reference location	Reference title
TSWP QAPP (Page B-3)	QAMS-005 Locator Page
TSWP QAPP (Page B-5)	10 CFR 830.120 Locator Page
TSWP QAPP (Sect. 3)	QA Objectives for Measurement of Data
TSWP QAPP (Sect. 4)	Sampling Procedures
TSWP QAPP (Sect. 5)	Sample Custody
TSWP QAPP (Sect. 6)	Calibration Procedures and Frequency
TSWP QAPP (Sect. 7)	Analytical Procedures
TSWP QAPP (Sect. 8)	Data Review and Reporting
TSWP QAPP (Sect. 9)	Internal Quality Control Checks
TSWP QAPP (Sect. 10)	Audits and Surveillances
TSWP QAPP (Sect. 11)	Preventive Maintenance
TSWP QAPP (Sect. 12)	Specific Routine Procedures to Assess Data Precision, Accuracy, and Completeness
TSWP QAPP (Sect. 13)	Nonconformance and Corrective Action Procedures
TSWP QAPP (Sect. 14)	QA Reports to Management
TSWP QAPP (Sect. 15)	Qualifications and Training of Personnel
TSWP QAPP (Sect. 16)	Field Changes
TSWP QAPP (Sect. 17)	Document Control and Records Management

Table 3. Field operating procedures

Procedure no.	Procedure
RAAS-002	Paducah Records Management
RAAS-004	Archival of Environmental Data with the ER Program
RAAS-005	Quality Assured Data
RAAS-006	Data Management Coordination
RAAS-008	On-site Handling and Disposal of Waste Material
MAS-012	Collection of Sludge/Sediment Samples
RAAS-013	Filter Pack and Screen Selection for Wells and Piezometers
MAS-024	Lithologic Logging
RAAS-027	Monitoring Well Installation
MAS-026	Monitoring Well Development
MAS-027	Monitoring Well Installation
RAAS-030	Powered Industrial Trucks
MAS-035	Handling, Transporting, and Relocating Waste Containers
FTP-400	Equipment Decontamination
FTP-405	Cleaning and Decontaminating Sample Containers and Sampling Equipment
FTP-525	Subsurface Soil Sampling
FTP-625	Chain-of-Custody
FTP-650	Labeling, Packaging, and Shipping of Environmental Field Samples
FTP-1200	Field Quality Control
FTP-1215	Use of Field Logbooks
FTP-1220	Documenting and Controlling Field Changes to Approved Plans
TP-DM-300-2	Data Entry
TP-DM-300-7	Data Validation
TP-DM-300-10	Analytical Laboratory Interface
TP-DM-300-13	Tracking Analytical Data

training and prior work experience in implementing QA activities and a demonstrated ability to perform their required QA functions. The structure of the QA team is shown graphically in Fig. 1.

3.1 RESPONSIBILITIES AND AUTHORITIES

The principal parties involved in QA activities for the installation of the SPH treatability study system include DOE, BJC, the RAAS Subcontractor's project team, and the SPH Subcontractor.

3.1.1 DOE and Regulatory Agencies

DOE performs oversight of the project and of BJC. DOE will review and approve the TSWP, the SPH Design Package, and the CQCP and will participate in Readiness Reviews. DOE also is responsible for communications with the EPA and state regulatory agencies. The EPA and the Kentucky Department for Environmental Protection also will review and comment on these documents.

3.1.2 BJC

BJC is responsible for communications with the DOE. This responsibility includes submission of the QA documentation demonstrating that the TSWP, the SPH Design Package, and the CQCP specifications and performance standards were achieved.

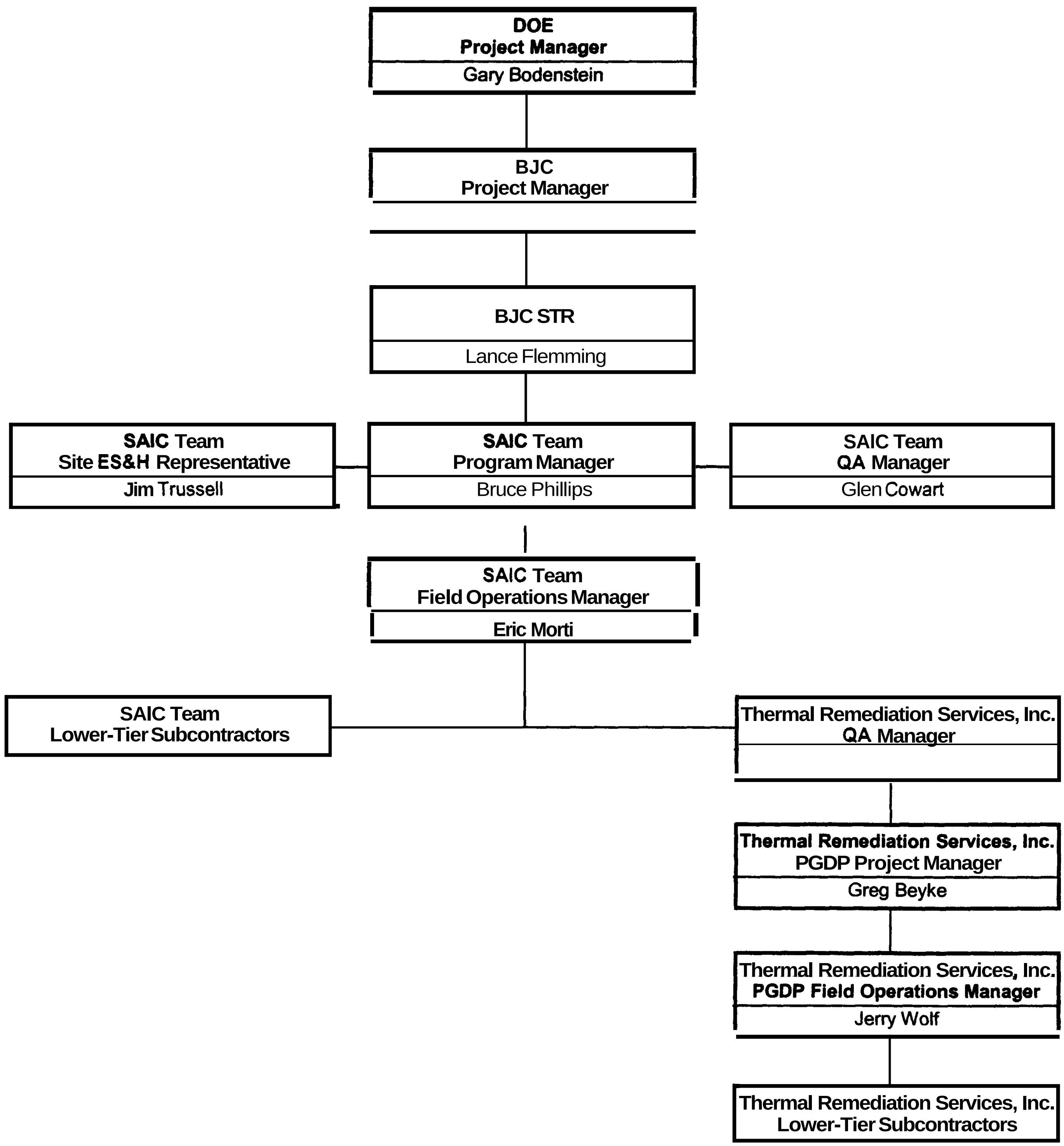

Fig. 1. QA Team organization chart.

3.1.3 RAAS Subcontractor Program Manager

The RAAS Subcontractor Program Manager is directly responsible for the overall quality of the Subcontractor's projects under the general order contract and for ensuring that project goals and objectives are met in a high-quality manner. The RAAS Subcontractor Program Manager will be responsible for allocating resources throughout the project and for communicating with BJC.

3.1.4 RAAS Subcontractor QA Manager

The RAAS Subcontractor QA Manager will be responsible for verifying implementation of the QA program by the project team during the installation of the treatability study system, approving nonconformance reports and corrective actions, and reviewing and approving any project specific procedures.

3.1.5 RAAS Subcontractor Field Operations Manager

The RAAS Subcontractor Field Operations Manager is responsible for implementing the SPH treatability study, including all plans and field activities, and for communicating with the RAAS Subcontractor Program Manager. The RAAS Subcontractor Field Operations Manager will perform the following QA functions:

- Have a complete understanding of the TSWP, the SPH Design Package, and the CQCP;
- Recognize and immediately report deviations from the TSWP, the SPH Design Package, and the CQCP to the RAAS Subcontractor Program Manager;
- Be available at all times work is ongoing and prepare any field change orders;
- Communicate with RAAS Subcontractor's Field Supervisors, subcontractors, and other involved parties during system installation activities;
- Record, maintain, and forward progress reports and other project data to the appropriate parties;
- Secure and maintain documents that approve changes to the TSWP, the SPH Design Package, and the CQCP; and
- Review work product for acceptance, rejection, or further evaluation, and verify that appropriate corrective measures have been taken to resolve nonconformance situations.

3.1.6 SPH Subcontractor's QA Manager

The SPH Subcontractor's QA Manager will report to the RAAS Subcontractor's Field Operations Manager and is responsible for ensuring that all QA aspects of the TSWP, the SPH Design Package, and the CQCP that are assigned to the SPH Subcontractor are implemented. The SPH Subcontractor QA Manager provides direction to the SPH Subcontractor's staff on QA issues and interfaces with RAAS Subcontractor's QA personnel. The SPH Subcontractor's QA Manager will perform the following QA functions:

- Have a complete understanding of the TSWP, the SPH Design Package, and the CQCP;
- Recognize and immediately report deviations from the TSWP, the SPH Design Package, or the CQCP to the RAAS Subcontractor Field Operations Manager;

- Communicate with the RAAS Subcontractor Field Operations Manager, the SPH Subcontractor's Project Manager, and other involved parties during system installation activities;

- Secure and maintain documents that approve changes to the TSWP, SPH Design Package, or CQCP;

- Ensure that those QA and QC procedures, as well as project-specific procedures, for health and safety, personnel training, waste management, and work activities that are assigned to the SPH Subcontractor are implemented;

- Ensure that the SPH Subcontractor produces detailed field notes documenting all field activities and that these notes are properly maintained and are retrievable; and

- Ensure that a nonconformance log is prepared and maintained during installation activities and that progress is being made to resolve all nonconformance issues that are the responsibility of the **SPH** Subcontractor.

