100-HR-3 Pump and Treat System Operations and Maintenance Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

P.O. Box 550
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited
100-HR-3 Pump and Treat System Operations and Maintenance Plan

Date Published
May 2016

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Assistant Secretary for Environmental Management

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Title: 100-HR-3 Pump and Treat System Operations and Maintenance Plan

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Washington State Department of Ecology

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Date: 5/31/16
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## Terms

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ALARA</td>
<td>as low as reasonably achievable</td>
</tr>
<tr>
<td>CERCLA</td>
<td><em>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</em></td>
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<tr>
<td>CHPRC</td>
<td>CH2M HILL Plateau Remediation Company</td>
</tr>
<tr>
<td>Cr(VI)</td>
<td>hexavalent chromium</td>
</tr>
<tr>
<td>CSM</td>
<td>conceptual site model</td>
</tr>
<tr>
<td>D&amp;D</td>
<td>decontamination and decommissioning</td>
</tr>
<tr>
<td>DMCS</td>
<td>Document Management Control System</td>
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<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
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<tr>
<td>DOE-RL</td>
<td>DOE Richland Operations Office</td>
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<tr>
<td>DQA</td>
<td>data quality assessment</td>
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<tr>
<td>ECO</td>
<td>environmental compliance officer</td>
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<tr>
<td>Ecology</td>
<td>Washington State Department of Ecology</td>
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<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>ESD</td>
<td>explanation of significant differences</td>
</tr>
<tr>
<td>ESHR</td>
<td>Environmental, Safety, Health, and RadCon</td>
</tr>
<tr>
<td>FDC</td>
<td>functional design criteria</td>
</tr>
<tr>
<td>GFCI</td>
<td>ground fault circuit interrupter</td>
</tr>
<tr>
<td>gpm</td>
<td>gallons per minute</td>
</tr>
<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
</tr>
<tr>
<td>IAROD</td>
<td>interim action record of decision</td>
</tr>
<tr>
<td>IC</td>
<td>institutional control</td>
</tr>
<tr>
<td>ISMS</td>
<td>Integrated Safety Management System</td>
</tr>
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<td>ISRM</td>
<td>in situ redox manipulation</td>
</tr>
<tr>
<td>ITEM</td>
<td>Integrated Training Electronic Matrix</td>
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<tr>
<td>IX</td>
<td>ion exchange</td>
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<td>JCS</td>
<td>Job Control System</td>
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<td>O&amp;M</td>
<td>operations and maintenance</td>
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<td>OU</td>
<td>operable unit</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>--------------</td>
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<tr>
<td>P&amp;T</td>
<td>pump and treat</td>
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<tr>
<td>PLC</td>
<td>programmable logic controller</td>
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<td>PPS</td>
<td>Plateau Remediation Company Procedure System</td>
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<td>RAO</td>
<td>remedial action objective</td>
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<td>remedial process optimization</td>
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<td>S&amp;GRP</td>
<td>Soil and Groundwater Remediation Project</td>
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<td>SAP</td>
<td>sampling and analysis plan</td>
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<td>SCADA</td>
<td>Supervisory Control and Data Acquisition</td>
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<td>SMR</td>
<td>Sample Management and Reporting</td>
</tr>
<tr>
<td>TPA</td>
<td>Tri-Party Agreement</td>
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<tr>
<td>Tri-Party Agreement</td>
<td>Hanford Federal Facility Agreement and Consent Order</td>
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<td>WMP</td>
<td>waste management plan</td>
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1 Introduction

In 1996, an interim action record of decision (IAROD) (EPA/ROD/R10-96/134, Record of Decision for the 100-HR-3 and 100-KR-4 Operable Units Interim Remedial Actions, Hanford Site, Benton County, Washington) was issued for the 100-HR-3 and 100-KR-4 Groundwater Operable Units (OUs) in the Hanford 100 Area. Pump and treat (P&T) technology for remediation of hexavalent chromium (Cr(VI)) was selected as the interim remedy for the 100-HR-3 OU. The remedy was refined by an amendment in 1999 (EPA/AMD/R10-00/122, Interim Remedial Action Record of Decision Amendment for the 100-HR-3 Operable Unit, Hanford Site, Benton County, Washington) to include in situ chemical treatment through installation of an in situ redox manipulation (ISRM) barrier as an additional interim remedy for a Cr(VI) groundwater plume west of the 100-D/DR Reactors.

In April 2003, an explanation of significant differences (ESD) was issued to provide notice of revisions to the project schedule and cost estimate associated with the ISRM remedial action (EPA/ESD/R10-03/606, Explanation of Significant Difference for the 100-HR-3 Operable Unit, Hanford Site, Benton County, Washington). The 2003 ESD also allowed use of the ISRM evaporation pond and provided requirements for decommissioning the pond.

In August 2009, an ESD was issued to provide notice of revisions to the cost estimate and reinjection locations with the P&T interim action (EPA et al., 2009, Explanation of Significant Differences for the 100-HR-3 and 100-KR-4 Operable Units Interim Action Record of Decision: Hanford Site Benton County, Washington). Expansion of the P&T system to address Cr(VI) groundwater concentrations that continued to exceed the cleanup levels was identified in the future cost estimate. The 2009 ESD also revised the reinjection standards and location requirements for treated water.

Breakthrough of Cr(VI) was identified at the northeast end of the ISRM barrier, indicating the ability of the ISRM to meet remedial action objectives (RAOs) has varied, and the required treatment levels are not consistently achieved. The Washington State Department of Ecology (Ecology) and U.S. Environmental Protection Agency (EPA) determined P&T of the groundwater as the alternative action to be taken when barrier breakthrough is identified. A letter of nonsignificant change to the IAROD issued in 2010 documented the Ecology and EPA determination that P&T system expansion (i.e., pumping wells downgradient of the barrier) will be used to address the ISRM breakthrough (11-AMCP-0002, “Non-Significant Change for the 100-HR-3 and 100-HR-3 Operable Units Interim Action Record of Decision, Hanford Site, Washington, July 2010, Memo to File Regarding: Supplemental Actions for the In-Situ Reduction/Oxidation Manipulation Barrier Performance for the 100-HR-3 Groundwater Operable Unit Interim Remedy”). The nonsignificant change to the IAROD (11-AMCP-0002) also indicated that the barrier would no longer be actively maintained. Current plans for the ISRM barrier are to continue performance monitoring.

The interim actions are intended to capture and remediate areas of contaminated groundwater and provide information that leads to the final remedy. Interim cleanup levels for contaminated groundwater were established in the IAROD (EPA/ROD/R10-96/134) and IAROD amendment (EPA/AMD/R10-00/122). The network of 100-HR-3 Groundwater OU P&T systems is a major component for implementing interim remedial actions. Figure 1-1 shows the 100-D and 100-H Areas, located in the 100-HR-3 OU on the Hanford Site.
Figure 1-1. 100-HR-3 Operable Unit
This operations and maintenance (O&M) plan supports the remedial design/remedial action work plan (RD/RAWP) for the 100-HR-3 OU (DOE/RL-2013-31, Remedial Design/Remedial Action Work Plan for the 100-HR-3 Groundwater Operable Unit Interim Action) and outlines the activities necessary to operate, maintain, and monitor two P&T facilities in the 100-HR-3 OU from operations through decommissioning. These activities are supported by the sampling and analysis plan (SAP) (DOE/RL-2013-30, Sampling and Analysis Plan for the 100-HR-3 Groundwater Operable Unit), and waste management plan (WMP) (DOE/RL-97-01, Interim Action Waste Management Plan for the 100-HR-3 and 100-KR-4 Operable Units).

1.1 Purpose of the O&M Plan

The purpose of this plan is to describe O&M of the 100-HR-3 P&T systems that are designed to meet the RAOs for the interim remedial action at 100-HR-3 OU, as stated in the IAROD (EPA/ROD/R10-96/134), IAROD amendment (EPA/AMD/R10-00/122), and ESD (EPA et al., 2009). Maintaining an adequate and functioning O&M program throughout the lifecycle of a remedy is critical for success of the remedy and ultimate achievement of the interim action RAOs. 100-HR-3 interim action RAOs include the following:

- Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River. To meet this objective, the U.S. Department of Energy (DOE)-Richland Operations Office (RL) has implemented a P&T system to meet the following operational requirements:
  - Groundwater above 20 µg/L Cr(VI) will not be discharged to injection wells that are not upgradient of extraction wells.
  - Water treated using ion exchange (IX) to remove Cr(VI) will be injected through wells to hydraulically manage Cr(VI) plumes.
  - Groundwater above 50 µg/L Cr(VI) will not be discharged.
- Protect human health by preventing exposure to contaminants in the groundwater.
  - The interim action is expected to provide adequate protection of human health via institutional controls (ICs), and the interim remedial action itself will not pose any unacceptable risks to human health.
- Provide information that will lead to the final remedy.
  - Effectiveness of the interim action will be evaluated based on site-specific data. This evaluation should include treatment cost, efficiency, evaluation of other technologies, hydraulic impacts, and effectiveness of contaminant removal from the aquifer.

1.2 Scope of the O&M Plan

The O&M plan describes O&M of the DX and HX P&T systems in the 100-HR-3 OU of the Hanford Site. The O&M plan includes the following information:

- Operational criteria
- Routine and preventive O&M
- Upset conditions
- Corrective maintenance
- O&M methods and training
- Inspection requirements
• Operational monitoring
• Reporting
• Decontamination and decommissioning
• Health, safety, and quality assurance (QA)

The O&M plan includes information on scheduling of maintenance activities to minimize impacts to system performance.

This O&M plan presents information based on the system design in calendar year 2014. Information on previous system design, project history, and remedial performance is provided in the annual summary reports for P&T operations. The following reports summarize operations for the DX and HX P&T systems:

• DOE/RL-2011-25, Calendar Year 2010 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations and 100-NR-2 Groundwater Remediation
• DOE/RL-2012-02, Calendar Year 2011 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation
• DOE/RL-2013-13, Calendar Year 2012 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation
• DOE/RL-2014-25, Calendar Year 2013 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump-and-Treat Operations, and 100-NR-2 Groundwater Remediation
• DOE/RL-2015-05, Calendar Year 2014 Annual Summary Report for the 100-HR-3 and 100-KR-4 Pump and Treat Operations, and 100-NR-2 Groundwater Remediation

This plan will be updated or revised when relevant or substantive changes are made to the operating system or supporting primary documents that affect the project.

1.3 Remedy Description

Removal of Cr(VI) from contaminated groundwater using P&T technology was selected by the IAROD (EPA/ROD/R10-96/134) as the interim remedy for 100-HR-3. The HR-3 and DR-5 P&T systems were designed to meet RAOs by providing hydraulic containment of the Cr(VI) plumes and preventing discharge to the Columbia River. The IAROD noted the potential for other groundwater co-contaminants to be present, and anionic contaminants such as nitrate, technetium-99, and uranium-238 could be reduced by the IX system required to remove chromium. The system was not expected to impact other potential co-contaminants (strontium-90 and tritium).

The IAROD amendment (EPA/AMD/R10-00/122) selected in situ chemical treatment through installation of an ISRM barrier as an additional interim remedy for remediation of a Cr(VI) groundwater plume west of the 100-D/DR Reactors (100-D Area) within the 100-HR-3 OU. As the lead agency, DOE implemented these interim remedies within the 100-HR-3 OU. The remedy includes ICs to prevent exposure of human receptors to contaminated groundwater. The following subsections provide brief descriptions of the interim remedies.

