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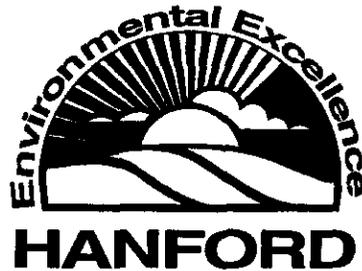
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Rev. 03

200-BP-5, Unit #2 Pilot-Scale Groundwater Treatment System Operating Procedures

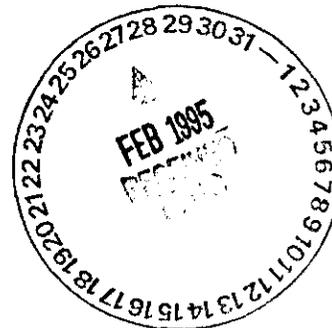
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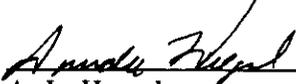
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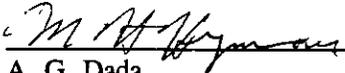
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OPERATING PROCEDURES

Revision No. 03

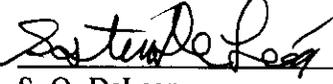
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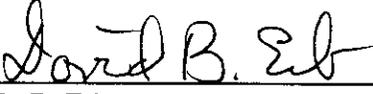
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ACRONYMS

| | |
|-----|---------------------------------|
| AC | air connector |
| BV | ball valve |
| FIT | flow indicating transmitter |
| FS | flow switch |
| GAC | Granulated Activated Carbon |
| HPT | Health Physics Technician |
| MCC | Main Control Center |
| MCP | main control panel |
| MBV | motor-operated ball valve |
| PLC | programmable logic controller |
| RCT | Radiological Control Technician |
| RWP | Radiation Work Permit |
| SAP | Sampling Analysis Plan |

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the procedures for operating the Pilot-Scale Treatment System for the removal of cobalt and technetium from the groundwater in the 200-BP-5 Operable Unit. The BY Crib Site, also known as BP-5, Unit #2, is located in the 600 Area a half mile north of the BY Cribs in the 200 East Area. The Treatment System is an ion exchange adsorption system that has been selected as the technology to be evaluated in performing a treatability test. Treatability tests are used to confirm the selection of a particular technology for remediating groundwater before proposing an interim remedial measure plan. This treatability test will evaluate the effectiveness of ion exchange for the removal of cobalt and technetium from the groundwater. Construction and operating costs will also be gathered and used to evaluate the cost effectiveness of using this type of technology on the Hanford Site.

1.2 SCOPE

The treatability test for Unit 2 will be performed at a location within the bounds of a plume derived from the 216-BY Cribs, that was once a series of treatment and disposal facilities for the B-Plant in 200 East Area. The operation will include a well (or wells) for extraction of groundwater to be treated and a well for disposal of the treated effluent; two 8,200 gal storage tanks, one for storage of influent and one for storage of treated effluent; a process water tank that provides water for chemical makeup (if required) and backflushing of the process columns; an influent pump station (mounted on a skid) with prefilters; a process treatment skid with control panel; and an effluent pumping station (on a skid) with filters for pumping treated effluent to a storage tank through flexible hose directly to the disposal well or to a pumper truck for transfer to the disposal well storage tank. In addition, because of the long distance to the disposal well, a 4,200 gal tank is required as a holding tank for a tank truck to transport treated water to the disposal well. The overall system will be connected with a series of hoses fitted with quick disconnect fittings, and power and signal cables. The tanks and skids are fitted with manifolds for ease of connection to the hoses. A portable generator will provide 480V ac, 3-phase power that will provide primary power to run the pumps. The 480V ac in turn will be reduced to 240/120V ac, single-phase with transformers and a power distribution system.

The Pilot-Scale Treatment System will initially be operated on a 6-hour/day basis. Once shakedown of the system has been completed, the extraction well pump and the effluent pump(s) will operate 24 hours/day for filling the influent tank and disposing of treated effluent from the effluent storage tank; the process system will be operated 6 to 8 hours/day.

1.3 PRESTARTUP

1. A startup checklist will be completed before startup, and a copy is to be maintained in the field files. Performance of the startup checklist will be documented in the field logbook. Refer to process flow diagram (Figure 1-1) for performing the

startup checklist. In addition, use the equipment list below for performing the equipment component check.

- Extraction Well Pump
- Feed Pumps
- Effluent Pumps
- Filters (Influent and Effluent)
- Ion Exchange/Granulated Activated Carbon (GAC) Columns
- Influent/Effluent Storage Tanks
- Failsafe Motor-Operated Ball Valve (MBV)
- Air Release Valves
- Flowmeters
- Flow Switches (FS)
- Level Indicators/Controls
- Pressure Indicators/Transmitters/Controllers
- Differential Pressure Indicators/Transmitters
- Temperature Indicators/Transmitters
- Dissolved Oxygen Monitors
- Turbidity Monitors
- pH Indicators/Transmitters
- Flex Hose
- Flexible Connectors
- Ion Exchange Resin
- GAC.