3.1.7 SPH Subcontractor's Project and Field Managers

The SPH Subcontractor's Project and Field Managers are responsible for the implementation of those aspects of the treatability study installation contracted to the SPH Subcontractor. They also are responsible for fulfilling the QA/QC tasks from the TSWP SAP, TSWP QAPP, TSWP ES&HP, TSWP WMP, the **SPH** Design Package, and the CQCP assigned to them by the SPH Subcontractor's QA Manager. The SPH Subcontractor's Project and Field Managers will provide direction to their field staff and lower-tier subcontractors and will interface with RAAS Subcontractors management and field personnel. The SPH Subcontractor's Project and Field Managers will perform the QA and QC functions and activities assigned to them and will be responsible for the following:

- Have a complete understanding of the TSWP, the **SPH** Design Package, the CQCP, and all controlling field procedures provided by the RAAS Subcontractor;

- Recognize and immediately report deviations from the TSWP, the SPH Design Package, or the CQCP to the SPH Subcontractor QA Manager and the RAAS Subcontractor Field Operations Manager;

- Be onsite, or immediately available, at all times work is ongoing and have the authority to implement corrective actions during field activities;

- Communicate with the SPH Subcontractor's QA Manager, field personnel, lower-tier subcontractors, and other involved parties during the system installation activities; and

- Secure and maintain documents that approve changes to the TSWP, the SPH Design Package, or the CQCP.

The SPH Subcontractor's Field Manager will perform the following functions:

- Participate in the daily work planning meetings as well as any site-specific health and safety, work process, or ***QNQC*** training activities;

- Prepare and maintain a set of as-built drawings during system construction and installation;

- Prepare and maintain detailed field notes documenting all field activities;

- Prepare and maintain a nonconformance log during installation activities and work to resolve nonconformance issues; and
- Direct and review the Health and Safety, QNQC, and work efforts of the SPH Subcontractor's field personnel and lower-tier subcontractors.

3.2 PROJECT MEETINGS

Meetings will be held to achieve a high degree of communication among members of the project team. These meetings will help to minimize errors and promote quality performance during the system installation phase of the project. In addition to the key personnel specified for attendance at each meeting, personnel from BJC may be included at all meetings, as appropriate.

3.2.1 Preconstruction Meeting

A preconstruction meeting will be held with the key project personnel to ensure that the entire team has a clear understanding of the project objectives, the SPH Design Package, health and safety issues, QNQC requirements, and work procedures. At a minimum, the key project personnel attending these meetings will include the RAAS Subcontractor's Field Operations and Site Health and Safety Managers and the SPH Subcontractor's Project and Field Operations Managers. Site-specific requirements and work procedures will be reviewed with all parties. This meeting also will allow the key team members to meet and develop solutions to any potential problems known to the team prior to the initiation of installation activities. The RAAS Subcontractor Field Operations Manager will document this meeting and provide meeting notes to all parties.

3.2.2 Readiness Reviews

Due to the complexity of the project, Readiness Reviews will be held prior to beginning each major phase of system installation. Separate Readiness Reviews will be performed before initiating subsurface drilling, surface equipment installation, and SPH operations. The purpose of these reviews is to resolve all reviewers' questions and to demonstrate that personnel, subcontractors, materials, equipment, and procedures are in place so that work may commence. Work will not commence on a new phase of system installation until all comments have been reviewed, and resolution of all comments from all parties has been achieved. BJC will issue formal notice to proceed to the RAAS Subcontractor, following the review of comments from all parties. The RAAS Subcontractor Field Operations Manager will ensure that these meetings and subsequent comment review cycles are documented.

3.2.3 Weekly Progress Meetings

A weekly progress meeting will be held with the key project members and other appropriate parties to discuss progress and planned activities. At a minimum, the key project personnel attending these meetings will include the RAAS Subcontractor's Field Supervisor, who reports directly to the RAAS Subcontractor's Field Operations Manager, and the SPH Subcontractor's Field Operations Manager, who reports directly to the SPH Subcontractor's Project Manager. The RAAS Subcontractor Field Operations Manager will document these meetings and prepare meeting notes for all parties, as necessary.

3.2.4 Daily Meetings

The field team will meet daily, before work activities begin, during the course of the system installation to discuss, plan, and coordinate the work, health and safety, and QA/QC activities to be performed that day. These meetings will be documented in the field notebooks of the SPH Subcontractor's Project or Field Operations Manager.

3.2.5 Problem Resolution Meetings

Special meetings will be held when and if a problem or work deficiency occurs or may occur that could impact safety, quality, cost, or the project schedule. All parties involved will attend to discuss the problem or deficiency, to review possible solutions, and to implement a plan of action to resolve the problem or deficiency. The RAAS Subcontractor Project Manager, or Field Operations Manager, will document the meeting and provide meeting notes to all parties.

4. QUALITY CONTROL ACTIVITIES

Adherence to the SPH Design Package, and health and safety requirements and procedures will be required during installation of the SPH treatability study system. The measures required to verify the quality of work performed and compliance with the specified project requirements include: successful completion of the readiness reviews; the inspection of materials, equipment, and workmanship before and during the performance of each task comprising the SPH system installation effort; and the resolution of all reported deficiencies and nonconformance issues.

Preparatory activities will include the following:

- Verifying that all required submittals have been accepted by the Contracting Officer;
- Reviewing contract documents and design specifications with the project team;
- Reviewing the site-specific hazard analysis and the ES&HP (DOE 2001b);
- Reviewing the TSWP WMP (DOE 2001b);
- Ensuring that the field team has reviewed and discussed the work procedures that will be followed;
- Reviewing procurement specifications, selecting suppliers, and tracking procurements;
- Successfully completing the readiness review process; and
- Ensuring that materials and equipment are properly received, inspected, tested, inventoried, and stored.

Progress monitoring activities will include the following:

- Checlung work quality to ensure that contract requirements and design specifications are being met;
- Verifying site activities are in accordance with the ES&HP (DOE 2001b);
- Checlung that QA provisions are in place and that QC activities are being completed in compliance with QA requirements and procedures;
- Checking that daily QC inspections are sufficiently rigorous to ensure continuing compliance with the QA program;
- Checlung that nonconformance issues are being recorded, tracked, and resolved; and
- Checlung that QC reporting is accurate, timely, complete, and in compliance with QA requirements and procedures.

Follow-up and completion activities will include:

- Resolution of all nonconformance reports, and
- Resolution of all outstanding discrepancies.

4.1 ENVIRONMENTAL HEALTH AND SAFETY

Health and Safety procedures and requirements are provided in the TSWP ES&HP. The TSWP ES&HP describes the health and safety related QA and QC activities that will be performed during installation of the treatability system and provides the roles, responsibilities, and authorities of the various team members. Where appropriate, activity-specific health and safety procedures and health and safety related QA and QC requirements are included in the field operating procedures listed in Sect. 2.4 of this CQCP.

4.2 WASTE MANAGEMENT

Waste management procedures and requirements are provided in the TSWP WMP. The TSWP WMP describes the waste management related health and safety, QA, and QC activities that will be performed during installation of the treatability system and provides roles, responsibilities, and authorities for the various team members. Where appropriate, the TSWP SAP, TSWP QAPP, and field operating procedures listed in Sect. 2.4 contain activity-specific waste management procedures and waste management QA and QC requirements.

4.3 FIELD ACTIVITIES

The QA and QC requirements for the various system installation-related field activities defined in the TSWP and the SPH Design Package are provided in the TSWP SAP, TSWP QAPP, and field operating procedures listed in Sect. 2.4 of this CQCP.

The project documents containing the QC requirements for the installation of each critical system component are listed in Table 4. In addition to the QC requirements contained in the documents listed in Table 4, the QC requirements for Documentation, Procurement, Notification and Corrective Process, and Personnel Qualifications and Training contained in this CQCP also apply to the installation of critical system components.

5. DOCUMENTATION

The TSWP, SAP, QAPP, ES&HP, WMP, SPH Design Package, CQCP, and field operating procedures identify system installation activities that should be monitored, describe the varying level of monitoring required, and assign responsibility for monitoring. To be effective, these QA/QC monitoring activities must be documented. The SPH Subcontractor's QA Managers will be responsible for documenting that QA/QC requirements assigned to the SPH Subcontractor have been properly addressed and satisfied.

5.1 MATERIALS AND EQUIPMENT

The QC documentation for materials and equipment purchased may include some, if not all, of the following: engineering documents, drawings, QA Program Manuals, inspection procedures, and inspection reports. Quality verification documents may include some, if not all, of the following: material verification reports, material test reports, cleaning verification reports, inspection verification reports, performance testing reports, and summary reports that cover procurement requirements, approved changes, waivers, or deviations. QA/QC assurance documents for materials, equipment, and services will be traceable to purchase orders or requests.

Table 4. QC requirements for installation of critical system components

System Component	Location of applicable QC requirements
Electrodes/VR wells, Groundwater monitoring wells, and Vacuum monitoring piezometers	ES&HP WMP SPH Design Package CQCP Sect. 7.1, 7.3, 7.4, 10.1, 10.2, 10.4 and Appendix A SAP Sect. 1.3.1, 1.4.7, 1.4.8, 1.5, 1.6, and 1.8 Procedure Nos. RAAS-013, 027, and 008, FTP-400 and 405
SPH PCU	ES&HP SPH Design Package CQCP Sect. 7.2, 10.3, 10.7, and Appendix A
SPH PCU remote control system	SPH Design Package CQCP Sect. 7.1, 7.2, 7.5, 10.1, 10.5, and 10.7
Vapor Recovery System	ES&HP WMP SPH Design Package CQCP Sect. 7.1, 7.2, 7.3, 10.1, 10.3, 10.4, 10.6, 10.7 and Appendix A SAP Sect. 1.4.7, 1.4.8, 1.5, and 1.6
Vapor Treatment System	ES&HP SPH Design Package CQCP Sect. 7.1, 7.2, 10.1, 10.3, 10.6, and 10.7 SAP Sect. 1.4.7, 1.4.8, 1.5, and 1.6
Data acquisition systems	ES&HP SPH Design Package COCP Sect. 7.1. and 10.5

5.2 FIELD LOGBOOK

The SPH Subcontractor's Field Operations Manager will maintain a field logbook. Entries into the logbook will be dated and initialed by the SPH Subcontractor's personnel making the entry. In addition to other project requirements, the logbook will contain a diary of daily events and progress and a record of site meetings and visitors. The logbook also will contain any observations of unusual or previously unnoticed site conditions. QNQC activities that will be recorded in the logbook include:

- Inspections of materials, supplies, and equipment (both construction equipment and system equipment);
- Inspections of work quality, including the quality of lower-tier subcontractors;
- Notations of possible improvements to QA/QC, health and safety, or work quality procedures;
- Implementation of records of QA/QC activities, including notations of any implemented improvements to QA/QC, health and safety, or work quality guidelines; and
- Field data and information for which a recording form has not previously been prepared.

5.3 DATA FORMS

Prior to the start of installation activities, the **SPH** Subcontractor's **QA** Manager will ensure that those forms required by the TSWP **QAPP** and any controlling RAAS Subcontractor procedures necessary for recording field data and information have been produced. The **SPH** Subcontractor's Project and Field Operations Managers will be responsible for ensuring that these forms are available to field personnel and that they are used to properly record data and information. The Subcontractor's Field Operations Manager also will be responsible for the safekeeping, filing, retrieval, and retention of all completed data forms in the SPH Subcontractor's possession.