1.3.1 Initial Pump and Treat System Description

The HR-3 P&T system began operation in July 1997, with an initial configuration of five extraction wells located in the 100-H Area. In August 1997, an additional four wells were added in the 100-D Area for a total of nine extraction wells. The 100-D Area extraction wells connected to the HR-3 P&T system were
located in the northern plume of the 100-D Area. Extracted groundwater was transferred through an
aboveground pipeline to a treatment building in the 100-H Area. Cr(VI) was removed from the extracted
groundwater using a metal anion-exchange system. Treated water was then discharged to three injection
wells, which are screened in the unconfined aquifer underlying the 100-H Area. By 2008, the HR-3
system had 10 extraction wells, 4 of which were located in 100-D. In 2010, two additional extraction
wells were added, both of which were completed in the Ringold formation upper mud. The final treatment
capacity for the HR-3 P&T system was 1,100 L/min (300 gallons per minute [gpm]).

The DR-5 P&T system began operating in July 2004 with an initial configuration of three extraction wells
and one injection well and an extraction rate of 190 L/min (50 gpm). In 2010, one extraction well and one
injection well were added. The DR-5 P&T system was constructed to treat significant concentrations of
Cr(VI) in the 100-D Area southwest of the original HR-3 P&T system. Groundwater was treated at the
DR-5 treatment facility using a metal anion-exchange system. Treated groundwater was then injected
back into wells in the 100-D Area.

In 2008, a number of activities were initiated to meet interim milestones and comply with interim action
RAOs. A remedial process optimization (RPO) study was initiated to determine how to optimize the
remedial strategy and provide continuing improvement of Cr(VI) remediation in the 100-HR-3 OU
groundwater by 2012 (SGW-38338, Remedial Process Optimization for the 100-D Area Technical
Memorandum Document). RPO activities included refinement of the conceptual site model (CSM),
system performance evaluation, technology screening, alternative development, groundwater modeling,
decision analyses, optimization of the system O&M, and optimization of long-term monitoring.

The RPO study recommended implementing additional P&T system capacity to address Cr(VI)
groundwater concentrations that still exceeded the cleanup levels established in the IAROD
(EPA/ROD/R10-96/134) and IAROD amendment (EPA/AMD/R10-00/122). The HR-3 and DR-5 P&T
systems continued operations until 2011 when they were replaced by the DX and HX P&T systems.
At that time, the DR-5 and HR-3 systems were taken out of service and prepared for cold standby.
Information on the deactivation and disposition of the DR-5 and HR-3 P&T systems is contained in
Chapter 6 of the 100-HR-3 RD/RAWP (DOE/RL-2013-31).

1.3.2 DX and HX Pump and Treat System Description

As a result of the RPO review and a more accurate delineation of the Cr(VI) plumes, two new P&T
systems were designed. The new P&T systems (named DX and HX) have expanded capacity that enables
greater hydraulic control of the larger plumes and increased Cr(VI) mass removal capability. The DX
system began operating in December 2010, and the HX system began operating in October 2011.
Once the new systems were fully operational, the original P&T systems were shut down and placed in
cold standby. The DR-5 P&T system was placed in cold standby in November 2011, and the HR-3 P&T
system was placed in cold standby in March 2012.

The conceptual design basis for the DX and HX systems is based on the RPO study (SGW-38338). Design
criteria for the DX and HX P&T systems are contained in the following functional design criteria (FDC):

- SGW-40243, Functional Design Criteria for the 100-DX Pump and Treat System
- SGW-43616, Functional Design Criteria for the 100-HX Pump and Treat System

The DX and HX P&T systems are designed to achieve the RAO for protecting aquatic receptors in the
Columbia River. The designs located extraction wells upgradient of regions where Cr(VI) was detected in
the near river substrate and areas with elevated concentrations of Cr(VI) in the aquifer. As the Cr(VI)
plumes have been better defined, the remedial action has targeted inland locations to limit plume
migration and remove contaminant mass from inland areas of the plumes.
Numerical modeling was used to simulate hypothetical groundwater flow conditions and assess preliminary well locations and pumping rates to meet the RAO for Cr(VI) using the new expanded P&T systems. Results of the modeling analysis supported installation of 70 new RPO wells. The RPO wells are located mainly in the Horn area, north of 100-H, to capture the low concentration dispersed plume that has migrated northeast from 100-D. Figure 1-2 shows the well network for the DX and HX P&T systems and the location of the DX and HX facilities as of December 2014. Each network includes selected extraction and injection wells from the HR-3 and DR-5 systems, selected monitoring wells converted for use as extraction and injection wells, and new extraction and injection wells. Information obtained during installation of the new RPO wells was used to update the CSM.

Each P&T system includes an extraction well network, transfer building(s), a treatment building, and an injection well network. Water is pumped from the extraction wells to transfer tanks where it is collected to provide a consistent feed source to the treatment buildings. The DX system has a second transfer building which contains a transfer tank and an effluent tank. Extracted water is then routed to the influent tanks in the treatment buildings. After treatment, the treated water is routed to the effluent tanks and then returned to the aquifer through injection wells.

During 2014, the DX P&T system included 43 extraction wells and a design capacity of 2,300 L/min (600 gpm). Treated water was returned to the aquifer through 14 injection wells. Figure 1-3 shows a schematic diagram of the DX P&T system as of July 2014. The extraction wells are shown on the left and middle of the diagram. Extracted groundwater is routed to the transfer tanks where it is collected and pumped to the influent tank at the treatment building. An acid injection system adds sulfuric acid to groundwater in the influent tank to lower the pH, which increases IX resin effectiveness. After passing through the treatment trains, the treated water is collected in a series of two effluent tanks. A caustic injection system adds sodium hydroxide in the effluent tank to raise the pH of treated water, which is returned to the aquifer via the injection wells, which are shown on the right side of the diagram. A transfer line is shown that connects the effluent tank in the DX transfer building to the HX P&T system. This line is not currently in use.

During 2014, the HX P&T system included 31 extraction wells and a design capacity of 3,000 L/min (800 gpm). Treated water was returned to the aquifer through 14 injection wells. Figure 1-4 shows the HX P&T system wells and process building as of March 2014. Extraction wells are shown on the left and middle of the diagram. Extracted groundwater is routed either directly to the influent tank in the treatment building or to a transfer tank where it is collected and pumped to the influent tank at the treatment building. After passing through the treatment trains, the treated water is collected in the effluent tank and returned to the aquifer via the injection wells, which are shown on the right side of the diagram.

The treatment building houses the treatment portion of the P&T system. Figure 1-5 shows a simple line diagram that represents the layout of the DX and HX treatment systems. Groundwater from the extraction wells (or via a transfer tank) enters the treatment system on the left side of the diagram and is collected in the influent tank. Because of its weak base nature, pH of the extracted groundwater influent is adjusted to below 6.7 to optimize resin performance. The pH adjustment is accomplished by addition of 93 wt percent sulfuric acid to the influent. Level monitors and pH instrumentation are used to monitor this process. From the influent tank, groundwater is pumped to one or more of the treatment trains located within the treatment building. A sampling port is located downstream of the influent tank to collect influent water samples.
Figure 1-2. Layout of the DX and HX Systems and Wells for the 100-HR-3 Operable Unit, 2014
Cr(VI) is removed from extracted groundwater using IX technology. After successful testing of ResinTech® SIR-700 resin at the KW P&T in the 100-KR-4 OU, it is now being used in the DX and HX P&T systems. Test results are documented in SGW-51721, 100-KW Pump and Treat ResinTech SIR-700 Test Results and Recommendations for Use Across 100-KR-4 Operable Unit. ResinTech SIR-700 is a weak base anion exchanger with high selectivity and capacity for chromate and dichromate. Adjusting the groundwater pH to less than 6.7 increases the efficiency of ResinTech SIR-700 resin. As shown on Figure 1-5, the DX P&T system has piping for six IX trains. Each IX train can be configured to run with either two treatment vessels, three treatment vessels, four treatment vessels (as shown), or split flow (two groups of two treatment vessels each). Each train will always contain a lead column and polishing column. Sample ports located after each column in the IX train are used to monitor the treatment efficiency of the treatment columns. The HX P&T system has piping for eight IX trains that can be configured in a similar manner.

Following IX treatment, treated water is collected in the effluent tank. In the effluent tank, pH of the treated water is adjusted to about 7.0. The pH adjustment is accomplished by the addition of 50 wt percent sodium hydroxide caustic solution to the effluent tank. Level monitors and pH instrumentation are used to monitor this process (Figure 1-5). The treated water is pumped to the injection wells (or a second effluent tank at DX and then to injection wells) for injection into the aquifer. A sampling port is located downstream of the effluent tank to collect effluent water samples.

The DX and HX systems are designed to provide treatment capacities of 2,300 L/min (600 gpm) and 3,000 L/min (800 gpm), respectively. Table 1-1 summarizes the treatment capabilities and performance over the lifespan of each P&T system through December 31, 2014 (DOE/RL-2015-05).

Table 1-1. 100-HR-3 OU Pump and Treat Systems Performance Summary

<table>
<thead>
<tr>
<th>System</th>
<th>Design Capacity (L/min [gpm])</th>
<th>Volume Treated (ML [Mgal] as of 12/31/14)</th>
<th>Hexavalent Chromium Mass Removed (kg [lb] as of 12/31/14)</th>
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<tr>
<td>DX</td>
<td>2,300 (600)</td>
<td>4,298 (970)</td>
<td>1,403 (2,926)</td>
</tr>
<tr>
<td>HX</td>
<td>3,000 (800)</td>
<td>4,081 (925)</td>
<td>93.1 (180)</td>
</tr>
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OU = operable unit

® ResinTech is a registered trademark of ResinTech Inc., West Berlin, New Jersey.
Figure 1-4. HX Pump and Treat System Schematic, 2014
Figure 1-5. Simple Line Diagram of the DX and HX Treatment Systems
The IAROD amendment (EPA/AMD/R10-00/122) requires Cr(VI) removal to the maximum extent practicable, with Cr(VI) concentrations not to exceed 20 µg/L in the treatment system effluent. Injection well operation is managed to control hydraulic gradients. Table 1-2 shows the 100-HR-3 OU P&T system extraction and injection wells as of December 31, 2014.

<table>
<thead>
<tr>
<th>DX Extraction Wells</th>
<th>HX Extraction Wells</th>
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<tr>
<td>199-D4-38</td>
<td>199-D8-88</td>
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<tr>
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<td>199-D8-89</td>
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<tr>
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<table>
<thead>
<tr>
<th>DX Injection Wells</th>
<th>HX Injection Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>199-D5-44</td>
<td>199-D8-94</td>
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<tr>
<td>199-D5-42</td>
<td>199-D8-93</td>
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<td>199-D5-129</td>
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<td>199-D7-4</td>
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<td>199-D2-12</td>
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</tr>
<tr>
<td>199-D2-10</td>
<td>199-D6-1</td>
</tr>
</tbody>
</table>

* Well completed in Ringold Formation upper mud first water bearing unit

OU = operable unit
1.3.3 Other Remedy Components

This subsection describes components of the 100-HR-3 groundwater remedy that augment the P&T system.

1.3.3.1 In Situ Redox Manipulation Barrier

The permeable reactive barrier uses ISRM technology to create a treatment zone in which ferric iron is reduced to ferrous iron within the aquifer sediments. This is accomplished by injecting sodium dithionite into the aquifer through wells and then withdrawing the unreacted reagent and reaction products. Sodium dithionite serves as a reducing agent for iron, producing a reducing environment. As groundwater migrates through the treatment zone, mobile Cr(VI) is reduced to less toxic and less mobile trivalent chromium, which precipitates from solution.