5.4 QC FORMS

The, **SPH** Subcontractor's QA Manager will be responsible for reviewing the **QA/QC** requirements for the project and ensuring that all required **QC** data and information recording forms have been produced. The **SPH** Subcontractor's Field Operations Manager will be responsible for ensuring that **QC** data and information is recorded on the proper forms and for the safekeeping, filing, retrieval, and retention of these data forms until they are provided to the SPH Subcontractor's **QA** Manager.

5.5 AS-BUILT DRAWINGS

The **SPH** Subcontractor's Field Operations Manager will be responsible for ensuring that as-built drawings for the SPH treatability study system are prepared and updated. The **SPH** Subcontractor's Field Operations Manager will provide updated as-built drawing to the RAAS Subcontractor, as requested, and the RAAS Subcontractor's Field Operations Manager will be responsible for ensuring the safekeeping, filing, retrieval, and retention of these drawings.

5.6 NONCONFORMANCE LOG

In addition to the requirements of the **TSWP QAPP,** the **RAAS** Subcontractors Field Operations Manager and the **SPH** Subcontractor's Field Operations Manager will be responsible for preparing and updating a nonconformance log for those activities assigned to their organizations. The log will remain onsite and will identify all nonconformance situations, the nature of the nonconformance, corrective actions necessary to resolve the nonconformance, and the status of the nonconformance. Additional discussion of nonconformance tracking and reporting can be found in Sect. 8 of this document and in Sect. 13 of the TSWP **QAPP.**

5.7 WEEKLY PROGRESS REPORTS

The **SPH** Subcontractor's Project Manager will be responsible for preparing weekly progress update reports for the RAAS Subcontractor Field Operations Manager. These reports will contain a summary of work completed during the week, verification that work performed meets contract and design requirements, reporting and updating significant nonconformance situations, projected work activities for the following week, and a comparison of the work completed with respect to the project schedule. These reports also will highlight any potential problems that could compromise safety, work quality, or project schedule.

6. PROCUREMENT

The SPH Subcontractor's QA Manager shall ensure that the requirements of the RAAS Subcontractor's procurement program are followed and that those items and services provided by suppliers meet the requirements of the final SPH Design Package as well as the expectations of the overall project team and DOE and BJC. The SPH Subcontractor's Project Manager will supervise the preparation of the technical specifications for the procurement of items and services by the SPH Subcontractor. Procurement specifications will be provided to the RAAS Subcontractor's Field Operations Manager, or designee, for review and approval prior to initiating purchases. The SPH Subcontractor's procurement process shall ensure the following:

- Designer, end-user, and supplier requirements are met throughout the procurement process;
- Materials, supplies, equipment, and services are obtained from qualified suppliers;
- Design and end-user requirements are accurately, completely, and clearly communicated to suppliers;
- The proper product or service is delivered on time and maintained in satisfactory condition until used; and
- The procurement process is documented and documentation is properly controlled.

6.1 SUPPLIER QUALIFICATIONS

The SPH Subcontractor's QA and Project Managers will be responsible for providing the RAAS Subcontractor Field Operations Manager with a list of lower-tier suppliers for approval prior to initiating the process of procuring materials, equipment, or services. Lower-tier subcontractors providing on-site services must meet the BJC Environmental Safety and Health prequalification criteria as well as federal, state, and site-specific health and safety training requirements.

If appropriate, the SPH Subcontractor will specify how its lower-tier suppliers of materials, equipment, and services are to be evaluated to verify their capability to meet project design, performance, and schedule requirements. The following activities may be used to evaluate lower-tier suppliers depending on how the purchased items or services relate to safety and the successful completion of the project:

- A review of the supplier's history for providing identical or similar items or services;
- A review of the supplier's information regarding product or service quality;
- Evaluation of supplier's certifications or registrations as awarded by accredited third parties;
- Evaluation of supplier's health and safety qualifications to ensure that they are consistent with BJC and other parties' requirements; and
- An assessment of the supplier's personnel and processes conducted at the supplier's facility.

While it is recognized that many of the purchases necessary for completion of SPH treatability study must be made from specialty providers, an effort will be made to identify at least three vendors for as many project materials, supplies, equipment, and services as possible. While cost will not be used as the sole criterion to select among prequalified vendors, it will be given significant consideration in the selection process.

6.2 PROCUREMENT DOCUMENTS

The SPH Subcontractor will produce requests for proposals and quotations or purchase orders for qualified suppliers that clearly state design requirements, acceptance criteria, and any test/inspection requirements for purchased items and services. Specifications and requirements will be drawn from the TSWP, the SPH Design Package, and this CQCP. Procurement documents will include **any** specifications, standards, or other documents referenced in the controlling design or QA/QC documents.

Critical requirements that must be fulfilled by the supplier will be clearly specified in requests for proposals and quotations or on purchase orders. Some of the requirements that must be met may include the following:

- delivery schedules,
- packaging requirements,
- the production of engineering documents,
- specific inspection procedures,
- specific testing procedures,
- the production of design reports,
- the production of manufacturing drawings,
- a QA/QC Program Manual,
- the production of performance testing and inspection reports,
- the delivery of Material Safety Data Sheets (MSDS),
- the production of Operating Manuals, and
- documentation of personnel qualifications and site-specific training.

These supplier documents will be traceable to the purchase order or purchase requirements.

6.3 INSPECTIONS

The **SPH** Subcontractor will follow the RAAS Subcontractor's procedures for supplier inspections as provided in the QA Project Plan for Paducah RAAS (SAIC, Revision 2, February 2000). Specific procedures include SAIC QAPP 10.1 "Inspections," SAIC QAPP 12.1 "Control of Measuring and Test Equipment," and SAIC QAPP 13.1 "Handling, Storage and Shipping." In all instances, items obtained from lower-tier suppliers will be inspected upon delivery to verify that the order was completely filled, that the delivered items match the ordered items, and that no items were damaged in shipping. Completed deliveries will be so documented. Deliveries containing orders not completely filled, items not meeting specifications, or damaged items will be tracked, through a documented process, until the discrepancies have been resolved. The inspection and nonconformance resolution processes will include verification that the supplier has provided all specified documentation, including MSDS and operating manuals.

If the SPH Design Package, the TSWP QAPP, or specific RAAS Subcontractor procedures call for special post-delivery inspections, testing, or calibrations, they will be performed in a timely manner and be adequate to ensure conformance with the controlling requirements.

Materials, supplies, and equipment belonging to lower-tier subcontractors will be inspected using the same procedure applied to similar items supplied by off-site vendors.

6.4 SUPPLIER PERFORMANCE MONITORING

The SPH Subcontractor's Project Manager will be responsible for periodically monitoring and evaluating the performance of the SPH Subcontractor's suppliers during the life of the project to confirm that acceptable items or services are produced and that schedule requirements are being met. Performance monitoring may include:

- Surveillance of work activities and preparation of nonconformance reports;
- Review of supplier plans and progress reports;
- Monitoring of supplier's progress and costs;
- Processing of change information;
- Review and disposition of progress and nonconformance reports;
- Evaluation of supplier's quality control and QA programs;
- Evaluation of supplier's personnel training and procedures;
- Evaluation of supplier's training certification records for personnel performing critical functions affecting project quality; and
- Inspection of supplier facilities and off-site processes.

Throughout the project, the SPH Subcontractor's Field Operations Manager will perform inspections on materials and equipment being stored onsite to ensure that quantities are adequate, that quality is not impacted by storage, and that storage locations and methods will not interfere with project flow, schedule, or safety. These inspections will be recorded in the SPH Subcontractor's Field Operations Manager's daily log. The scope and frequency of these inspections will be determined utilizing a graded approach that is based upon the possible impact to safety and project success that the inspected items represent.

6.5 SUPPLIER DOCUMENTS

The SPH Subcontractor will ensure that supplier-generated documents, including MSDS, are controlled and processed according to the same standards required for similar project documents generated by the RAAS Subcontractor.

6.6 PROCUREMENT RECORDS

The applicable requirements of the Document Control and Records Management procedures in the TSWP QAPP will be applied to procurement records produced during system installation. The SPH Subcontractor's Project Manager will ensure that procurement records are routed to the appropriate project team members and end-users and that the SPH Subcontractor maintains copies of these records. The SPH Subcontractor's Project Manager will provide for the retention, protection, updating, traceability, accountability, and retrievability of records in the SPH Subcontractor's possession. The schedules for procurement record retention and final disposition will be in accordance with the requirements of the Document Control and Records Management procedures in the TSWP QAPP.

7. FREQUENCY OF ACTIVITIES

The frequency of QC checks for materials, equipment, and the installation processes will be determined utilizing a graded approach that is based upon the items or process inspected and how they relate to safety or the successful completion of the project. Both the RAAS and SPH Subcontractors will be performing checks and inspections, but the RAAS Subcontractor will be responsible for ensuring that checks and inspections are done.

7.1 MATERIALS

Quality checks will be performed upon the delivery of all project materials, including those provided by lower-tier subcontractors and vendors. Checks will be made to assure that the correct products have been delivered to meet project specifications. These checks will be consistent with the procurement procedures specified for the products. At a minimum, a visual examination of all material deliveries will be performed to review the bills of lading, ensure that the correct quantity has been received, verify the labeling of the materials, check for possible damage, and reviewing MSDS. The soundness of the packaging will be determined and the materials then will be properly stored.

Daily inspections will be made to verify the quantity and integrity of materials in storage. These daily checks also will assess the continued safekeeping of remaining materials and ensure that storage practices are both safe and not a hindrance to current or planned work activities. Inspection of materials will meet the requirements of SAIC QAAP 13.1, Handling, Storage and Shipping (SAIC, Revision 2, February 2000).

7.2 SYSTEM EQUIPMENT

System equipment will be clean when arriving onsite and a radiological survey will be performed before it is released for use. prior to leaving the site, all system equipment will be decontaminated and a radiological survey will be performed on the equipment. Decontamination will be performed in accordance with the TSWP ES&HP (1b) and with procedure FTP-400 "Equipment Decontamination." Waste generated from the decontamination process will be handled in accordance with the TSWP ES&HP and TSWP WMP (DOE 2001b). Specific procedures include RAAS-008 "On-Site Handling and Disposal of Waste Material" and RAAS-035 "Handling, Transporting, and Relocating Waste Containers."

QA requirements for procurement, receiving, and inspection will apply to system equipment. System equipment will be inspected immediately upon arrival to the site. Although system equipment cannot be inspected under operating conditions before it is installed, visual inspections will be performed. Delivery documentation will be collected and checked against the procurement specifications. A check will be made to note that the model of the equipment matches the procurement specifications. The equipment will be examined to ensure that there are no signs of damage to the equipment or to ensure there are no incipient hazardous conditions such as fluid leaks or missing safety guards. Components such as belts, hoses, and cables will be inspected for misalignment or wear and tear and repaired or replaced, as necessary, before the equipment is placed into use.

If system equipment cannot be immediately placed in its proper staging location, it will be stored in a safe manner and in accordance with manufacturer's instructions. Equipment storage locations will be selected such that the equipment will not interfere with current or planned work activities, and additional moves will be minimized. Equipment will be checked daily to ensure that it has not been damaged by work activities.

Once it is possible to test system equipment under operating conditions, performance testing shall be completed. All required QC documents intended to indicate how the equipment performs against the specification requirements will be completed and justification or resolution of any deviations will be provided.

7.3 CONSTRUCTION EQUIPMENT

Construction equipment necessary for system installation activities will be clean when arriving on-site. A radiological survey will be performed on all construction equipment prior to its release for use. Down-hole equipment and tooling also will go through an on-site decontamination process before being released for use. Before leaving the site, construction equipment will be decontaminated and a radiological survey will be performed on the equipment. Decontamination will be performed in accordance with the TSWP ES&HP (DOE 2001b) and procedure FTP-400 "Equipment Decontamination." Waste generated from the decontamination process will be handled in accordance with the TSWP ES&HP and TSWP WMP (DOE 2001b). Specific procedures include RAAS-008 "On-Site Handling and Disposal of Waste Material" and RAAS-035 "Handling, Transporting, and Relocating Waste Containers."

Construction equipment will be inspected immediately upon delivery to the site and before it is used. The inspection will note the type and model of equipment and determine that it is appropriate for its intended use as defined by the design and procurement specifications. A visual examination will be performed to ensure that there are no signs of debilitating damage or hazards and incipient failures such as fluid leaks or worn components. If any of these conditions are discovered, they will be corrected before the equipment is put into use. At all times, safe storage, proper positioning, set-up, and use of construction equipment will be enforced and the performance of preventive maintenance will be verified daily.

7.4 DRILLING LOCATIONS

Drilling locations will be verified by civil survey and marked before setup of equipment on the site. Drilling locations will be reconfirmed before drilling equipment penetrates the soil. Locations will be established by civil survey after construction activities have been completed. Surveyed locations will be shown on the as-built drawings. Waste generated from drilling activities will be handled in accordance with the TSWP ES&HP and TSWP WMP (DOE 2001b). Specific procedures include RAAS-008 "On-Site Handling and Disposal of Waste Material" and RAAS-035 "Handling, Transporting, and Relocating Waste Containers.

7.5 DATA GATHERING DEVICES

Data gathering devices will be inspected upon delivery in the same manner as other project materials and will be checked to ensure that they meet the appropriate design and procurement specifications. Additionally, calibration certifications for devices that are delivered calibrated by the manufacturer will be collected, reviewed, and processed per the requirements of the "Calibration Procedures and Frequency" section of the TSWP QAPP. Specific procedures include QAPP 10.1 "Inspections" and QAPP 12.1 "Control of Measuring and Testing Equipment." Once calibration has been established, a calibration label will be attached to the device in accordance with the appropriate QA procedures.

Data gathering devices that require calibration prior to use, or periodic calibration, will be labeled "Do Not Use - Not Calibrated." Data gathering devices will not be used until the calibration requirements of the "Calibration Procedures and Frequency" section of the TSWP QAPP have been met and a calibration label has been attached to the device.

7.6 SAMPLING AND LABORATORY SERVICES

Field QC sampling will be conducted per the requirements of the "Internal Quality Control Checks," "Field Quality Control Samples," and "Analyhcal Laboratory Quality Control Samples" sections of the TSWP QAPP to check sampling techniques and the analytical accuracy and precision of laboratory services. If deficiencies are discovered in sampling techniques or laboratory services, corrective action will be initiated in accordance with the "Nonconformances and Corrective Action Procedures" section of the TSWP QAPP.

The types and frequency of field QC samples are specified in the TSWP QAPP. All QC samples will be shipped according to the chain-of-custody procedures specified in Section **1.4.5** of the TSWP SAP. Analytical laboratory QC samples will be analyzed as required by the analytical method specified in the TSWP QAPP for the parameters of interest, and the results will be included in the analytical report.

8. NOTIFICATION AND CORRECTION PROCESS

All problems associated with materials, supplies, equipment, and service suppliers will be documented and corrective actions taken immediately. In those instances where a potential for impact to safety or project success exists, the SPH Subcontractor's Project Manager will immediately notify the RAAS Subcontractor Field Operations Manager of the nonconformance situation.

The SPH Subcontractor's Project Manager will be responsible for implementing the activities required in the "Nonconformance and Corrective Action Procedures" section of the TSWP QAPP. At a minimum, the SPH Subcontractor will perform the following activities.

- All nonconforming shipments, materials, supplies, equipment, or subcontractor services will be documented and reported to the SPH Subcontractor's Project Manager. Documentation will include the date of the inspection, the items inspected, the nature of the nonconformance, any immediate corrective actions taken, and the name of the person performing the inspection.

- The SPH Subcontractor's Project Manager will immediately contact the RAAS Subcontractor Field Operations Manager of any nonconformance situations that could possibly impact safety, quality, or the success of the project.

- The SPH Subcontractor's Field Operations Managers will maintain a log of all nonconformance reports and will document corrective actions through final resolution. Resolved nonconformance reports will be so indicated on the log with a description of the corrective actions and final resolution. Nonconformance resolution will be documented **and** communicated to all parties.

- The SPH Subcontractor's Project Manager will provide the RAAS Subcontractor Field Operations Manager with a weekly update of this nonconformance log.

- Nonconforming materials, supplies, and equipment will be immediately tagged as being "out of conformance" and repaired, calibrated, or removed from the site as soon as reasonably possible. Tags used for this purpose will be easily recognizable and will be marked to indicate a contact person who can provide information on the status of the tagged items. Where possible, nonconforming items awaiting repair, calibration, or replacement will be stored together in designated areas.

- Lower-tier subcontractors who have failed to provide requested qualifications documentation, are in violation of health and safety procedures, or are found to be performing work that is nonconforming will be immediately notified of the nature of nonconformance and will be instructed on how to correct the nonconformance. If the nature of the nonconformance involves a health and safety violation, or threatens safety or project success, the activities of the subcontractor may be immediately suspended until the nonconformance can be successfully resolved.

- The SPH Subcontractor's Project Manager will perform follow-up inspections, as necessary, to ensure that the prescribed resolutions for nonconformance situations are being implemented. These follow-up inspections will be properly documented.

9. PERSONNEL QUALIFICATIONS AND TRAINING

The qualifications of site personnel are summarized in Table 5. All personnel will have training as specified in the TSWP SAP, QAPP, ES&HP, and WMP. All personnel also will receive site-specific orientation and training for the PGDP, including Radiological Worker Training 11. All personnel qualifications and training records will be recorded and maintained in accordance with the "Qualifications and Training of Personnel" section of the TSWP QAPP.

Table 5. Summary of personnel training and Certifications

Task	Required certification
All Workers	HAZWOPER Standard, 29 CFR 1910.120, 40-Hour training and current 8-hour refresher. Supervisors, additionally, shall have HAZWOPER 8-hour Supervisor Training. Medical monitoring General Site Training Radiological Worker Training II
SPH Project Manager	Design engineer and Project Manager on a minimum of three previous SPH projects
SPH Field Operations Manager	Field Operations Manager on a minimum of three previous SPH projects.
SPH Field Technicians	Field Technician on a minimum of one previous SPH project
Drillers	Commonwealth of Kentucky Certification Respiratory protection standard, 29 *CFR* 1910.134
Electricians	Commonwealth of Kentucky License
Forklift operations	Hoisting and rigging training, BJC-EH-2008 Power Industrial Truck Training, *CFR* 1910.178 (RAAS-030)

The specific activities required to install the SPH treatability study system require no special certifications, but do require specific skills and training. The SPH Subcontractor Project Manager will have direct experience as the lead design engineer and project manager on a minimum of three previous SPH projects. The SPH Subcontractor Field Operations Manager will have direct experience in the same role on a minimum of three previous SPH projects. The SPH Subcontractor's Field Technicians will have direct experience on a minimum of one previous SPH project.

A drilling company certified to install monitoring wells in the Commonwealth of Kentucky will provide drilling services. The drillers provided by the drilling subcontractor also will be certified to install monitoring wells or work under the supervision of a driller certified to install monitoring wells in the Commonwealth of Kentucky.

10. MATERIALS AND EQUIPMENT

10.1 MATERIALS

The **SPH** treatability study system will be constructed of the materials and components specified in the certified for construction version of the ***Design Drawings and Technical Specifications Package for the Six-Phase Heating Treatability Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky.***

10.2 WELL CONSTRUCTION MATERIALS

Installation of the **SPH** treatability study system will require the construction of seven electrodes (each containing VR wells), four multi-port groundwater monitoring wells, and fifteen soil vacuum monitoring piezometers. Construction details for each of these system components are presented in the SPH Design Package (DOE 2001c). If appropriate, the **SPH** Subcontractor will prepare site-specific work guidelines, including health and safety and **QA/QC** provisions, for the installation of each of these system components to supplement existing field procedures. If supplemental worlung guides are appropriate, they will be prepared prior to initiating construction activities. The SPH Subcontractor also will provide a training program for any site-specific work guidelines prepared for well construction activities.

The materials and critical specifications necessary to construct the electrodes/VR wells are identified in Table 6, the multi-port groundwater monitoring wells in Table 7, and the vacuum monitoring piezometers in Table 8. Many of the materials required for construction of the **SPH** treatability study can be obtained only from specialty manufactures and suppliers. Materials specifications in this document are based upon the SPH Design Package (DOE 2001c) and materials identified in the certified for construction version of the SPH Design Package will have precedence over those listed in this document. Substitutions of materials listed in this document will be permitted only through approved changes to the SPH Design Package.

QA and ***QC*** activities associated with construction materials will include inspections for damage and compliance with design and purchasing specifications. Inspections will be performed when the materials arrive onsite. Any discrepancies will be noted and resolved through the notification and correction process.

10.3 SYSTEM EQUIPMENT

The SPH treatability study system will consist of the large-scale components described in Table 9. System equipment will be manufacturer's prefabricated units matching the SPH Design Package criteria. QA and QC activities associated with system equipment will include inspection of the equipment for damage when it arrives onsite and for compliance with design and purchasing specifications. Additionally, system equipment will be tested as soon as possible to verify that it can perform to the **SPH** Design Package requirements, as configured. Any discrepancies will be noted **and** resolved through the notification and correction process.