1.3.3.2 Flow-Path Control

The 100-HR-3 OU remedial action includes extracting and injecting treated groundwater at strategic locations relative to groundwater contaminant plume(s). By refining extraction and injection locations, the plume(s) migration can be controlled, producing more efficient contaminant removal, directing high concentration plume segments toward extraction wells, and placing untreated co-contaminants in locations where natural attenuating processes, where applicable, can reduce contaminant concentrations.

1.3.3.3 Institutional Controls

The IAROD (EPA/ROD/R10-96/134) requires ICs during the interim action to prevent human exposure to contaminated groundwater. ICs are instruments (i.e., administrative and/or legal restrictions) designed to control or eliminate specific contaminants, which include entry restrictions and groundwater use restrictions. These ICs are implemented by programs not covered in the O&M plan. Groundwater use is restricted until cleanup levels are achieved. DOE/RL-2001-41, Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions, identifies current ICs for the Hanford Site, describes how ICs are implemented and maintained, and serves as a reference point for selecting future ICs. Controls to prevent exposure are achieved by implementing ICs throughout the interim action or until the pathway is eliminated or contaminant concentrations decline below health-based levels.
2 Organization, Operations, and Optimization

This chapter describes the 100-HR-3 OU P&T systems project organization, O&M program, and optimization process.

2.1 Project Organization

The project organization includes DOE-RL, Ecology, and the remediation contractor organizations that support 100-HR-3 OU interim remedial actions. Figure 2-1 provides the organizational structure as of December 31, 2014. The organizational structure may be modified as project requirements change, with updates provided at the next O&M plan revision. Organizational responsibilities and interrelationships are described in the following subsections.

Figure 2-1. Organization Chart for 100-HR-3 OU Pump and Treat Operations and Maintenance
2.1.1 DOE Lead Agency (Richland Operations Office)
DOE is the lead agency under Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (delegated by Executive Order 12580, Superfund Implementation, the primary authority under Section 104, “Response Authorities,” and Section 121, “Cleanup Standards”) to conduct removal and remedial actions at DOE facilities. DOE-RL is responsible for remedial actions throughout the Hanford Site and for managing the assigned activities including scope, budget, schedule, quality, personnel, communication, risk/safety, contracts, and regulatory interface. DOE works under regulatory oversight in accordance with CERCLA Section 120, “Federal Facilities,” as implemented through Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*, also known as the Tri-Party Agreement (TPA). DOE obtains Congressional funding for these functions.

2.1.2 Lead Regulatory Agency (Ecology)
Ecology is the lead regulatory agency for CERCLA remediation activities at the 100-HR-3 OU, as described in the TPA (Ecology et al., 1989a). The lead regulatory agency is responsible for overseeing activities to verify that applicable regulatory requirements are met. Lead regulatory agency approval is required on all TPA (Ecology et al., 1989a) primary documents.

2.1.3 Remediation Contractor
CH2M HILL Plateau Remediation Company (CHPRC) is the prime contractor responsible for implementing CERCLA remediation activities at the 100-HR-3 OU. CHPRC organizations, described in the following subsections, provide functional and operational support for remediation activities.

2.1.4 Soil and Groundwater Remediation Project
The Soil and Groundwater Remediation Project (S&GRP) is responsible for management and implementation of remediation activities at the 100-HR-3 OU and coordinates with DOE-RL, Ecology, and Remediation Contractor personnel. The following organizations within S&GRP provide functional and operational support for the remediation activities.

2.1.4.1 Remedy Selection and Implementation
Remedy selection and implementation provides direction and oversight for remediation activities and coordinates with DOE-RL, Ecology, and Remediation Contractor personnel. Remedy selection and implementation is responsible for coordinating and evaluating remediation data and ensuring compliance with state and federal laws. The group is also responsible for collecting P&T data and tracking trends to show cleanup performance.

Operable Unit Project Manager
The OU project manager provides direction and oversight for all activities and coordinates with DOE-RL, regulatory, and contractor personnel to support remediation activities. The OU project manager is responsible for sampling documents and requirements, field activities, and subcontracted tasks. The OU project manager works with the Operations; Remediation Support; Environmental, Safety, Health, and RadCon (ESHR); and Operations Assurance organizations to integrate the disciplines in planning and implementing work scope.

2.1.4.2 Remediation Support
The Remediation Support organization provides field and technical support to S&GRP. Field activities include groundwater well and investigative borehole drilling, well and borehole decommissioning, environmental sampling, and groundwater well maintenance. The organization also provides environmental sample planning, sample and data management, sample analytical support, and data quality assessment (DQA) services.
Sample Management and Reporting Organization
The Sample Management and Reporting (SMR) organization supports three primary work areas: sample data planning, sample and data management, and analytical support. Sample and data planning includes assistance in planning, generating, and reviewing data quality objective processes and reports, SAPs, sampling instructions, and DQA reports. The SMR organization also coordinates laboratory analytical work and ensures that laboratories conform to DOE/RL-96-68, Hanford Analytical Services Quality Assurance Requirements Document (HASQARD) or equivalent, as approved by DOE and the regulatory agencies. SMR receives analytical data from laboratories, enters the data into the Hanford Environmental Information System database, and arranges for data validation. SMR is responsible for informing the OU project manager of any issues reported by the analytical laboratories.

Sampling/Drilling Operations
The Sampling and Drilling Operations organization provides field sampling, well maintenance, drilling and decommissioning, and well planning support to S&GRP. The field sampling group provides trained and certified personnel to conduct sampling in accordance with HASQARD (DOE/RL-96-68). The well maintenance group is responsible for ensuring that wells remain operable during the life of the well. The well planning group is responsible for preparing and coordinating key documents needed to execute drilling projects safely and provide technical support.

2.1.4.3 Environmental, Safety, Health, and RadCon
The ESHR organization supports S&GRP by providing a safe work environment. The organization is responsible for protection of employees, the public, and the environment and provides assistance in complying with company, DOE, and Occupational Safety and Health Administration standards and requirements. Safe operations are achieved by applying the Integrated Safety Management System (ISMS) and Voluntary Protection Program.

Environmental Compliance
The Environmental Compliance organization reviews plans, methods, and technical documents to ensure that environmental requirements have been addressed; identifies environmental issues that affect operations and develops cost effective solutions; and responds to environmental/regulatory issues. The Environmental Compliance organization also oversees project implementation for compliance with environmental requirements.

Radiological Engineering
The Radiological Engineering organization is responsible for radiological support within S&GRP. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, work planning, and optimizing radiological controls. The Radiological Engineering organization identifies radiological hazards and implements appropriate controls to maintain worker exposures ALARA. The Radiological Control organization plans and directs radiological control technician support for all activities. The Radiological Engineering organization coordinates with the Health and Safety organization to determine personal protective equipment (PPE) requirements.

Health and Safety
The Health and Safety organization is responsible for coordinating industrial safety and health support within S&GRP. This is implemented through hazards analysis, job hazard analyses, and other pertinent safety documents. The Health and Safety organization assists project personnel in complying with applicable health and safety standards and requirements and coordinates with the Radiological Engineering organization to determine PPE requirements.
2.1.4.4 Operations Assurance

The Operations Assurance organization provides support to S&GRP to execute project activities in a manner that improves operational efficiency and performance. Operations Assurance responsibilities include training, methods, lessons learned, issues management, and emergency preparedness.

2.1.4.5 Operations

The Operations organization is responsible for O&M of the P&T systems. This includes ensuring that appropriate operations support functions (e.g., radiological protection and safety) are available to support operations activities and verifying that O&M methods have been prepared, approved, and implemented.

Pump and Treat Operations

The P&T Operations organization is responsible for planning and coordinating field resources and ensuring that workers are appropriately trained and available. The organization is also responsible for maintaining day-to-day safe configuration and continued operations of the facilities, identifying issues, and responding to system maintenance needs. The organization develops operational guides and conducts training and performance evaluations. Additional responsibilities include analyzing operational process control methods, maintaining operational records and reports, and reviewing all plant operating records.

Design and Pump and Treat Engineering

The Design and P&T Engineering organization is responsible for design and engineering of the P&T systems. This includes reviewing and approving FDC, design changes, construction submittals, and requests for information; performing engineering inspections for design compliance; and reviewing and approving methods.

Maintenance

The Maintenance organization is responsible for supervising all preventive and corrective maintenance of P&T facilities. This includes planning, scheduling, and directing maintenance of equipment and buildings and coordinating and supervising personnel and materials required for maintenance and repair of facilities.

Materials and Services

The Materials and Services organization coordinates storage, inventory, transportation, and delivery of materials to support P&T systems. The organization provides carpenters to support the P&T systems.

Waste Management

The Waste Management organization is responsible for communicating policies and protocols with the waste generators and ensuring compliance with state and federal requirements for proper storage, transportation, disposal, and tracking of wastes. Other responsibilities include identifying waste management sampling/characterization requirements, interpreting data to determine waste designations and profiles, and preparing and maintaining waste management documents.

2.2 Operations and Maintenance Program

O&M is managed through a system of the following established methods and databases:

- Job Control System (JCS) is a computerized work control process used to track work packages, maintenance activities, and work scheduling. The JCS database contains component/equipment information and maintenance schedules and provides a primary implementing interface for work control methods.

- Document Management Control System (DMCS) serves as the primary document issuance and change control database for controlled technical documents (i.e., plans, drawings, engineering document changes, specifications, supporting documents, facility modification packages, and
standards). Controlled drawings are managed in DMCS, which includes current, changing, and historical versions of drawings and change requests.

- Plateau Remediation Contract Material Services System is the primary implementing database for material control methods, and it provides processes for managing, purchasing, receiving, issuing, and controlling materials for project use.

- Integrated Training Electronic Matrix (ITEM) is the primary implementing database for training and qualification methods. ITEM provides processes to manage requirements, scheduling, completion, and records related to training and qualifications.

- Plateau Remediation Company Procedure System (PPS) provides processes for managing CHPRC procedures creation, access, distribution, and revision.

O&M methods and databases rely on automated electronic information management platforms for creating, storing, and updating components of the system on the Hanford local area network. Information specific to the 100-HR-3 OU P&T systems was uploaded into the electronic platform, and vendor information submittals were received during construction. Electronic information residing in this platform references the location of any supporting information not contained within the system (e.g., hard copy vendor submittal information). The following types of information are contained within the electronic platform:

- System description, including system equipment and treatment processes
- Preventive and corrective maintenance information for monitoring system equipment and process operations
- Process liquid stream sampling and reporting requirements
- Vendor equipment information
- System O&M information, including equipment manufacturer and vendor supplied O&M manuals (specific to individual system components or equipment)
- Spare parts list
- Standard operating methods addressing system operations
- System transient condition response actions and methods
- Alarm and spill response methods
- Training methods

The operator training necessary to operate and maintain the P&T system includes facility specific training, evaluation, and qualification along with required health and safety training. Training is discussed in Section 3.5.4 of this plan.

2.3 Operations and Remedial Process Optimization

RPO is an ongoing systematic evaluation that includes a comprehensive examination of all aspects of remedial systems that result in planned operational modifications. Results of the individual RPO analyses are integrated with remedial system performance monitoring data, groundwater monitoring data, plume capture analysis, and an overall evaluation of the well network to identify recommendations for changes to the system configuration and/or operation. Successful RPO requires development of a series of related
tasks that, when implemented, will enable and promote the objective of remedy optimization. These changes provide the opportunity to accelerate achievement of RAOs and reduce incremental and overall project costs. Optimization changes are prioritized to meet the following objectives:

1. Protect the river from discharges of Cr(VI)
2. Remove contaminant mass
3. Delineate Cr(VI) plumes

The following elements of the P&T systems are used to evaluate system performance and support process optimization:

- Extraction well performance includes evaluation of individual well performance and well function relative to known plume configuration. Extraction well pump sizing, placement, performance, and configuration of other well components (e.g., well diameter, screen characteristics, and sand pack characteristics) are assessed as part of this element. Well performance is evaluated using calculated specific capacity on a regular basis.