Table 6. Electrode and VR well construction materials

Material	Approximate quantity	Specifications
Steel Shot	56 tons	SAE 5444
Hydrating Solution	623 gal	Epson Salt, USP grade
Neat Type 1 Portland Cement Grout	1,000 lb	American Concrete Institute code
3/8 inch Bentonite Pellets[a]	4,900 lb	ANSI/NSF Std 60
Sand filter pack	2,500 lb	10-20 sieve
Metal Electrodes	84	SPH Subcontractor's design
Electrode Cable, 1/O	3,000 ft	SPH Subcontractor's design, similar to type KK or M16878/12
Electrode Cable, 4/0	2,100 ft	SPH Subcontractor's design, similar to type KK or M16878/12
Cable Lugs	168	UL9809
Teflon Shrink Tubing	28 ft	MIL-I-23053/12
Epoxy Insulating Resin	1 qt	Scotchcast 4
Steam Separator	7	SPH Subcontractor's design, alloy 304
Epoxy Fiberglass Well Screen	87.5 ft	ASTM-RTRP 11FE, MIL-P-28584B, or ASTM D5686
CPVC Well Casing	210 ft	ASTM F441
Teflon Steam Tubing	280 ft	ASTM D3295
1/2½ inch Bolt Sets	420	Grade 5, ASTM A449

[a]Bentonite will be free-flowing, high swelling, sodium based, Wyoming-type bentonite. High-density bentonite sluny will be a mixture of powered bentonite, and water. Bentonite will be mixed in a batch plant and the slurry will have a minimum of 30% solids by weight. Bentonite sluny will be placed with a side discharge tremie pipe.

Note: The use of bentonite has been reduced as much as possible. However, it will be necessary to use bentonite slurry in the construction of the electrodes, piezometers, and groundwater monitoring wells to provide some of the annulus seals and to prevent cement grout from migrating into lower sand or steel shot-filled intervals.

Table 7. Multi-port groundwater monitoring well construction materials

Material	Approximate quantity	Specifications
4-inch diameter, flush-joint well casing	440 ft	Schedule 40 stainless steel
4-inch diameter well screens (0.6-m (2-ft) sections)	28 sections	0.010-inch slot stainless steel
Solinist multi-level sampling system-prefabricated	440 ft (28 sampling ports)	Stainless steel, Teflon, and Viton Temperature resistant to 150°C
2-inch diameter, flush-joint riser pipe supporting the Solinist multi-level sampling system.	440 ft	Stainless steel
Neat Type 1 Portland Cement Grout	8,800 pounds	American Concrete Institute code
3/8 inch bentonite pellets[a]	4,250 pounds	ANSIMSF Std 60
Sand filter pack	15,500 pounds	10-20 sieve
18-inch diameter flush mount vault	4	MAS-027
4-inch diameter well casing end cap-flush joint	4	Schedule 40 stainless steel

"Bentonite will be free-flowing, high swelling, sodium based, Wyoming-type bentonite. High-density bentonite slurry will be a mixture of powered bentonite, and water. Bentonite will be mixed in a batch plant and the slurry will have a minimum of 30% solids by weight. Bentonite slurry will be placed with a side discharge tremie pipe.

Note: The use of bentonite has been reduced as much as possible. However, it will be necessary to use bentonite slurry in the construction of the electrodes, piezometers, and groundwater monitoring wells to provide some of the annulus seals and to prevent cement grout from migrating into lower sand or steel shot-filled intervals.

Table 8. Vacuum monitoring piezometer construction materials

Material	Approximate quantity	Specifications
3/8 inch Bentonite Pellets"	6,400	ANSI/NSF Std 60
Sand	10,100 lb	10-20 sieve
Grout	9,000 lb	Type I Portland Cement, ASTM C150
3/8 inch PFA Teflon Tubing	870 ft	ASTM D3295
1/4 inch PFA Teflon Tubing	450 ft	ASTM D3295
1 inch galvanized steel pipe	1,155 ft	ASTM AS3
1/2 inch O.D. Brass Sintered Metal Filters measuring 1.4 inches	30	40 micron mesh, 300°F temperature rating
1.25 inch Teel well point measuring 36-inches	30	No. 60 stainless steel gauze screens and brass fittings.

"Bentonite will be free-flowing, high swelling, sodium based, Wyoming-type bentonite. High-density bentonite slurry will be a mixture of powered bentonite and water. Bentonite will be mixed in a batch plant and the slurry will have a minimum of 30% solids by weight. Bentonite slurry will be placed with a side discharge tremie pipe.

Note: The use of bentonite has been reduced as much as possible. However, it will be necessary to use bentonite slurry in the construction of the electrodes, piezometers, and groundwater monitoring wells to provide some of the annulus seals and to prevent cement grout from migrating into lower sand or steel shot-filled intervals.

Table 9. Equipment specifications

Component	Type	Specifications
Condenser	SPH Subcontractor's design, water-cooled plate and frame heat exchanger with inlet and outlet separation	Inlet capacity: 900 scfm steam, 300 scfm air, 10 gpm liquid water, 100°C, 20 inch Hg Outlet conditions: 300 scfm air @ 100%RH <5°F above ambient, dP<1 inch Hg
VR Blower	rotary lobe	20 horsepower, 200 scfm, 14 inch Hg
Vapor Treatment	VOC adsorption by vapor phase GAC	2 **GAC** vessels in series, change-out vessel on-site. Minimum vessel size: 13,000 lbs. Minimum Flow Capacity: 1,500 scfm. TCE removal efficiency: >95%.
SPH Power Control Unit	DOE design, trailer-mounted	950 kVA, 13.8 kV input, 75V-1100V output, remote monitoring and control of electrical power and remote monitoring of temperature

Notes:
Scfm = standard feet per minute
Hg = Mercury
dP = differential pressure
kVA = kilovolt-amps, similar to kilowatts

10.4 CONSTRUCTION EQUIPMENT

Drill rigs capable **of** producing the boreholes necessary to install the electrodes/VR wells, the multi-**port** groundwater monitoring wells and the vacuum monitoring piezometers will be required. The summary **of** the drilling capabilities required for the **SPH** system installation is provided in Table 10.

Table 10. Summary of soil boring requirements

Activity	Boring diameter	Maximum boring depth	Drilling method
Electrodes/VR wells	14 in.	29.6 m (97 ft)	10 1/4-in. Auger or Roto-Sonic with 12-inch casing
Monitoring wells	12 in.	33.5 m (110 ft)	8 1/4-in. Auger or Roto-Sonic with 12-inch casing
Vacuum piezometers	8 in.	17.7 m (58 ft)	4 1/4-in. Auger
Post-Study borings	1 in.	18 m (60 ft)	Direct Push Technology

An all-terrain forklift with an 8,000-lb capacity rating will be required to receive the condenser and to receive the electrode and well construction materials.

QA and QC activities associated with construction equipment will include inspections for damage, proper decontamination, safe operating conditions, and the absence **of** fluid leaks. These inspections will be performed as soon as the equipment arrives onsite. The equipment, including accessories and tooling, also will be inspected to ensure that it is capable **of** performing to design and purchasing specifications. ***Any*** discrepancies will be noted and resolved through the notification and correction process.

10.5 DATA GATHERING INSTRUMENTS

Data gathering instruments will be used to assist the installation process and will be installed into the system to monitor and record operating parameters. These instruments, their required accuracy, and method of calibration is summarized in Table 11.

Table 11. Data gathering instrumentation

Instrumentation	Accuracy	Calibration
Type T Thermocouples	1°C	Factory calibration accuracy per ANSI specification
Vacuum Gauges	0.3 inch Hg	Factory calibration accuracy per ANSI specification
Thermometers	1.4°C	Factory calibration accuracy per ANSI specification
Water Manometers	0.05 inch H_2O	Water manometers are primary standards
Digital Manometers	2.5%	Weekly calibration to primary standard (water manometer)
Averaging Pitot Tube	equals gage accuracy	Calibration is not applicable to pitot tubes. Pitot tubes are read with water manometers or calibrated digital manometers.
Portable Multimeters	0.3%	Factory calibrated with NIST Traceable Calibration Certificate
Portable Ammeters	>40A: 12A <40A: 0.8A	N/A Connected to calibrated multimeter
Installed Voltmeters, Ammeters, Power Meters	*0.5%*	Calibrated using NIST-calibrated portable multimeter
On-line PIS - vapor treatment system stack	Range: 0-999 ppm VOCs Resolution: 0.1 ppm Range: 100-10,000 ppm Resolution: 1 ppm	Meets ISO Standard 8158 Functionally equivalent to Innova Model 1312 Two point field calibration of zero and standard reference gas.
Remote Monitoring Indications	0.5%	Calibrated using NIST-calibrated portable multimeter

Notes:
ANSI = American National Standards Institute
H_2O = Water
NIST = National Institute of Standards and Technology
A = amperes (amps)
PIS = Photoacoustic infrared spectroscopy
ISO = International Organization for Standardization

QC activities associated with data gathering instruments will include inspections for damage and for compliance with design and purchasing specifications. These inspections will be performed when the instruments arrive onsite. If specified by design requirements, data gathering equipment will be tested and calibrated prior to use. Once installed, all data gathering and reporting instruments and systems, including remote access and alarm notification systems, will be tested against the SPH Design Package specifications as part of system startup. Any discrepancies will be noted and resolved through the notification and correction process.

10.6 VR SYSTEM

Plastics, like other piping materials, expand when heated. In most cases, piping should be allowed to move unrestrained between desired anchor points (e.g., VR wells and the condenser) without abrasion, cutting, or restriction of the piping. The installation of expansion loops, offsets, changes in direction, or a Teflon-bellows expansion joint is required to minimize stresses between anchor points.

Specifications from the Harrington Industrial Plastics ***Engineering Handbook for Industrial Plastic Piping Systems*** (Harrington Industrial Plastics 2000) indicate that as chlorinated polyvinyl chloride (CPVC) pipe is heated from ambient conditions to the operating temperatures of a SPH system (approximately 100 °C), it expands at a rate of about 11 cm per 30.5 m (4.5 inches per 100 ft). If adjacent equipment or improper pipe clamping and support systems restrain movement from thermal expansion, the resultant stresses may cause damage to the equipment or piping.

In application to SPH, design rules for thermal expansion can usually be simplified to "do not connect a long straight run of piping to a well; an offset or change of direction is required before the wellhead connection."

The small area of the SPH treatability study results in fairly short runs of straight piping and no straight lengths in excess of 15.2 m. (50 ft) are expected. Therefore, based on standard design rules, a change of direction with a 1.5 m (5 ft) length provides sufficient flexibility to provide for thermal expansion. This 1.5 m (5 ft) length also is a convenient length for a Pitot tube instrument run and can serve both thermal expansion and system sampling purposes.

When CPVC piping is installed above ground, it must be properly supported to avoid unnecessary stresses and possible sagging. At SPH temperatures, the maximum distance between supports is shown in Table 12.

Table 12. Maximum CPVC pipe support distances

Pipe diameter	Maximum support spacing[a]
2-in. or less	1.5-m (5-ft)
4-in.	2.1-m (7-ft)
6-in.	2.7-m (9-ft)

Notes:
[a] (Harrington Industrial Plastics, 2000)

However, the requirements for piping support run counter to the requirement for unrestrained thermal expansion and it can be difficult to design a piping support system that does not restrain piping expansion, especially if there are many side branches such as typically found in VR systems.

The best solution is simply to lay the vapor recovery piping on the ground. The inherent flexibility of CPVC pipe allows it to conform to minor surface variations, providing the pipe with essentially continuous support without the binding that might lead to thermal expansion stresses. At-grade piping also is less of a tripping hazard.

CPVC undergoes surface oxidation and embrittlement when exposed to sunlight over a period of several years. The surface oxidation is visible as a piping color change from gray to white. While oxidized piping does not lose any of its pressure or vacuum capability, it does become more susceptible to impact damage. Where polyvinyl chloride (PVC) or CPVC pipe is expected to provide several years of service, it should be painted with a latex paint. Painting is not required due to the short duration of this treatability study.

If required by design specifications, heat tracing and insulation can be applied to PVC and CPVC pipe by normal methods. Because plastic pipe is a very poor heat conductor, the use of aluminized tape to attach the heat tracing is recommended. Heat tracing of pipe will not be employed during this project.

Plastics expand more quickly than metals as they are heated. If a female CPVC threaded fitting is mated with a male metal fitting, it is likely to leak as the system is brought up to operating temperature. The use of male CPVC threads with female metal threads is appropriate for heated systems if the pipe size is **5** cm (2 inches) or less. If the pipe size is greater than **5** cm (2 inches), a flanged plastic to metal transition is recommended.

Neither CPVC nor PVC is rated for contact with pure solvents. However, PVC is commonly used in vapor extraction systems to convey recovered chlorinated and petroleum hydrocarbon vapors from the subsurface. During Electrical Resistance Heating, conditions within the vapor recovery piping system are identical to those in a standard vapor extraction system except for the elevated temperatures. Solvents are present in the vapor recovery piping system in the vapor phase only, and CPVC is selected over PVC because of its superior performance at temperature. Tens of thousands of feet of CPVC have been utilized in construction of the vapor recovery systems for previous Electrical Resistance Heating projects without failure from solvent attack.

10.7 ELECTRICAL SYSTEMS

To the maximum extent possible, electrical connections will be accomplished in accordance with the applicable provisions of American Nations Standards Institute (ANSI) C2, National Electrical Manufactures Association WC-7, National Fire Protection Association 70. Exceptions will be made for prefabricated equipment and those components of the SPH system that operate on the principle of putting energy to ground.

Pnor to acceptance, an operational test of all electrical, electrical data gathering, **and** equipment control systems will be performed to determine if the systems meet the purpose and intent of the SPH Design Package. Testing shall demonstrate that the systems are not electrically, mechanically, structurally, or otherwise defective, are in safe and satisfactory condition, and conform to specified operating characteristics. If any deficiencies to pertinent components are revealed during these tests, they will be corrected and the tests will be repeated until all deficiencies have been resolved.

11. REFERENCES

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DOE 2001b. ***Treatability Study Work Plan for Six-Phase Heating, Groundwater Operable Unit, at Paducah Gaseous Diffusion Plant,*** DOE/OR/07-1889&D2, U.S. Department of Energy, Paducah, KY, September.

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EPA 1998. *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant,* U.S. Environmental Protection Agency, Atlanta, GA, February 13.

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APPENDIX A

QUALITY CONTROL CHECKS

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QUALITY CONTROL CHECKS

The TSWP identifies the processes and mechanisms that ensure adherence to the SPH Design Package. Critical QA/QC activities related to construction and installation of the SPH treatability study system are presented in the TSWP QAPP and this CQCP. The SPH Subcontractor's **QA** Manager will be responsible for the SPH Subcontractor's QNQC activities during the installation of the SPH treatability study system and will report directly to the RAAS Subcontractor Field Operations Manager. The SPH Subcontractor's QA Manager will direct the QNQC activities performed by the SPH Subcontractor's Project and Field Operations Managers, and various SPH Subcontractor personnel will assist the SPH Field Operations Manager in the performance of QA/QC activities during the course of the system installation.

Field documentation will be maintained throughout the system installation process per the requirements of the "Documentation" section of the TSWP ***SAP.*** Activity-specific field data sheets will be generated by the SPH Subcontractor per the requirements of the "Field Data Sheets" section of the TSWP ***SAP*** procedure to record all QC data collected during system installation.

Electrode Cable Assembly Checks:

Each electrode element has two cables for redundancy, except for the 11.9 to 17.1 m (39 to ***56*** ft) depth zone, which has four cables. The following electrode cable assembly checks will be performed on all electrode cables.

- Inspect electrode cables for nicks or damage.
- After crimping the cable lugs per the specifications of Thomas & Betts Corporation's Technical Advisory No. TAO1978B (Thomas & Betts 2000), pull on the cables to check for any "give."
- Inspect the shrink tube and epoxy filling at the cable lugs for gaps or holes.
- Measured electrical resistance between electrode cables at their upper end should be less than 0.5 Ohm as read with a factory calibrated portable multimeter.
- Verify that the voltage tattletales and drip tubes are secured to the cable at a maximum of **3.0-m** (10-ft) intervals. Voltages are read with a factory calibrated portable multimeter.

Electrode Installation Checks:

- Electrode zone 6 (27.7 to 29.6 m (91 to 97 ft) bgs), desired shot: 1,200-1,550 lb, hydrating solution: 6 gal
- Electrode zone 5 (23.8 to 27.1 m (78 to 89 ft) bgs), desired shot: 1,600-2,600 lb, hydrating solution: 11 gal
- Electrode zone 4 (17.7 to 23.3 m (58 to 76 ft) bgs), desired shot: 2,100-3,500 lb, hydrating solution: 18 gal
- Electrode zone 3 (11.9 to 17.1 m (39 to 56 ft) bgs), desired shot: 2,250-3,300 lb, hydrating solution: 17 gal
- Electrode zone 2 (5.2 to 11.3 m (17 to 37 ft) bgs), desired shot: 1,700-2,800 lb, hydrating solution: 20 gal

- Electrode zone 1 (2.5 to 4.5 m (8 to 15 ft) bgs, desired shot: 700-1200 lb, hydrating solution: 7 gal
- Neutral Zone, desired shot: 150-250 lb, no hydrating solution
- As each electrode zone is installed, verify the electrical resistance between the electrode cables and the backfill tattletales is less than 0.5 Ohm

Initial Start-up Checks:

Initial start-up checks are made with a factory calibrated portable multimeter.

- Verify that electrode zone 1 tattletale voltage is within 5 volts (V) of applied voltage.
- Verify that electrode zone 2 tattletale voltage is within 5 V of applied voltage.
- Verify that electrode zone 3 tattletale voltage is within 5 V of applied voltage.
- Verify that electrode zone 4 tattletale voltage is within 5 V of applied voltage.
- Verify that electrode zone 5 tattletale voltage is within 5 V of applied voltage.
- Verify that electrode zone 6 tattletale voltage is within 5 V of applied voltage.

Equipment Foundation Checks:

- Verify that equipment is properly level during installation.

Field Piping Installation Checks:

- Verify that piping is not constrained against thermal expansion except at VR wells and the condenser.
- Vacuum leak test piping between well valves and condenser inlet (apply 15 in. Hg, maintain 10 in. Hg after 16 hrs). Record data using a factory calibrated vacuum gauge.
- Hydrostatic test electrode drip hoses (apply 60 psi, maintain 50 psi after 16 hrs). Record data using a factory calibrated pressure gauge.

Thermocouple Checks:

- Check temperature readings at computer versus a hand-held thermocouple reader (within 2 degrees).

Mark piezometer thermocouple wire at 1.5 m (5 ft) intervals.

SPH Power Control Unit Checks:

- Tug on all power cable connections to check for loose connections.
- Inspect all compartments for foreign objects and damaged components.
- Visually inspect all cables for physical integrity.
- Hi Pot (high potential) test primary side of transformers at 15 kV. Hi Pot testing is performed by a Commonwealth of Kentucky-certified sub-tier subcontractor.

- Megger secondary side of transformers at 500V. Megger testing is performed by a Commonwealth of Kentucky-certified sub-tier subcontractor.

- Verify remote operation.

Equipment Interlock Checks:

- Verify that condenser fault shuts down blower.
- Verify that discharge tank high level shuts down vapor treatment system.
- Verify that vapor treatment fault shuts down blower.
- Verify that vapor extraction fault shuts down SPH system.

Vapor Recovery System Checks:

- Adjust each VR well to extract 5-25 scfm (0.1 to 2.7 inch w.c. d.p.), if possible. Measurements are made using averaging pitot tubes read with water manometers or calibrated digital manometers.

- Verify that differential pressure from blower inlet to furthest well is less than 2 in. Hg.

- Perform vacuum influence and temperature checks. Vacuum measurements are made using averaging pitot tubes (read with water manometers or calibrated digital manometers) or with factory calibrated vacuum gauges. Temperature measurements are made with type T thermocouples read with calibrated thermocouple readers.

- Verify that vacuum in the 13 piezometers within, or immediately adjacent to, the treatment zone is greater than 0.05 in. w.c. at 3.0 and 6.1 m (10 and 20 ft) bgs. Measurements are made using averaging pitot tubes read with water manometers or calibrated digital manometers.

- Record vacuum/pressure in all piezometers at 8.8 m (29 ft) bgs. Measurements are made using averaging pitot tubes read with water manometers or calibrated digital manometers.

- Record baseline temperatures in all vacuum monitoring piezometers at 1.5 m (5 ft) intervals from total depth to 1.5 m (5 ft) bgs. The SPH Design Package specifies a total depth of 17.7 m (58 ft) bgs for the vacuum monitoring piezometers. Actual depths will be set in the field based upon site conditions encountered during construction of the piezometers. Temperature measurements are made with type T thermocouples read with calibrated thermocouple readers.

Induced Voltage Survey:

When energy is first applied to the electrode field, induced voltage surveys are performed across the surface of the electrode field, around the perimeter of the electrode field, and at objects protruding from the subsurface. Where possible, induced voltage checks also are performed at the terminal ends of utilities passing through or within 6.1 m (20 ft). During induced voltage surveys, data is recorded with a factory calibrated portable multimeter.

- Connect the 5.2 to 11.3 m (17 to 37 ft) bgs electrode interval to the PCU, apply a low voltage (50-150 V), and perform an induced voltage survey.

- Connect the 2.5 to 4.5 m (8 to 15 ft) bgs, 5.2 to 11.3 m (17 to 37 ft) bgs, and 11.9 to 17.1 m (39 to 56 ft) bgs electrode intervals to the PCU and perform an induced voltage survey.