- Extracted water conveyance performance includes evaluation of conveyance pipe routing, head loss, and transfer station performance.

- Treatment system performance includes evaluation of the mechanical and chemical process components of the treatment system. Evaluation includes assessment of contaminant removal efficiency, effluent water quality, hydraulic throughput, material consumption, component service life, and overall cost.

- Treated water conveyance performance includes evaluation of conveyance pipe routing, head loss, and transfer station performance.

- Injection well performance includes evaluation of individual well performance and well function relative to known plume configuration. Well placement, performance, and configuration of well components are assessed as part of this element. Well performance is regularly evaluated using calculated specific capacity as described in ECF-Hanford-14-0035, Description of Groundwater Calculations and Assessments for the Calendar Year 2013 (CY2013) 100 Areas Pump-and-Treat Report.

Extraction well hydraulics and pipeline conveyance capacity, treatment system throughput, injection conveyance, and hydraulic capacity must be balanced to achieve optimum performance. Extraction and injection well performance may decline over time, resulting in lower throughput. To assess the need for well maintenance, extraction well pumping and injection rates are correlated with water level measurements at each well to detect changes that could affect well performance. Steadily declining pumping water levels at extraction wells or steadily increasing water levels at injection wells may indicate the need for well maintenance. An extraction and injection well monitoring and maintenance plan (SGW-58236, Well Maintenance Plan for the 100-HR-3 and 100-KR-4 Groundwater Treatment Facilities) was developed to support 100-HR-3 OU P&T operations. Extraction and injection well performance are evaluated as part of process optimization.

Analysis of contaminant capture and modification of well field pumping rates are important elements of the P&T system performance evaluation. A pumping rate analysis, based on system performance of the prior year and planned system modifications, is used to derive recommended pumping rates for the upcoming year. If recommended pumping rates are not achievable, system reconfiguration, maintenance, and/or modifications would be evaluated. This process is outlined in Figure 2-2. System performance information is summarized in the annual P&T report.
Figure 2-2. System Flow Optimization

1. Contaminant capture analysis of prior operational year
2. Planned Operational Modifications
3. Plan and schedule maintenance modifications
4. Are component modifications required to achieve recommendations?
5. Yes
6. No
7. Provide feedback for pumping rate analysis
8. Yes
9. No
10. Are rates achievable?
11. Yes
12. No
13. Document conditions preventing recommendations
14. Implement system changes

1. Pumping rate analysis for upcoming year
2. Pumping rate recommendations to Operations
3. Are rates achievable?
4. Yes
5. No

Figure 2-2. System Flow Optimization
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3 Operations and Maintenance

This chapter presents information associated with routine and preventive maintenance, upset conditions, corrective maintenance, training, and inspections related to the 100-HR-3 OU P&T systems.

3.1 Operations Overview

Routine 100-HR-3 OU P&T operation consists of pumping groundwater from extraction wells and conveying the stream through aboveground pipes to one of two treatment facilities for removing Cr(VI) from the extracted groundwater. Reduced Cr(VI) concentrations in the treated effluent meet the state surface water quality standard of 10 µg/L in the Columbia River. Treated water is returned to the aquifer through a series of injection wells. Concentrations of Cr(VI) in the treated water are routinely checked to ensure that the pump and systems are operating as expected and RAOS are being met.

The treatment system has a design capacity to treat 5,300 L/min (1,400 gpm), although changes in water levels may result in lower operating flows. The treatment system uses the Supervisory Control and Data Acquisition (SCADA) system, which is an automated control system that provides data acquisition, monitoring, and control capability for operations and equipment. The SCADA system employs centralized server equipment to communicate with instrumentation and equipment by way of programmable logic controllers (PLCs) located throughout the main process building and transfer buildings and at the wells. PLCs pick up information directly from process instruments and chemical analyzers to control devices, such as valves. Servers are programmed with software that polls, displays, and records real time process data that occur throughout the facility. Operations personnel are able to adjust control and alarm set points as well as operate specific pieces of equipment in manual mode from operator workstations. By using this instrumentation and control system, integrating operational methods, PLCs, and set points and limit alarms, 100-HR-3 OU P&T systems have the ability to shut down components automatically that may be impacted by upset conditions due to sudden and unavoidable failure of control or process equipment or unintended failure of a process to operate in a normal or usual manner. The automated control systems, including remote notification and alarm capabilities, allow for continuous operation.

Treatment process systems and equipment are operable from SCADA system stations located in the control rooms of each P&T system (DX and HX). Sensors and transmitters are provided to allow control of several key process parameters, such as flow rates, pump discharge pressure, tank or vessel water level, well water level, temperature, and pH. Water level transmitters are provided for extraction wells, injection wells, influent tanks, and effluent tanks. Flow indicating transmitters are provided for each extraction well and each injection well. Flows for each extraction well are independently adjustable with limited interaction between wells. At a minimum, measurements of pH are recorded from the influent tank, from three in-line pH meters at the outflow of the influent tank, from the effluent tank, and from three in-line pH meters at the outflow of the effluent tank. Temperature is monitored in both the influent and effluent tanks. Sampling locations at the treatment facility and transfer buildings are provided to sample influent and effluent streams. As shown on Figure 1-5, sampling ports are located downstream of system components (i.e., influent tanks, IX vessels, and effluent tanks) to collect water samples.

3.2 Routine and Preventive Maintenance

Routine maintenance activities are necessary to ensure long-term integrity and success of P&T systems. A thorough and adequately implemented routine and preventive maintenance program ensures properly maintained equipment and provides for early detection of equipment issues. The river stage (e.g., low water as identified in the SAP [DOE/RL-2013-30]), as well as compliance, facility performance, resource
constraints, and weather conditions, are considered when scheduling maintenance activities. Activities are scheduled to avoid plant shutdown during low river stage.

This section summarizes routine and preventive maintenance for proper care and efficient operation of remedy components. Equipment specific inspection forms and a maintenance frequency have been developed using recommendations contained in the manufacturer/vendor supplied manuals and evaluations by the P&T engineering group. Records from maintenance and inspection forms are entered into the JCS.

Typical routine and preventive maintenance of P&T system components is performed in accordance with methods approved by the Operations group. Table 3-1 contains the title and a brief description of typical routine and preventive maintenance methods for the DX and HX P&T systems.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Compressor</td>
<td>A safe, uniform method to perform annual inspections and maintenance on the Ingersoll-Rand© Model 2545 Air Compressor, or equivalent, at P&amp;T buildings. The method includes use of lock-out/tag-out for taking the equipment out of service to perform maintenance on air filters, oil filters, v-belts, and crankcase oil.</td>
</tr>
<tr>
<td>Backup Lights</td>
<td>A safe, uniform method to perform quarterly and annual inspections of backup lights at P&amp;T facilities. Inspections include visual inspection and illumination tests. This method also covers repairs or replaces backup lights that fail inspection.</td>
</tr>
<tr>
<td>Backwash and Sluice Pump</td>
<td>A safe, uniform method for performing inspections of pipe connections and mechanical seals and periodic maintenance on P&amp;T backwash and sluice pumps. The method includes use of lock-out/tag-out to take the equipment out of service to clean air vents and replace oil.</td>
</tr>
<tr>
<td>Pulsa Series 680 Pumps</td>
<td>A safe, uniform method for performing visual inspections and lubrication activities on Pulsafeeder® Pulsa Series 680 pumps, or equivalent, located at the DX and HX facilities. The method includes use of lock-out/tag-out to take the equipment out of service for performing visual inspections and maintenance on oil in the gearbox and reservoirs.</td>
</tr>
<tr>
<td>Motorized Position Valve</td>
<td>A safe, uniform method to perform a periodic functional test of motorized position valves at P&amp;T facilities. Each valve is manually cycled open and shut before being returned to its original configuration.</td>
</tr>
<tr>
<td>Backup Generator</td>
<td>A safe, uniform method for periodically testing backup generators at P&amp;T facilities.</td>
</tr>
<tr>
<td>GFCI Receptacle/Breaker</td>
<td>A safe, uniform method for visually inspecting permanently installed GFCI receptacles/GFCI breakers at P&amp;T facilities and performing a trip test.</td>
</tr>
<tr>
<td>Motors and Pumps at Groundwater Facilities</td>
<td>A safe, uniform method for visually inspecting pump motors and pumps at P&amp;T facilities performing periodic preventive maintenance. The method includes use of lock-out/tag-out to take the equipment out of service for lubricating motor bearings and pump bearings and changing pump oil.</td>
</tr>
<tr>
<td>Durafet® II Industrial pH Electrode</td>
<td>A safe, uniform method for performing maintenance on the Durafet II Industrial pH Electrode, or equivalent. This method includes periodic checks of spare electrodes and replenishment of pH storage solution. It also includes...</td>
</tr>
</tbody>
</table>
### Table 3-1. Typical Routine and Preventive Maintenance Methods

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>biannual testing, inspecting, and cleaning of pH electrodes and meters. Electrodes are calibrated as needed with 4.01, 7.00, and 10.01 buffer solutions.</td>
<td></td>
</tr>
<tr>
<td>American Society of Mechanical Engineers Pressure Relief Valve</td>
<td>A safe, uniform method for inspecting and testing American Society of Mechanical Engineers pressure relief valves in P&amp;T facilities. The method tests the valve, regulator, seat leakage, and lift pressure of each valve and makes adjustments, as needed. The method also provides third party inspection of relief valves.</td>
</tr>
<tr>
<td>Portable Meter and Probe</td>
<td>A safe, uniform method for inspecting, cleaning, and verifying proper operation of the Hach© HQ series, or equivalent, portable meter used at P&amp;T facilities. This method applies to pH probes.</td>
</tr>
<tr>
<td>Safety Shower</td>
<td>A safe, uniform method of testing and inspecting showers. This method also ensures cleanliness of water.</td>
</tr>
<tr>
<td>Fixed Ladder</td>
<td>A safe, uniform method for inspecting fixed (installed) ladders.</td>
</tr>
<tr>
<td>Overhead Door</td>
<td>A safe, uniform method for inspecting overhead doors. Includes use of lock-out/tag-out for taking equipment out of service.</td>
</tr>
<tr>
<td>Alarm Dialers</td>
<td>A safe, uniform method for setup, testing, and inspecting the alarm dialers (auto dialers).</td>
</tr>
<tr>
<td>Uninterrupted Power Supply</td>
<td>A safe, uniform method for replacement of uninterrupted power supply.</td>
</tr>
</tbody>
</table>

Note: The following notes apply to Tables 3-1 and 3-2:

- Ingersoll-Rand is a copyright name of Ingersoll-Rand Company, Campbellsville, Kentucky.
- Pulsafeeder is a registered trademark of Pulsafeeder Engineered Products, Rochester, New York.
- Durafet is a registered trademark of Honeywell, Freeport, Illinois.
- Hach is a copyright of the Hach Company, Loveland, Colorado

GFCI = ground fault circuit interrupter

A routine and preventive maintenance frequency was developed for the equipment using information from manufacturer/vendor guidelines and engineering evaluations. The recommended frequency for conducting routine and preventive maintenance is incorporated into the JCS. Table 3-2 provides a summary of typical routine and preventive maintenance activities and the recommended frequency. Work packages are used to schedule, plan, and document maintenance activities. Frequencies are modified based on equipment performance and evaluation. Frequency modification requires Engineering approval, documented in JCS, and will be updated in this O&M plan at the next revision. Work packages are also entered into the JCS.