- Verify to greater than that tattletale voltage is within 5 V of applied voltage; record on "Electrode Checks" sheet.
- Increase power 500 kW and perform an induced voltage survey.

CPVC Installation:

Solvent cementing is the preferred method of joining CPVC pipe and fittings, providing a chemically fused joint. The following basics should be clearly understood by the installer.

1. Pipe must be cut square and saw burrs completely removed.
2. The joining surfaces must be clean and dry, then softened with a primer to make them semi-fluid.
3. Sufficient cement must be applied to fill the gap between pipe and fittings.
4. Assembly of pipe and fittings must be made while the surfaces are still wet and fluid.
5. Joint strength develops as the cemeht dries. In the tight part of the joint, the surfaces will tend to fuse together. In the loose part, the cement will bond to both surfaces.
6. Penetration and priming should be achieved with a suitable primer. Primer will penetrate and soften the surfaces more quickly than cement alone. This priming step is especially important in cold weather.
7. More than sufficient cement to fill the loose part of the joint must be applied. Besides filling the gap, adequate cement layers will penetrate the surface more deeply before drying, providing a stronger joint.

For a proper joint to be developed between CPVC pipe and pipe fittings, cutting, cleaning, and preparation of the joint is of primary importance. The installer should follow the following basics.

1. Condition pipe and fitting to the same temperature.
2. Cut pipe square to the desired length.
3. Remove burrs and chamfer the end of the pipe at a 10°-15° angle for 1/16 inch.
4. Clean the pipe and fitting of all dirt, moisture, and grease.
5. Using a proper applicator, apply primer freely with a scrubbing motion to the fitting socket, keeping the surface and applicator wet until the surface has been softened. This usually requires 5-15 seconds, more in cold weather.
6. Prime the pipe as for the fitting.
7. Quickly apply primer to the fitting a second time.
8. Apply a liberal coat of cement to the pipe. Flow the cement on with the applicator. Do **not** brush the cement out to a thin paint-like layer.
9. Apply a medium layer of solvent cement to the fitting socket.

10. Fully insert the pipe into the socket. Give the pipe a quarter-turn during insertion, if possible. Hold the joint together until both soft surfaces are firmly gripped (usually less than 15 seconds for small diameter piping, larger sizes or cold weather might require more time). Care must be used because the fitting sockets are tapered and the pipe will try to push out of the fitting just after insertion.

11. After assembly, a properly made joint will show a thin ring or bead of cement completely around the junction of the pipe and fitting. Any gaps in this bead may indicate a defective assembly job.

12. Handle newly assembled piping carefully until initial set time shown in Table A.1 has taken place. Set times are provided for various ambient temperatures and pipe diameters.

13. Allow the joint to cure for adequate time before pressure testing. Joint cure times are shown in Table A.2 for various ambient temperatures and pipe diameters.

Table A.l. CPVC cement set times

Temperature	Set time' Diameters <1.5 inches	Set time' diameters of 1.5 to 3 inches	Set time' diameters >3 inches
>60°F	15 minutes	30 minutes	1 hour
40°-59°F	1 hour	2 hours	4 hours
<39°F	3 hours	6 hours	12 hours

Notes:

[a] (Harrington Industrial Plastics 2000)

Table A.2. CPVC cement cure times

Ambient temperature	Cure time' Diameters < 1.5 inches	Cure time' diameters of 1.5 to 3 inches	Cure time' diameter > 3 inches
>60°F	1 hour	2 hours	6 hours
40°-59°F	2 hours	4 hours	12 hours
<39°F	8 hours	16 hours	48 hours

Notes:

[a] (Harrington Industrial Plastics 2000)

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APPENDIX B

PROJECT FORMS

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EQUIPMENT ARRIVAL INSPECTION/CERTIFICATION

Date	Expected Arrival Date	Component Description	Transported By	Vendor	Is component damaged?	Describe damage	Shipper Notified?	Indicate Resolution	Date Resolved	Inspector's Initials

CT ABLE Y

Use this form to record result of inspection and testing of each electrode cable assembly.

Date	Inspector's Name	Electrode Cable Designator (e.g., EI-depth"A")	Is cable nicked or insulation damaged?	Do lugs "give" when pulled?	Does shrink tube/epoxy have any gaps or damage?	Are voltage tattletales and drip tubes secured at 10 ft. intervals?	Indicate actions taken to correct problems.

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ELECTRODE INSTALLATION CHECKS

This form shall be used to record details of each electrode installation.

			Zone 6 27.7 to 29.6 m 91 ot 97 ft. bgs		Zone 5 23.98 to 27.1 m 78 to 89 ft. bgs		Zone 4 17.7 to 23.3 m 58 to 76 ft. bgs		Zone 3 11.9 to 17.1 m 39 to 56 ft. bgs		Zone 2 5.2 to 11.3 m 17 to 37 ft. bgs		Zone 1 2.5 to 4.5 m 8 to 15 ft bgs		Neutral Zone	
Date	Supervisor's Name	Electrode Designator	Shot (1,200~ 1,550 lb)	Hydrating Solution (6 gal)	Shot (1,600~ 2,600 lb)	Hydrating Solution (11 gal)	Shot (2,100~ 3,500 lb)	Hydrating Solution (18 gal)	Shot (2,250~ 3,000 lb)	Hydrating Solution (17 gal)	shot (1,700~ *2,800* lb)	Hydrating Solution (20 gal)	Shot (700 ~ 1,200 lb)	Hydrating Solution (7 gal)	Shot (150 ~ 250 lb)	Hydrating Solution (NONE)

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INTER-ELECTRODE CABLE RESISTANCE CHECKS

Use this form to record resistance between electrode cables following installation.

Date	Inspector's Name	Electrode Cable Designator (e.g., E1-depth"A")	Record resistance between each cable and other electrode cable at similar depths. (Req'd <0.5 ohms)								

ELECTRODE TATTLETALE VOLTAGE CHECKS

Use this form to record voltage between each electrode cable and it's tattletale after initial startup.

Date	Inspector's Name	Electrode Cable Designator (e.g., E1-depth"A")	Record voltage between each cable and its tattletale. (Should be within 5 volts of applied voltage)								

Equipment Foundation Checks

Use this form to record inspection and testing of the equipment foundations .

Date: ______________________________

Project Name: ______________________________

Inspector's Name: ______________________________

Description of equipment foundations being inspected: ______________________________

____

____

____

Perform *the* following inspections. Record inspection results and flag all non-conforming equipment foundations.

1. Verify that each equipment foundation is level within 1-inch per 10 feet.
   - A. Power Control Unit Foundation ____________
   - B. Condenser Foundation ____________
   - C. Vapor Recovery Blower Foundation ____________
   - D. GAC Vessel Foundation ____________
   - E. Storage Tank Foundations ____________

2. If gravel is used for the foundation - verify that it is a minimum of 2-inches thick.
   - A. Power Control Unit Foundation ____________
   - B. Condenser Foundation ____________
   - C. Vapor Recovery Blower Foundation ____________
   - D. GAC Vessel Foundation ____________
   - E. Storage Tank Foundations ____________

3. Drive a pick-up truck over the foundation, verify that tire tracks are less than IN-inch deep.
   - A. Power Control Unit Foundation ____________
   - B. Condenser Foundation ____________
   - C. Vapor Recovery Blower Foundation ____________
   - D. GAC Vessel Foundation ____________
   - E. Storage Tank Foundations ____________

4. Verify that the foundation extends at least 2-feet beyond the foot print c the equipment on it.
   - A. Power Control Unit Foundation ____________
   - B. Condenser Foundation ____________
   - C. Vapor Recovery Blower Foundation ____________
   - D. GAC Vessel Foundation ____________
   - E. Storage Tank Foundations ____________

Water Piping In n :hecks

Use this form to record inspection and testing of the water piping systems .

Date: ______________________

Project Name: ______________________

Inspector's Name: ______________________

Description of **piping section(s) being** inspected: ______________________

Perform the **following visual inspections. Mark** conforming **inspections with** a **"yes"** and **non-conforming inspections with** a "No".

Flag all **non-conforming** system components for **repair** or replacement.

	Yes/No	**Number** of Failures
1. Do piping materials and diameters match project specifications		
3. Check support distances against design specifications - are distances within specifications?		
4. Check support fittings, are fittings secure?		
5. Inspect each joint - are all fitting secure?		
6. Inspect each pint - was pipe dope or tape used on threaded fittings?		
7. Inspect each joint - was glue used on slip fittings?		
8. Inspect each joint - is workmanship of satisfactory quality?		
9. Inspect each flange fitting - Is the flange gasket in place?		
10. Inspect each flange fitting - are all flange bolts tight?		
11. Are all valves located per design specifications?		
12. Inspect each valve - are valve types per design specifications?		
13. Inspect each valve - is each valve properly positioned for the water flow direction?		
14. Inspect each valve - is the valve operational through fully-open and fully-closed?		
15. Inspect each valve - is each valve securely in place?		
16. Inspect each valve - was pipe dope or tape used on all threaded fittings?		
17. Inspect each valve - was glue used on all slip fittings?		
18. Inspect each valve - is workmanship of satisfactory quality3		
19. Are all check valves located per design specifications?		
20. Inspect each check valve - is each valve properly positioned to check reverse flow?		
21. Inspect each check valve - are the valves securely in place		
22. Inspect each check valve - was pipe dope or tape used on all threaded fittings?		
23. Inspect each check valve - was glue used on all slip fittings?		
24. Inspect each check valve - is workmanship of satisfactory quality?		
25. Are all totalizers located per design specifications?		
26. Inspect each totalizer - are they positioned properly for the water flow direction?		
27. Inspect each totalizer - are they securely positioned?		
28. Are all sampling locations and gauges located per design specifications?		
29. Do the measurement ranges of all gauges match design specifications?		
30. Are all gauges calibrated to the design specifications?		
31. Inspect each sampling location - are all proper sampling ports present?		
32. Inspect each sampling location and gauge - are they properly positioned?		
33. Inspect each sampling location - is the sampling port properly sized?		
34. Inspect each sampling port and gauge - are they installed perpendicular to the pipe face?		
35. Inspect each sampling port and gauge - are ports and gauges securely positioned in the pipe?		
36. Inspect each sampling port - are all sampling port capped?		

Hydrostatic test on electrode drip system piping from electrode head supply **manifold(s)** to water supply **valve:**

Pressure applied at start of leak test (minimum 60 psi): ______________

Pressure 16 hours after start of hydrostatic test (if <50 psi, repair leak(s) and repeat test): ______________

Date hydrostatic test passed: ______________

Hydrostatic test on condensate **discharge line** from the condenser to the **final discharge** point:

Pressure applied at start of leak test (minimum 60 psi): ______________

Pressure 16 hours afler start of hydrostatic test (if <50 psi, repair leak(s) and repeat test): ______________

Date hydrostatic test passed: ______________

Vacuum Piping Installation Checks

Use this form to record inspection and testing of the vapor recovery piping system from the vapor recovery well heads through the vapor treatment system discharge.