In addition to preventive maintenance for mechanical components, a routine maintenance program for remedial system wells is implemented in accordance with WAC 173-160-381, “Minimum Standards for Construction and Maintenance of Wells,” “What Are the Standards for Decommissioning a Well?” and WAC 173-160-171, “What are the Standards for Chemical Conditioning?” Well maintenance, consisting primarily of fixed interval well inspection, cleaning, and redevelopment, is expected to reduce the frequency of well failures and contribute to extended service life for submersible pumps. The program includes extraction, injection, and monitoring wells within the 100-HR-3 OU.
<table>
<thead>
<tr>
<th>Equipment/Component</th>
<th>Activity</th>
<th>Frequency*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backwash and Sluice Pumps</td>
<td>Inspection and Lubrication</td>
<td>Upon Engineering request</td>
</tr>
<tr>
<td>Pulsa Series 680 Pumps or Equivalent</td>
<td>Inspection and Lubrication</td>
<td>2 years</td>
</tr>
<tr>
<td>Treatment System Motors</td>
<td>Inspection and Lubrication</td>
<td>6 months</td>
</tr>
<tr>
<td>GFCI Receptacle/Breaker</td>
<td>Test</td>
<td>Monthly</td>
</tr>
<tr>
<td>Exhauster Fans</td>
<td>Inspection</td>
<td>Annually</td>
</tr>
<tr>
<td>Air compressors</td>
<td>Inspection</td>
<td>2 years or as needed</td>
</tr>
<tr>
<td>Backup Generator</td>
<td>Inspection</td>
<td>Monthly</td>
</tr>
<tr>
<td>Backup Lights</td>
<td>Inspection and Testing</td>
<td>3 months and annually</td>
</tr>
<tr>
<td>Ion Exchange Train Relief Valve</td>
<td>Test and/or Replacement</td>
<td>&lt;10 years</td>
</tr>
<tr>
<td>Flow, Water Level, and Pressure</td>
<td>Inspect and Check Calibration</td>
<td>1 year, 2 years, 3 years; Recalibrate as needed; 3 years, Third Party Inspection</td>
</tr>
<tr>
<td>Instrumentation; Leak Detection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH Instrumentation</td>
<td>Calibration Check</td>
<td>Daily and weekly readings(^{b}); calibration check every 3 months</td>
</tr>
<tr>
<td>Hach Meters and Probes or Equivalent</td>
<td>Calibration Check</td>
<td>3 months</td>
</tr>
<tr>
<td>ResinTech SIR-700 Resin</td>
<td>Resin Changeout</td>
<td>Dependent on effluent monitoring and contaminant concentrations in the treatment train discharge water; currently occurs at 4- to 5-year intervals</td>
</tr>
<tr>
<td>Safety Shower</td>
<td>Inspection</td>
<td>6 months</td>
</tr>
<tr>
<td>Safety Shower Aquanille Stick</td>
<td>Inspect and Replace</td>
<td>3 years</td>
</tr>
<tr>
<td>Replacement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Ladder</td>
<td>Inspection</td>
<td>Annually</td>
</tr>
<tr>
<td>Overhead Door</td>
<td>Inspection</td>
<td>6 months and annually</td>
</tr>
<tr>
<td>Alarm Dialers (Auto Dialer)</td>
<td>Inspection and Testing</td>
<td>Annually or upon request (inspect when changes to call out list [change in personnel])</td>
</tr>
<tr>
<td>Uninterrupted Power Supply</td>
<td>Replacement</td>
<td>3 years</td>
</tr>
</tbody>
</table>

* As defined by the specific equipment preventive maintenance activity.

\(^{b}\) During the regular work shift (Monday through Thursday)

### 3.3 Upset Conditions

An upset condition is a sudden and unavoidable failure of control or process equipment or unintended failure of a process to operate in a normal or usual manner. Upset conditions may include periods of...
variation in contaminant removal efficiency or off-normal operation of essential subsystems, such as unexpected accumulation of solids in extraction well components, biofouling, formation of insoluble precipitates in system components, or effluent concentrations and pH values outside of targets.

Upset conditions are normally identified by Operations personnel through automated alarms, control indicators, or routine examination of operating equipment. Controls are in place throughout the P&T system to identify potential upset conditions. The automated control system is designed with a series of interlocks to establish set points and limits for safe operation. Parameters that are monitored include tank water levels, pump speeds, wellhead water levels, flow pressures, and pH. In some cases, interlocks will trigger warning alarms. In other cases, interlocks may trigger an alarm or shut down a component, series of components, or facility.

If an upset condition is confirmed, the event will be documented in the logbook along with the following information:

- Location(s) and date(s)
- Description of upset condition
- Conditions and factors that contributed to upset condition
- Corrective actions taken

Periodic resin conditioning may produce a change to the operating system. Resin conditioning is periodically performed when treatment water samples indicate an increasing trend of Cr(VI) in the treated water exiting an IX vessel. Increasing levels of Cr(VI) indicate decreasing removal efficiency of resin in the IX vessel. Conditioning involves lowering the pH of water entering the IX vessel and then isolating the vessel from the treatment system. The low pH water is allowed to sit in the IX vessel for a period of days. After the resin has been conditioned, the vessel is valved back into the treatment system. At the discretion of the design authority, confirmation sampling may be performed, and individual treatment processes may be evaluated to assess treatment efficiency.

DOE-RL will be notified in instances of significant upset conditions, including a discharge or spill of a reportable quantity of material.

3.4 Corrective Maintenance

Corrective maintenance activities are unplanned repairs of system components after failure. Typical examples include worn out pumps, leaking pipe joints, and failed electronic components. If a failure occurs, the system will be evaluated to determine the possible problem, what actions should be taken to correct the problem, and if an alternative operating configuration is feasible. Corrective maintenance activities will then be performed in accordance with approved work packages, which are controlled by JCS.

Maintenance activities will be documented in the JCS, and a summary of significant maintenance activities that result in extended system downtime will be provided in the annual P&T report. Depending on the corrective maintenance activities, the routine and preventive maintenance schedule may be reviewed and modified.

Since the startup of the DX and HX P&T systems, two corrective maintenance activities resulted in extended periods of downtime. In February 2012, the DX P&T system was shut down for corrective maintenance on the caustic lines/mixer caused by buildup inside the mixer on the downstream end. During January 2013, system throughput was again affected by scale buildup in the treated effluent injection piping after the caustic injection point, which restricted overall system flow and resulted in the
system operating at less than 80 percent of design capacity. A second pipe following the caustic injection point was installed to switch over between pipelines when pipe cleanout/replacement is needed due to scale buildup. Following installation of the second pipe and system repairs, the system throughput increased to more than 90 percent for the remainder of 2013.

3.5 O&M Methods and Training

The following subsections give an overview of the treatment facility operating methods; routine methods; and environmental, health, and safety methods used for each of the active 100-HR-3 OU P&T systems. The general training processes used to ensure personnel are trained to the methods and work activities are also described. Method revisions and approval are controlled by PPS. PPS provides current methods.

3.5.1 Typical Treatment Facility Operation Methods

The active 100-HR-3 OU P&T systems are operated in accordance with operating methods. The methods provide the necessary information and direction for proper startup, operation, and shutdown of all system components, including the treatment facilities, transfer buildings, and extraction and injection wells. The methods include the operational steps needed to put the system into a normal operating lineup and place the system in service. The methods also include the steps for responding to alarms and performing a routine system shutdown. Table 3-3 contains the title and a brief description of typical operating methods for the DX and HX P&T systems.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX Pump and Treat Operation</td>
<td>Operating instructions and guidelines for the DX P&amp;T system. The method provides instructions for normal system startup, shutdown, abnormal conditions, alarm, and manual modes for the DX P&amp;T system operations. Normal system startup and shutdown will occur via the HMI* computer in the DX Process Building. All IX manual operations (e.g., resin load, backwash, and unload) will occur in the DX Process Building. Valve, breaker, switch alignments, and manual equipment operation will occur throughout the system.</td>
</tr>
<tr>
<td>HX Pump and Treat Operation</td>
<td>Operating instructions and guidelines for the HX P&amp;T system. This method provides instructions for normal system startup, shutdown, abnormal conditions, alarm, and manual modes for the HX P&amp;T system operations. Normal system startup and shutdown will occur via the HMI computer in the HX Process Building. All IX manual operations (e.g., resin load, backwash, and unload) will occur in the HX Process Building. Valve, breaker, switch alignments, and manual equipment operation will occur throughout the system.</td>
</tr>
<tr>
<td>DX Pump and Treat Lineup</td>
<td>This method contains the supporting valve, equipment, switch, and electrical lineups for operations use. This method is used by certified system operators to perform system line up verification to support facility operation of the DX P&amp;T system and to support post-maintenance verification of lineups after major work.</td>
</tr>
<tr>
<td>HX Pump and Treat Lineup</td>
<td>This method contains the supporting valve, equipment, switch, and electrical lineups for operations use. This method is used by certified system operators to perform system line up verification to support facility operation of the HX P&amp;T system and post-maintenance verification of lineups after major work.</td>
</tr>
<tr>
<td>HMI Notifications for 100 Area Pump and Treat</td>
<td>This method provides guidance for responding to P&amp;T HMI system operational notifications. The notifications, which are indicated on the HMI monitor screen, include warnings, alarms, and trips.</td>
</tr>
</tbody>
</table>
### Table 3-3. Typical Treatment Facility Operation Methods

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX Pump and Treat Bulk Acids Unloading</td>
<td>This method provides instructions for unloading bulk deliveries of concentrated sulfuric acid to the T-M8 Tank at the DX P&amp;T facility. The method lists precautions, required tools and protective equipment, and procedural steps for completing the activities. Tanker trucks covered by this method are vendor supplied bulk chemical tankers.</td>
</tr>
<tr>
<td>HX Pump and Treat Bulk Acids Unloading</td>
<td>This method provides instructions for unloading bulk deliveries of concentrated sulfuric acid to the T-H8 Tank at the HX P&amp;T facility. The method lists precautions, required tools and protective equipment, and procedural steps for completing the activities. Tanker trucks covered by this method are vendor supplied bulk chemical tankers.</td>
</tr>
<tr>
<td>DX Pump and Treat Bulk Caustic Unloading</td>
<td>This method provides instructions for unloading bulk deliveries of concentrated caustic (sodium hydroxide) solution to the T-M12 Tank at the DX P&amp;T facility. The method lists precautions, required tools and protective equipment, and procedural steps for completing the activities. Tanker trucks covered by this method are vendor supplied bulk chemical tankers.</td>
</tr>
<tr>
<td>HX Pump and Treat Bulk Caustic Unloading</td>
<td>This method provides instructions for unloading bulk deliveries of concentrated caustic (sodium hydroxide) solution to the T-H12 Tank at the HX P&amp;T facility. The method lists precautions, required tools and protective equipment, and procedural steps for completing the activities. Tanker trucks covered by this method are vendor supplied bulk chemical tankers.</td>
</tr>
<tr>
<td>DX Acid and Caustic Enclosures Work</td>
<td>This method provides instructions for performing work in the acid or caustic (sodium hydroxide) pump enclosures. This method is used for DX facility acid or caustic enclosure entry and is limited to the following work: acid or caustic pump stroke adjustment, acid or caustic backpressure regulator adjustment, pressure damper gas adjustments for system tuning, venting acid and/or caustic systems, system inspections, valve manipulations, and small acid/caustic or Pulsafeeder lube oil cleanup activities. The method lists precautions, required tools and protective equipment, and steps for completing the activities.</td>
</tr>
<tr>
<td>HX Acid or Caustic Enclosures Work</td>
<td>This method provides instructions for performing work in the acid or caustic (sodium hydroxide) pump enclosures. This method is used for HX facility acid or caustic enclosure entry and is limited to the following work: acid or caustic pump stroke adjustment, acid or caustic backpressure regulator adjustment, pressure damper gas adjustments for system tuning, venting acid and/or caustic systems, system inspections, valve manipulations, and small acid/caustic or Pulsafeeder lube oil cleanup activities. The method lists precautions, required tools and protective equipment, and steps for completing the activities.</td>
</tr>
<tr>
<td>Well Tasks</td>
<td>This method applies to all well tasks that involve installation and/or removal of items from a well. This method is for use by maintenance personnel in support of various installation/removal activities that preserve the ability of the well to meet data quality objectives and support collecting required measurements. It also applies to well services performed to support hydrologic and vadose testing, well construction, remediation, maintenance, and decommissioning activities. As appropriate, personnel performing activities will comply with minimum standards for the construction and decommissioning of wells (WAC 173-160, “Minimum Standards for Construction and Maintenance of Wells”).</td>
</tr>
</tbody>
</table>
### Table 3-3. Typical Treatment Facility Operation Methods