Date: ______________________

Project Name: ______________________

Inspector's Name: ______________________

Description of piping section(s) being Inspected: ______________________

____

____

____

Perform the following visual inspections. Mark conforming Inspections with a "yes" and non-conforming inspections with a "No".

Flag all non-conforming system components for repair or replacement.

	Yes/No	Number of Failures
1. Do piping materials and diameters match project specifications		
2. Is CPVC piping used in all areas where piping temperatures could be above 125 F?		
3. Is piping constrained against thermal expansion except at VR wells and at the condenser?		
4. Check support distances against design specifications-Are distances within specifications?		
5. Check support fittings, are fillings secure?		
6. Inspect each joint - are all filling glued in place?		
7. Inspect each joint - is workmanship of satisfactory quality?		
8. inspect each flange fitting - is the flange gasket in place?		
9. Inspect each flange fitting - are all flange bolts tight?		
10. Are all valves located per design specifications?		
11. Inspect each valve - are valve types per design specifications?		
12. Inspect each valve - is each valve properly positioned for the air flow direction?		
13. Inspect each valve - is the valve operational through fully-open and fully-closed?		
14. Inspect each valve - is each valve glued in place?		
15. Inspect each valve - is workmanship of satisfactory quality?		
16. Are all check valves located per design specifications?		
17. Inspect each check valve - is each valve properly positioned to check reverse flow?		
18. Inspect each check valve - is each valve glued in place?		
19. Inspect each check valve - Is workmanship of satisfactory quality?		
20. Are all sampling ports and gauges located per design specifications?		
21. Inspect each gauge - do the measurement ranges match design specifications?		
22. Inspect each gauge - are they calibrated per design specifications?		
21. Inspect each sampling location - are all proper sampling ports present?		
17. Inspect each sampling port and gauge - are they properly positioned?		
18. Inspect each sampling port - is the sampling port properly sized?		
19. Inspect each sampling port and gauge - are they installed perpendicular to the pipe face?		
20. Inspect each sampling port and gauge - are they securely positioned m the pipe?		
21. Inspect each sampling port - is each sampling port capped?		
22. With the piping system under vacuum (min. 1-inch Hg) - can any leaks be heard?		

Are portions of the piping system installed subsurface? ______________________

____

____

Do the project specifications require leak testing on piping installed subsurface? ______________________

If the project specifications require leak testing an vacuum piping installed subsurface then complete the following tests:

Apply a vacuum to the section of piping being tested and collect the following data:

Description of piping section(s) being tested: ______________________

____

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____

Vacuum applied at start of leak test (minimum 15 inches Hg): ______________________

Vacuum 16 hours after start of leak test (if <10 inches Hg. repair piping and repeat leak test):

Date vacuum leak test passed: ______________________

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[illegible] E READING CHECKS

Use this form to record computer versus hand-held thermocouple readings. Design specification w/in 2 Degrees.

Date	Inspector's Name	Thermocouple Number	Depth: _______Bgs		Depth: _______Bgs		Depth: _______Bgs		Depth: _______Bgs	
			PC	H-H	PC	H-H	PC	H-H	PC	H-H

SPH POWER CONTROL UNIT CHECKS

This form is used to complete inspection of SPH Power Control Units prior to initial startup.

1. Are all power cable connections tight at their terminations? ______yes ______no

2. Complete a visual inspection of all compartments for foreign objects or foreign materials and for damaged components.

   Are all compartments clear of foreign objects and materials? ______yes ______no

   Are all components found to be free from physical damage? ______yes ______no

3. Perform a visual inspection of all power cables for physical integrity, including nicks, abrasions, and indication of excessive heat.

   Are all power cables found to be free from physical deformities? ______yes ______no

4. A "Hi Pot" test must be completed on the primary side of the main power transformers at 15 kV by a Commonwealth of Kentucky-certified sub-tier contractor. Upon completion, attach the Hi Pot inspection form to this page.

   Has the Hi Pot test been completed? ______yes ______no

   Is the Hi Pot inspection form attached to this page? ______yes ______no

5. A meggar test must be completed on the secondary side of the main power transformers at 500 V by a Commonwealth of Kentucky-certified sub-tier contractor. Upon completion, attach the contractor's inspection form to this page.

   Has the meggar test been completed? ______yes ______no

   Is the meggar test form attached to this page? ______yes ______no

If the answer to any question above is "No," list each discrepancy and describe the actions taken to correct the discrepancy, then re-perform this check-list.

____

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Completed By: ________________________ Date: ______________

Inspector's Name: ____

Vapor Recoverv and Treatment Svstem Checks

Use this form to record inspection and testing of the vapor recovery blower, the condenser and the GAC vessels.

Date: ______________________

Project Name: ______________________

Inspector's Name: ______________________

Description of equipment being inspected: ______________________

____

____

____

Perform the following inspections. Record inspection results and flag all nonconforming system components.

Vapor Recovery Blower (positive displacement):

1. Verify that the sheaves are sized to provide design vacuum and flow. ______
2. Check that the oil is clean and that levels match manufactures recommendations. ______
3. Grease the bearings if the bearing system is not sealed.
4. Check the belts for wear and tightness (1/2-inch deflection with moderate pressure in mid-point between sheaves). ______
5. Inspect the inlet filter and replace if dirty. ______
6. "Bump" the motor and check the direction of rotation, reverse if necessary. ______
7. Check that all gauges required by design specifications are in place. ______
8. Ensure that all gauges are calibrated per design specifications. ______
9. Ensure that the blower has a pressure release valve. ______
10. Ensure that shields cover all rotating components. ______
11. Ensure that all piping inside the blower system is secure and fittings are tight. ______

Condenser: ______

1. Service the motor for the cooling fan per manufactures recommendations.
2. Check the belts for wear and tightness (112-inch deflection with moderate pressure in mid-point between sheaves). ______
3. "Bump" the motor and check the direction of rotation, reverse if necessary. ______
4. Inspect the cooling tower for scale buildup and clean if necessary. ______
5. Fill the cooling tower with 300-500 gallons of water that is low in silt, total dissolved solids, and metals. ______
6. Inspect the level switches and clean if necessary. ______
7. Inspect inlet and outlet filters and clean or replace as necessary. ______
8. Check all level switches to assure proper operation.

GAC Vessels

1. Ensure that air flow is in the proper direction. ______
2. Ensure that all pipe fittings are secure. ______

SITE VOLTAGE SURVEY CHECKS

Use this form to record step-step and step-touch voltages following initial startup.

1. On initial startup of the system, set the PCU output to between 50 and 150 volts.
2. On a site map, enter the location number from this
3. Briefly describe the test location below indicating the points contacted with the voltage

Maximum allowable step-step voltage is 30V
Maximum allowable step-touch voltage is 15V

Date/Time:______________ Inspector's Name:______________________________

PCU Output Voltage:__________ **VAC**

Location Number	Voltage Detection Points		Voltage Reading
	Red Probe	Black Probe	
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			

Use this form as a continuation for Page 1 of the Site Voltage Survey Check.

Location Number	Voltage Detection Points		Voltage Reading
	Red Probe	Black Probe	

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Comment Response Summary

for the
Construction Quality Control Plan for the Six-Phase Heating Treatability Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky
(DOE/OR/07-1944&D1 issued February 6,2001)

Prepared for
United States Department **of** Energy
Office **of** Environmental Management
for the Remedial Action Assessment Subcontract
under contract **23**900-BA-RM086F

COMMENT RESPONSE SUMMARY *Construction Quality Control Plan for the Six-Phase Heating Treatability Study* *at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* **(DOE/OR/07-1944&D1 issued February 6,2001)**			
Comment Number	**Sect. Page/Para.**	**Reviewer and Comment**	**Response**
1.	General	Environmental Protection Agency **(EPA):** "A majority of the information presented in the CQCP is clearly presented with the exception of the timing of activities to be performed during the actual operation **of** the Six-Phase Heating unit during the treatability study. **A** detailed time line illustrating the various phases of heating to be performed during the treatability study should be prepared and included within the CQCP."	Agreed that a generic timeline should be included; however, the actual length of the heating cycles will be based on operations data. Section **4.6** of the 90% Design Package discusses the heating sequence in detail.
2.	Sect. 2.1 ; Para. **6;** (Page 3; **Para**.3)	EPA: "It **is** stated within this paragraph that resistive heating will continue for about 70 days. However in section **2.2 of** the CQCP under the "Treatment Time" bullet, it is stated that 130 days of resistive heating are planned for the treatability study. Which duration is correct, 70 days or **130** days? The correct **time** frame **must** be stated in both Section **2.1** and Section **2.2** of the document."	Agreed. The **D2** document will be corrected to be consistent.

COMMENT RESPONSE SUMMARY

Construction Quality Control Plan for the Six-Phase Heating Treatability Study at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

(DOE/OR/07-1944&D1 issued February 6, 2001) (continued)

Comment Number	Sect. Page/Para.	Reviewer and Comment	Response
3.	Sect. 2.1; Para. 7; (Page 3; Para.4)	EPA: "It is stated within this paragraph that soil and groundwater samples will be collected within 2 to 3 weeks of stopping resistive heating, and that post-test data will be compared to pre-test (baseline) data to determine remedial effectiveness of the study. In order to compare the pre-test and post-test data, the post-test samples must be collected at the same temperature as the pre-test samples. Will the subsurface formations cool to pre-test temperature within the stated 2 to 3 week time frame? Will subsurface temperature be measured prior to initiation of both pre-test and post-test sampling to ensure that pre-test conditions are not achieved within the 2 to 3 week time frame, will post-test sampling be delayed until the subsurface formations do achieve pre-test conditions?"	The cooling time for the pilot test area will be in excess of one year. Given that the groundwater flow velocity is about 1 ft per day, delaying sampling beyond 2 to 3 weeks will provide meaningless data. Groundwater samples will be collected using an in-line cooler to reduce the water temperature to less than 4°C before sampling. Soil cores immediately will be capped and placed on ice to cool prior to conducting any soil handling or sampling. A small amount of soil VOCs may be lost during the cooling process. However, the VOC losses during these few minutes are likely to be very small in relation to the removal of active boiling during the remediation over the course of weeks.
4.	Sect. 3.2.2; (Page 12)	EPA: "Based on the information presented in this section, it is unclear as to whether or not readiness reviews will be conducted for pre-test and post-test subsurface soil and groundwater sampling. Recommended that the text be revised to make clear that readiness reviews will be conducted for these activities."	Agreed. Readiness reviews will be conducted for both the baseline and post-test sampling.
5.	Sect. 6.6; (Page 20)	EPA: "Need to insert a space at the beginning of this sentence."	Agreed.