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Replace Extraction Well Pump/Motor</strong></td>
<td>This method provides instructions for replacing the pump and motor in an extraction well. The method addresses all work that is required for all work crews. The method includes instructions for removing insulation, heat trace, and electrical power and mechanically disconnecting piping at the well head. The method includes removing equipment from the well and cleaning and configuring the piping and motor-pump assembly before and after installation.</td>
</tr>
<tr>
<td><strong>Setup and Operation of Alarm Dialers</strong></td>
<td>This method provides verification of the setup and operation of alarm dialers in the DX and HX P&amp;T facilities. An alarm dialer is an electronic device that monitors the P&amp;T systems for alarm signals that indicate a problem. When a problem is detected, it will communicate the problem to the correct on call personnel, so it can be rectified. This method provides steps to test the alarm dialers and perform maintenance as needed.</td>
</tr>
</tbody>
</table>
| **Support Equipment Operations**              | This method provides instructions for operation of support equipment at the P&T facilities. This method identifies the operation of peripheral equipment used on an infrequent basis, for each facility, in more detail than outlined in the overall facility method. The general operating methods do not include this information because they focus on primary equipment and daily operations; however, this document is referenced. This method includes the following support equipment and activities:  
  - Transfer water to sump area  
  - Remove liquids from secondary containment area  
  - Drain filters, isolate filter, and vent filter housings  
  - Vent train vessels  
  - Operate backup generator (maintenance monthly)  
  - Operate air compressor (maintenance every 2 years)  
  Maintenance for each piece of support equipment is addressed in separate routine/corrective maintenance methods and are performed on a set schedule. |
| **Chromium Measurement of Water Samples**     | This method provides instructions to operate the spectrophotometer for the purposes of determining hexavalent chromium concentrations in water samples. This method is used by qualified system operators to sample and measure for hexavalent chromium concentrations in water samples taken from P&T process systems. The method includes requirements for collecting samples, preparing the samples for analysis, verifying operation of the spectrophotometer, wavelength for measurement, performing the measurements, disposing of the samples, and entering the data. |
| **pH and Temperature Readings**               | This method provides instructions for operating the Hach HQ40d/HQ30d meters and probes, or equivalent, used for monitoring at sample ports, separate from the in-line or in-tank probes. This method applies to activities that require pH and temperature sampling of P&T projects or facilities process water, groundwater, or purgewater. The method includes requirements for verifying operation of the meters and probes, performing the measurements, cleaning the equipment, storing the equipment, and recording the data. |
| **In-Tank and Inline pH Probes**              | This method provides instructions for calibration and maintenance of pH sensors and transmitters located within the influent tank, effluent tank, and inline. Instructions are specific for the make and model of equipment. Calibration checks are conducted every 90 days with maintenance conducted, as needed, per the calibration check or when any unusual readings are noted. |

* The Human Machine Interface (HMI) computer is used to access the computer program that controls the P&T system.  
  P&T = pump and treat
3.5.2 Routine Methods

Routine methods are used to complete repetitive tasks, such as inspections and calibrations, which are performed on a regular frequency. Records from completion of routine methods are maintained in the JCS. Operators, support craft, and other support personnel follow routine methods to perform the following day-to-day activities:

- Housekeeping inspections
- Waste storage area inspections
- Instrument calibrations
- Inspections of facility equipment and machinery and routine adjustments
- Inspections of tanks, secondary containment devices, and sumps

Table 3-4 contains the title and a brief description of typical routine methods for the DX and HX P&T systems.

<table>
<thead>
<tr>
<th>Activity/Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX Pump and Treat Rounds</td>
<td>A method that provides instructions and data sheets for DX P&amp;T system daily rounds. This method shall be used by qualified system operators to perform rounds in support of facility operations and includes routine checks of facility equipment, IX trains, and wells.</td>
</tr>
<tr>
<td>HX Pump and Treat Rounds</td>
<td>A method that provides instructions and data sheets for HX P&amp;T system daily rounds. This method shall be used by qualified system operators to perform rounds in support of facility operations and includes routine checks of facility equipment, IX trains, and wells.</td>
</tr>
<tr>
<td>Portable and Fixed Ladders; Mobile Ladder Stands; Mobile Ladder Stand Platforms</td>
<td>A safe, uniform method for inspection of permanently affixed ladders, portable ladders, mobile ladder stands, and mobile ladder stand platforms to ensure conformance to the requirements of 29 CFR 1910, Subpart D, Article 1910 25-27 and 29, and the equipment is in safe condition.</td>
</tr>
<tr>
<td>Pump and Treat Safety Shower and Eyewash</td>
<td>A safe, uniform set of instructions for cleaning/disinfecting, flushing, testing the flow capacity, and refilling the fixed safety shower/eyewash locations at the P&amp;T facilities.</td>
</tr>
<tr>
<td>S&amp;GRP CERCLA Waste Storage Areas</td>
<td>A safe, uniform set of instructions for performing waste management inspection activities of CERCLA waste storage areas. The method includes steps for weekly inspection of S&amp;GRP waste storage areas, response to abnormal conditions, and reporting.</td>
</tr>
<tr>
<td>Cold Weather Protection Plan</td>
<td>This cold weather protection plan provides instructions and checklists to ensure P&amp;T equipment and facilities are protected against the effects of cold weather. The method applies to P&amp;T facilities as well as active pump stations, gauges, heat sensing devices, outdoor storage areas, and mobile office facilities. Facility-specific checklists are attached to this plan for use by the Operations Manager to document cold weather protection inspections.</td>
</tr>
<tr>
<td>Spectrophotometers</td>
<td>A safe, uniform method for calibrating the spectrophotometers for hexavalent chromium measurements. A calibration check is performed a minimum of every 180 days (six months). The method includes steps for preventive maintenance and replacing lamps.</td>
</tr>
<tr>
<td>Activity/Component</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>pH Sensors and Transmitters</td>
<td>A safe, uniform method for removing, cleaning, calibrating, and reinstalling (or replacing) in-line pH sensors or pH transmitters used in the P&amp;T facilities. The method includes steps for cleaning the sensors, performing calibration, and verifying system alarm settings.</td>
</tr>
<tr>
<td>Submersible Pressure Transducers (4-20mA)</td>
<td>This method covers the acceptance testing of submersible current-loop pressure transducers used in support of the P&amp;T facilities. The method includes steps to visually inspect, clean, and test the transducers. Each transducer is tested by applying a known pressure, measuring the transducer’s response, and calculating the transducer’s deviation from the applied pressure.</td>
</tr>
<tr>
<td>Data Loggers</td>
<td>A safe, uniform method to verify calibration of data loggers. The method includes steps to configure parameters and verify the settings.</td>
</tr>
<tr>
<td>Submersible Pressure Transducers</td>
<td>This method covers the acceptance testing of submersible current-loop pressure transducers used in support of the P&amp;T facilities. The method includes steps to visually inspect, clean, and test the transducers. Each transducer is tested by applying a known pressure, measuring the transducer’s response, and calculating the transducer’s deviation from the applied pressure.</td>
</tr>
<tr>
<td>pH Sensors and Transmitters</td>
<td>A safe, uniform method for removing, cleaning, calibrating, and re-installing (or replacing) pH sensors used in the P&amp;T facilities. The method includes steps for cleaning the sensors, performing a calibration, and verifying system settings.</td>
</tr>
<tr>
<td>Effluent/Influent Tank Temperature Probe</td>
<td>The in-tank temperature probes are calibrated every 90 days or when an unusual reading is noted.</td>
</tr>
</tbody>
</table>

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980

P&T = pump and treat

1.3.5.3 Environment, Health, and Safety Methods

Specific methods are used to complete the following environment, safety, and health activities.

The methods are approved by the appropriate manager of the Environment, Health, or Safety organizations:

- **Waste handling.** All waste streams associated with operation of the 100-HR-3 OU P&T systems are managed in accordance with the WMP (DOE/RL-97-01). Requirements of the WMP are implemented by methods that address specific waste streams, as described in Section 4 of the WMP, such as drill cuttings, spent resins, and spent filter elements.

- **Safety equipment.** Methods are used to ensure correct use and maintenance of safety equipment within P&T facilities. This includes portable fire extinguishers, emergency lights, tank alarms, leak detection, spill cleanup, and other protection systems.

- **Alarm and spill response methods.** Methods are used to ensure that proper response is taken when a process alarm indicator is triggered, an abnormal condition occurs, or a spill occurs. These methods include operational steps for determining the process upset, isolating it, and shutting down the system (if necessary).
Table 3-5 contains the title and a brief description of typical environment, health, and safety methods.

<table>
<thead>
<tr>
<th>Activity/Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable Eyewash</td>
<td>A safe, uniform method to perform monthly visual inspections and periodic maintenance (a minimum of every three months) on portable eyewash stations. Inspections include checking the eyewash for leaks, flow, and pressurization. Maintenance includes draining, cleaning, and flushing the eyewash, replacing the eyewash solution, and pressurizing the eyewash.</td>
</tr>
<tr>
<td>Pump and Treat Facilities Emergency and Safety Equipment</td>
<td>A safe, uniform method to perform weekly and monthly inspections of emergency and safety equipment. The method covers first aid kits, safety showers, permanent eyewashes, fire extinguishers, spill kits, portable eyewashes, and emergency exit checks at the P&amp;T facilities.</td>
</tr>
<tr>
<td>Spill or Leak Response</td>
<td>A safe, uniform method to respond to wet and dry spills of process water, known hazardous substances, dangerous wastes, mixed wastes, oil, or petroleum products within the P&amp;T facilities. This method applies to facility personnel manageable spills/releases that can be mitigated by facility staff, regardless of the quantity, except for small drips and splatters that can be immediately wiped up. For any spill or leak, the “SWIMS” system is initiated: Stop, Warn, Isolate, Minimize, Secure. The Operations Supervisor (OS) is notified as soon as possible, and together the OS and operator determine if the leak or spill is facility manageable. Events that requires additional resources and/or instructions not contained in this method to mitigate a spill/release event are not facility manageable. The OS contacts the reporting Single Point of Contact to initiate additional response and make all reporting requirements. Such a spill/release may require a response from Emergency Support Services (Hanford Fire Department).</td>
</tr>
<tr>
<td>Environmental Event</td>
<td>This method defines the process for implementing environmental requirements associated with the minimization, reporting, cleanup, and documentation of environmental events, including those with potential for or involving the release of hazardous substance(s) to the environment. In addition, this method defines the process for reporting and documenting accidental damage to protected natural and cultural resources. This method applies to all nonemergency spills and releases, and includes notification and reporting requirements for compliance with regulatory standards.</td>
</tr>
<tr>
<td>Environmental Protection Requirements</td>
<td>This method defines the requirements established to protect human health and the environment. The method identifies the regulatory basis for spill prevention and reporting. Spills or leaks of dangerous wastes or hazardous substances are reported in accordance with 40 CFR 302 and WAC 173-303.</td>
</tr>
<tr>
<td>Waste Packaging and Handling</td>
<td>A safe, uniform method for inspecting, preparing waste containers, packaging, labeling, transferring, and shipping various types of waste for S&amp;GRP activities. The scope of this work is limited to low-level radioactive waste, material or waste managed as radioactive material, U.S. Department of Transportation compliant packaging of low-level, low-level mixed, hazardous/dangerous, and non-regulated waste.</td>
</tr>
</tbody>
</table>
3.5.4 Training

The responsible manager ensures that their personnel have received the appropriate training pertaining to their job tasks and work activities. This will also include general Hanford Site training. Training may include classroom, computer-based, and on-the-job activities. The responsible manager also ensures that their personnel are up to date on required training.

For P&T facility operators, this training covers facility startup and shutdown, operation adjustments, as well as specific methods and tasks they perform. The training enables the operators to experience a number of routine and nonroutine events prior to actual hands-on contact with operations and equipment.

3.6 Inspection Requirements

The following subsections describe typical inspections for the 100-HR-3 OU P&T systems.

3.6.1 Extraction and Injection Well Inspection

Facility piping and fittings are visually inspected weekly as a part of the operator rounds method to detect leaks and identify potential maintenance needs. Inspection findings are documented as a part of the operator rounds report and maintained by Operations. Items requiring maintenance or repair are identified and communicated to the Remediation Support organization for implementation of corrective action.

3.6.2 Conveyance Line Inspections

Conveyance lines are inspected visually for leaks following construction, repairs, or modifications to lines. Lines are also inspected in response to operational indicators of a conveyance line anomaly. Items requiring maintenance or repair are identified and communicated to the Remediation Support organization for implementation of corrective action.

3.6.3 Monitoring Well Inspection

The physical condition of monitoring wells is inspected by the groundwater sampling crew during each sampling event. Conditions requiring maintenance or repair are noted and communicated to the Remediation Support organization for implementation of corrective action.

3.6.4 Typical Periodic Inspections

Observations and inspections are performed for each of the P&T facilities, as specified in the operator rounds method. Operator rounds include periodic observations and inspections of tanks, pumps, transfer lines, valves, IX vessels, leak detection equipment, and safety equipment in each P&T facility. Inspection results are documented on operator rounds datasheets. Periodic inspections are also performed for support systems, such as decontamination equipment, spill kits, eyewashes, safety showers, and fire extinguishers. Items requiring maintenance or repair are identified and communicated to the Remediation Support organization for implementation of corrective action.
4 Operational Monitoring

As described in the IAROD (EPA/ROD/R10-96/134) and summarized in Chapter 1, the selected remedy combines P&T, ICs, and an evaluation of remedy effectiveness to achieve the RAOs. The IAROD also stipulates that compliance monitoring will include analysis of results in a timely manner to support modifications to the treatment system in order to meet RAOs.

Operational monitoring is designed to evaluate how well the treatment process functions and facilitate operation of the system. Operational monitoring is described in the following two subsections, and includes P&T process monitoring and treatment process water monitoring. Performance monitoring data are used to optimize the treatment system, assess remedy performance, and determine progress toward achieving RAOs. Performance assessment includes evaluating how well the remedial action complies with the river protection objective and quantifies mass removal of Cr(VI). Chapter 6 of the 100-HR-3 RD/RAWP (DOE/RL-2013-31) describes compliance monitoring, which is conducted at the end of the remedial action to demonstrate achievement of cleanup. These different types of monitoring are as follows:

- **P&T process monitoring** – collection and evaluation of data on the operational components of the treatment system
- **Treatment process water monitoring** – collection and evaluation of data on Cr(VI) removal by the system from extraction wells, effluent tanks, and influent tanks
- **Performance monitoring** – collection and evaluation of groundwater quality and groundwater elevation data

The following sections briefly describe the planned data collection associated with operational monitoring.

4.1 Pump and Treat Process Monitoring

P&T process monitoring is conducted during operations to ensure that system components are operating as expected and alert operators of upset conditions. These operational system data are used in conjunction with the treatment process water monitoring to evaluate IX resin performance, assess aquifer and Cr(VI) plume response, and optimize extraction and injection well pumping rates for system performance.

Operational system data are collected throughout the treatment system for a range of parameters on specific system components. Specific parameters are monitored continuously by the operational control systems (Table 4-1). A schematic of the treatment system showing the location of flow, water level, and pH monitoring sensors is presented on Figure 1-5.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Component(s) Monitored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>Extraction/injection wells, IX trains, influent/effluent tanks</td>
</tr>
<tr>
<td>Liquid Level</td>
<td>Extraction/injection wells, influent/effluent tanks, acid/caustic tanks</td>
</tr>
<tr>
<td>pH</td>
<td>Influent/effluent tanks and piping using Rosemount® pH sensor model 396R-10-21-54 (or equivalent) for in tank monitoring and Durafer III pH sensor model 51453503-505 (or equivalent) for inline monitoring</td>
</tr>
</tbody>
</table>
Table 4-1. Operational System Monitoring

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Component(s) Monitored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Process stream influent/effluent, process building and transfer building, influent and effluent tanks</td>
</tr>
<tr>
<td>Water Pressure</td>
<td>Extraction wells, feed pumps, IX trains, booster pumps</td>
</tr>
<tr>
<td>Differential Water Pressure</td>
<td>Extraction/injection filters, IX vessels</td>
</tr>
<tr>
<td>Drive Frequency</td>
<td>All variable frequency drive motors</td>
</tr>
<tr>
<td>Motorized Positioning Valve Position</td>
<td>Injection wells</td>
</tr>
<tr>
<td>Amperage</td>
<td>Selected electrically controlled components</td>
</tr>
<tr>
<td>Voltage</td>
<td>Selected electrically controlled components</td>
</tr>
<tr>
<td>Leak Detection</td>
<td>Floor sumps in transfer and process buildings, acid/caustic tanks</td>
</tr>
</tbody>
</table>

Note: Rosemount is a registered trademark of Emerson Process Management, Irvine, California.

Flow rates are typically measured during operations using inline flow meters in extraction and injection wells and in the treatment plant influent piping. Flow rate information is relayed to SCADA, which automatically controls pumps and valves, as needed, to optimize flow rates, with overall flow parameters set and monitored by the system operators. The measured pressures are also recorded, which can be used to identify an unusual drop in system pressure that might indicate a leak.

During P&T system operations, groundwater elevation data are collected from the system well network by water level transducers. Water level data are used to control extraction rates and injection rates and assess the need to rebalance flow rates to optimize capture zone boundaries. Water level data are also integrated with sitewide water level data to construct groundwater elevation contour maps for evaluating groundwater flow directions, hydraulic gradients, and hydraulic capture and flow control.

Water levels are continuously monitored in extraction wells, based on height above the pump intake. Injection wellhead levels are monitored continuously as depth below ground surface. These measurements are relayed to PLCs where the information is used to control pumps and valving in order to maintain efficient system operation. Control limits are set for the PLCs to prevent extraction well pumps from running dry and injection wells from flooding to the ground surface.

4.2 Treatment Process Water Monitoring

Treatment process water monitoring includes collecting water samples from the extraction wells, influent tanks, IX resin vessels, and effluent tanks to monitor Cr(VI) concentrations through the treatment process to ensure that the system is operating as expected. Data are also used to assess Cr(VI) removal efficiency and the need for IX resin change out. Data collected from extraction wells and effluent tanks also provide information to use in performance monitoring and process optimization.

Figure 1-5 presents a schematic of the treatment system showing the sampling locations for the influent tanks, IX resin vessels, and effluent tanks. Extraction well samples are collected from a port located downstream of the extraction line filter. Effluent tank samples provide characterization of Cr(VI) concentrations at the injection wells prior to reinjection.
Treatment process water samples are collected and analyzed by system operators as summarized in Table 3-3. A summary of the method is provided in Section 4.2.1. Table 4-2 summarizes frequency for treatment process water Cr(VI) monitoring. In addition to the treatment process water monitoring, performance monitoring (as described in the 100-HR-3 SAP [DOE/RL-2013-30]) analyzes groundwater samples at the laboratory using EPA Method 7196 for Cr(VI).

Table 4-1. Treatment Process Water Monitoring for Hexavalent Chromium

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Location</th>
<th>Data Use</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexavalent Chromium</td>
<td>Extraction wells</td>
<td>Monitor remedy performance and transient conditions</td>
<td>Monthly</td>
</tr>
<tr>
<td>Hexavalent Chromium</td>
<td>Influent/effluent tanks, ion exchange resin vessels</td>
<td>Monitor ion exchange resin performance and mass removal; demonstrate discharge requirements achievement</td>
<td>Weekly</td>
</tr>
</tbody>
</table>

Additional parameters may be measured, as determined by the design authority and project scientist, to monitor operational performance and effects.

The IAROD (EPA/ROD/R10-96/134) acknowledged potential for other groundwater co-contaminants to be present in the injected effluent. These co-contaminants may be extracted along with Cr(VI) contaminated groundwater, pass through the P&T system, and be returned to the aquifer via the injection wells. The 100-HR-3 SAP (DOE/RL-2013-30) contains requirements for monitoring co-contaminants in the influent and effluent tanks and the extraction wells.

4.2.1 Hexavalent Chromium Field Sampling and Analysis

Samples are collected from ports located within the DX and HX facilities. Measurements for Cr(VI) are conducted within the facility to maintain adequate temperatures, clearance, cleanliness, and a flat solid surface for analysis. Cr(VI) analyses are conducted using a portable spectrophotometer following manufacturer guidelines. Field samples are analyzed following EPA Method 8023, as adapted from Standard Methods for the Examination of Water and Wastewater (1,5-Diphenlcarbohydrazide Method [APHA/AWWA/WEF, 2012]). The following is a summary of activities outlined in this method:

- **Collect Water Sample** – identifies PPE, instrument calibration check, chemical reagent check, collection, holding time from collection to analysis, and recording

- **Sample Preparation** – identifies test selection, filling and cleaning sample cell, reagent addition, measurement wavelength (540 nm for Cr(VI)), time for reagent reaction and measurement, and recording

- **Instrument Calibration and Accuracy Check** – identifies references and frequencies for verifying calibration, and methods for standard and confirmatory accuracy check

The expected precision for Cr(VI) using the method used is:

<table>
<thead>
<tr>
<th>Concentration Range (mg/L)</th>
<th>95% Confidence Interval (in mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.010–0.700 mg/L</td>
<td>Lower Limit</td>
</tr>
<tr>
<td></td>
<td>0.497</td>
</tr>
</tbody>
</table>
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5 Reporting

This chapter describes reporting requirements for the 100-HR-3 OU P&T systems while the systems are in operation, as well as final remedial action closure reporting once the 100-HR-3 OU RAOs have been met. An overview of the CERCLA 5-year review process also is presented. The reports discussed in this chapter may be prepared as individual project-specific reports, or they may be combined into area-specific (e.g., annual P&T report) or Hanford Sitewide reports.

5.1 System Operations and Remedy Performance Report

A system performance report will include information on P&T operations (e.g., average flow rates, contaminant monitoring results from the system and hydraulic monitoring well network, and mass removal) and progress toward meeting remedial goals. The system performance information is compiled annually and reported in the annual P&T report.

Once DOE, in consultation with the lead regulatory agency, has determined that RAOs and final cleanup levels have been met, a final close out report will be prepared. The report will provide information as outlined in OSWER Directive 9320.2-22, *Close Out Procedures for National Priorities List Sites*, which identifies site completion as the end of all response actions. The site completion designation generally means that response actions at the site were completed, and it is anticipated that no further response is necessary to protect human health and the environment.

5.2 CERCLA 5-Year Review

In accordance with 40 CFR 300.430(f)(4)(ii), “National Oil and Hazardous Substances Pollution Contingency Plan,” “Remedial Investigation/Feasibility Study and Selection of Remedy,” DOE conducts five-year reviews because the selected remedy has not achieved cleanup levels that allow for unlimited use and unrestricted exposure. A CERCLA 5-year review of the 100-HR-3 OU remedial actions began in 2001 and continued in 2006 and 2011. The time of the next Hanford Site consolidated 5-year review is 2016, and reviews will be conducted every 5 years until cleanup levels are attained. The reviews will be conducted pursuant to CERCLA Section 121(c) and as provided in the current EPA guidance (EPA 540-R-01-007, *Comprehensive Five-Year Review Guidance*).

5.3 Records Management

Record material that forms the basis for selection of the final action will be managed in accordance with procedures specified in Section 9.4 of the TPA (Ecology et al., 1989a). Materials that form the basis for the final close out report (Section 6.4 of the 100-HR-3 RD/RAWP [DOE/RL-2013-31]) will be maintained per OSWER Directive 9320.2-22.

The following records are associated with O&M of the 100-HR-3 OU P&T systems:

- Operation logs
  - Field logbooks and laboratory reports
  - Monitoring results
  - Emergency and transient condition events
- Annual reports
- Maintenance records
- Operating costs
- Personnel records
5.4 Change Control

The 100-HR-3 OU project manager is responsible for tracking changes and obtaining appropriate reviews by contractor staff. The 100-HR-3 OU project manager will discuss the change with DOE-RL, who will then discuss significant and fundamental changes with the lead regulatory agency, as described in Sections 9.3 and 12.4 of the TPA Action Plan (Ecology et al., 1989b, Hanford Federal Facility Agreement and Consent Order Action Plan). Appropriate documentation will follow, in accordance with the requirements for the type of change. Table 5-1 summarizes the project modifications that may occur, type of change, and corresponding documentation requirements. Changes that impact the remedial design or remedial action should be managed in accordance with change management requirements in the 100-HR-3 RD/RAWP (DOE/RL-2013-31).

<table>
<thead>
<tr>
<th>Type of Change</th>
<th>Documentation Process</th>
<th>Project Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project File</td>
<td>Reroute injection or extraction conveyance.</td>
</tr>
<tr>
<td></td>
<td>(Technical Memos or</td>
<td>Modify ion exchange vessel configuration.</td>
</tr>
<tr>
<td></td>
<td>Calculations)</td>
<td>Modify well pumping rates within record of decision specified limits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Modify instrumentation and control systems.</td>
</tr>
<tr>
<td></td>
<td>RL Informational</td>
<td>Temporarily suspend operations due to unplanned circumstances (e.g., power surges or</td>
</tr>
<tr>
<td></td>
<td>Notifications</td>
<td>weather extremes).</td>
</tr>
<tr>
<td></td>
<td>Tri-Party Agreement</td>
<td>Add extraction/injection well (well realignments).</td>
</tr>
<tr>
<td></td>
<td>Change Notice</td>
<td>Remove extraction/injection wells (well realignments).</td>
</tr>
<tr>
<td></td>
<td>or Document Revision</td>
<td>Permanently modify treatment system capacity to less than described in Table 1-1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Change ion exchange media type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Permanently modify sampling requirements defined in Table 4-2.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Permanently discontinue pumping at specific wells in response to plume cleanup/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>achieving remedial action objectives in specific plume segments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Update to the remedial design/remedial action work plan (DOE/RL-2013-31)</td>
</tr>
<tr>
<td>Nonsignificant Changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significant Changes</td>
<td>Explanation of Significant Differences</td>
<td>Realize cost increase or decrease (&gt;+50% or &lt;-30%).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add another contaminant treated with same technology.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add new/additional hexavalent chromium contaminant plume areas to the remedy.</td>
</tr>
<tr>
<td>Fundamental Changes</td>
<td>Record of Decision Amendment</td>
<td>Remedy change.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add constituent treatment (additional technology).</td>
</tr>
</tbody>
</table>
6 Decontamination and Decommissioning

Decontamination and decommissioning (D&D) of the 100-HR-3 OU DX and HX P&T systems will be addressed after DOE, EPA, and Ecology determine that active remediation is complete, or the treatment system is no longer required. Requirements will be addressed in a D&D plan, which will be developed and submitted prior to the end of the active remediation period. Information on D&D of the DR-5 and HR-3 and D&D of the DX and HX P&T systems is presented in Chapter 6 of the 100-HR-3 RD/RAWP (DOE/RL-2013-31).
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This chapter describes health, safety, and quality requirements associated with operating the 100-HR-3 OU P&T systems.

### 7.1 Health and Safety

The hazardous waste operations safety and health program was developed for employees involved in hazardous waste site activities. The program was developed to comply with the requirements of 29 CFR 1910.120, “Occupational Safety and Health Standards,” “Hazardous Waste Operations and Emergency Response,” and 10 CFR 835, “Occupational Radiation Protection,” to ensure the safety and health of workers during hazardous waste operations.

The health and safety program was developed to define chemical, radiological, and physical hazards and to specify the controls and requirements for day-to-day work activities on the overall Hanford Site. The program incorporates applicable core functions and guiding principles outlined in ISMS and governs the following elements per 29 CFR 1910.120(b)(4)(ii):

- Safety and health hazard analysis identifying hazards and their mitigations
- Employee training assignments
- PPE to be used by employees for tasks and operations
- Medical surveillance requirements
- Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques
- Site control measures
- Decontamination methods
- Emergency response plan, including necessary PPE and other equipment
- Confined space entry methods
- Spill containment measures

The objective of ISMS is to integrate working safely into management and work practices at all levels, addressing all types of work and all types of hazards to ensure safety for workers, the public, and the environment. ISMS integrates working safely into planning and execution of work.

In accordance with SGW-41472, *Soil and Groundwater Remediation Project Site Specific Health and Safety Plan (HASP)*, all S&GRP field activities are conducted via a work package, method, or statement of work. Each of these processes requires a hazard analysis. S&GRP documents their hazard assessment of industrial hygiene hazards via formal Industrial Hygiene Exposure Assessments. Mitigative controls from these exposure assessments are incorporated into job hazard analyses, work packages, and methods as appropriate.

Project field staff are required to comply with the health and safety program at all times. Field staff potentially exposed to hazardous substances, health hazards, or safety hazards and responsible managers receive the requisite training before they are permitted to engage in P&T work activities. Visitors will be briefed on site hazards and controls, must read and sign the health and safety plan, and must be escorted by a member of the P&T operations organization or designee. Visitors are not allowed into contamination controlled areas or into areas where waste systems are open with the potential for exposure.

#### 7.1.1 Upset Events

Upset events within the P&T system that exhibit emergency conditions require immediate notification and response from the Hanford Fire Department in accordance with the S&GRP HASP (SGW-41472).

The following are examples of upset events addressed by the S&GRP HASP:
• Life threatening injuries
• Fire
• Radiological/chemical hazard events
• Nonfacility manageable spills or leaks

In accordance with the S&GRP HASP, all upset events require notification of the Shift Office.

Table 3-5 identifies the general definitions and describes the S&GRP spill or leak method and its applicability. Events that can be mitigated by facility staff using the instruction are defined as a facility manageable spill or release. An event that requires additional resources and/or instructions outside those contained in the method for mitigation is a nonfacility manageable method. When there is a non-facility manageable spill or leak of chemicals or unknown constituents, the Hanford Fire Department is contacted for support.

The general instructions for responding to a spill or leak include initiating SWIM:

• S – stop all nonemergency work activities in the area of the spill or leak
• W – warn others in the area of the spill or leak
• I – isolate area if possible and safe to do so
• M – minimize exposure and contamination by safely performing any of the following tasks, as needed, to mitigate risk:
  – Shut down pumps
  – Swap pumps
  – Close valves
  – Reduce flows or pressures
  – Secure subsystems
  – Shutdown facility operations

After notifying the Operations Supervisor, the operator and supervisor determine if the leak or spill is facility manageable or nonfacility manageable. For facility manageable spills or leaks of water or process water, specific notifications and methods for cleanup and waste disposal are identified within the method. For chemical spills or leaks, specifically sulfuric acid and sodium hydroxide, neutralization options and disposal instructions are included.

7.1.2 General Hazards

Several general hazards have been identified within S&GRP. These hazards have been evaluated and are considered easily recognized and mitigated by employee’s fundamental knowledge and training. General hazards are not typically included in work packages or methods unless particular emphasis is needed. General hazards found with S&GRP include the following:

• Dust
• Heat stress
• Cold stress
• Contact with untreated or pH adjusted water
• Abrasion, laceration, cut, or puncture hazards to the hands
Scrapes to the hands
Foot injury due to falling or rolling objects
High noise
Head injury due to falling or flying objects or electrical shock or burns
Head bump hazard
Bomb threat, suspicious object, or written threat letter
Hostage situation/armed intruder
Range fire

7.1.3 Facility Emergency Response

Requirements for emergency preparedness programs at DOE sites are set forth in DOE O 151.1C, Comprehensive Emergency Management System. The S&GRP Operations organization is responsible for implementing emergency response plans and related documentation, as well as verifying that employees, including subcontractor employees, receive the required training to ensure that adequate levels of preparedness and response are maintained.

Based on hazards surveys, 100-HR-3 OU P&T facilities are classified as general purpose facilities. General purpose facilities are defined as office buildings or facilities that contain no hazardous materials in excess of any regulatory quantities that require emergency preparedness planning. The governing requirement for the P&T facilities is 29 CFR 1910.38, “Emergency Action Plans.” For the P&T facilities, personnel are evacuated from the danger area when an emergency occurs and do not directly assist in handling the emergency.

Emergency response information for the 100-HR-3 OU P&T facilities is posted on facility emergency response information boards, which are located in the control rooms of each P&T system. Facility emergency response information boards are located in the 1804-D Building (DX) and the 689 Building (HX). The boards provide evacuation routes and locations of staging areas as well as emergency contact information.

7.2 Quality Assurance

The remediation contractor (CHPRC) is responsible for maintaining a QA program. The QA program provides the quality requirements applicable to activities performed by CHPRC. Quality requirements for activities within the scope of environmental cleanup and restoration conducted by CHPRC are included in an Environmental Quality Assurance Program Plan. Implementation of environmental quality requirements for S&GRP is included in the organization’s QA project plan.

The S&GR QA project plan defines the processes used by S&GRP to produce quality data and ensure that operations are fully compliant with all applicable quality affecting requirements. The plan provides additional QA requirements for S&GRP such as quality objectives, methods, operational approaches, and goals for performing the work scope.

CHPRC implements QA requirements on a graded approach. The graded approach for environmental activities that involve generating, acquiring or using environmental data is based on the intended use of the data, analytical protocol selected, and parameters of accuracy, precision, comparability, completeness, and representativeness.
8 References


1910.120, “Hazardous Waste Operations and Emergency Response.”

Subpart D, “Walking-Working Surfaces.”


DOE/RL-2013-49, REV. 0


160-171, “What Are the Requirements for the Location of the Well Site and Access to the Well?”

160-381, “What Are the Standards for Decommissioning a Well?”