2. Perform a safety and readiness walkthrough (a physical inspection) of the system, including the storage tanks, wells being used, hoses, process system, and generator to verify that the system is functional, properly connected, and ready for safe operation. Verify that all necessary safety equipment is available and functional (e.g., fire extinguishers, eye wash). Record discrepant conditions in the field/discrepancy logbooks and correct before startup. Perform a walkdown of the hoses connecting the system, following the flow from the well pump to the disposal well to verify integrity as follows:

- Extraction Well Pump discharge to the Influent Storage Tank inlet
- Influent Storage Tank outlet to the Influent Pump skid suction manifold
- Influent Pump skid discharge to the Process System skid inlet manifold
- From the inlet manifold to the first column inlet (at top for down flow), from the bottom of the first ion exchange column to the inlet of the second ion exchange column
- From the outlet (bottom) of the second ion exchange column, to the inlet off the GAC column
- From the outlet of the GAC column, to the Process System skid discharge manifold

- Process System skid discharge manifold to the Effluent Storage Tank inlet manifold
- Effluent Storage Tank outlet manifold to the Effluent Pump skid suction manifold
- Effluent Pump skid discharge to a holding tank or tanker truck

OR

Disposal Well Tank or tanker truck (at the disposal well) to the Disposal Well manifold

OR

Effluent Pump skid discharge to the Disposal Well manifold.

3. If operating in day shift mode (6 to 8 hours) for treatment only, verify that all valves are closed, including sample valves. If operating in 24-hour mode, verify that ball valves (BV) BV-1, BV-2, BV-4, BV-6 or BV-7, BV-8, BV-9, and MBV-1 are open while the extraction well pump is operating.
4. Verify that filter housing lids are closed and tightened and that filters are ready to accept flow.
5. Verify that gages are connected and appear to be in working condition.
6. Verify that columns are properly connected for series flow through three columns as noted in Section 1.3, step 2, then out to the outlet manifold.
7. Verify that heat tracing and heaters are operating, if applicable.

NOTE: Table 1-1 is provided to document these steps.

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Table 1-1. Prestartup Checklist.

| | | |
|--|---|----------------------|
| Date: | | |
| Operators: | | |
| Perform a safety walkthrough (physical inspection) of the system to verify that the system is functional, properly connected, and ready for safe operation. Perform the following: | | |
| | Prestartup Checklist | Verified/Date |
| 1. | Extraction Well Pump discharge to the Influent Storage Tank inlet | |
| 2. | Influent Storage Tank outlet to the Influent Pump skid suction manifold | |
| 3. | Influent Pump skid discharge to the Process System skid inlet manifold | |
| 4. | Verify that the two ion exchange columns and one GAC column are connected from the Process System skid inlet manifold to the three columns in series flow, then out to the Process System skid discharge manifold | |
| 5. | Process System skid discharge manifold to the Effluent Storage Tank inlet manifold | |
| 6. | Effluent Storage Tank outlet manifold to the Effluent Pump skid suction manifold | |
| 7. | Effluent Pump skid discharge to a holding tank or tanker truck OR Disposal Well Tank or tanker truck (at the disposal well) to the Disposal Well manifold OR Effluent Pump skid discharge to the Disposal Well manifold | |
| 8. | Verify that all valves are closed, including sample valves. Verify switches are in the appropriate position for the equipment that may be operating (e.g., the well pump - if it is operating 24 hours/day) | |
| 9. | Verify filter housing lids are closed and tightened and that filters are ready to accept flow | |
| 10. | Verify that gages are connected and appear to be in working condition | |
| 11. | Verify that heat tracing and heaters are operational, if applicable. | |

2.0 STARTUP AND OPERATION

To start operations, the Pilot-Scale Treatment System will be configured by manually aligning BVs, using sight level gages and/or tank level indicators on the Influent and Effluent Storage Tanks, and differential pressure instrumentation for monitoring process conditions. Valves are to be aligned for flow from the Extraction Well Pump to the Influent Storage Tank, then from an Influent Pump through Influent Filters, through three columns in series flow and out to the Effluent Storage Tank. The treated effluent in the Effluent Storage Tank will be discharged to an effluent holding tank, tanker truck, or directly to the Disposal Well via one of the Effluent Pumps and Effluent Filters. The tanker truck will transport and pump the treated effluent to another holding tank at the Disposal Well site. The treated effluent then will be gravity drained to the Disposal Well from either the Disposal Well Tank or the tanker truck if the effluent is not pumped directly into the Disposal Well.

The system will use level, flow, and pressure instrumentation and interlocks to prevent overflows of the Influent and Effluent Storage Tanks, protect pumps from loss of flow, alarm when filters must be changed and ion exchange/GAC columns must be backwashed, and monitor well levels.

Use the checklists provided in the following chapters to record system operation. These will be located on site in a field logbook.

2.1 ELECTRICAL POWER

1. Verify that the disconnect switches on the generator, the DP-2 disconnect, the Main-Main Control Center (MCC) disconnect, the main control panel (MCP) disconnect, and the MCP transformer disconnect are off and that the electrical connectors are properly connected. During cold weather activities, the generator, the generator disconnect, and the disconnect for DP-2 will be left on to allow heat tracing to heat the piping.
2. Before starting operation, start the generator; or if permanent power is available, go to the next step. The generator may be left on 24 hours/day during cold weather activities. If the generator is on, go to the next step.
3. If the generator is not running and before start of operations, verify that the 480V ac power control switches to equipment (pumps, etc.) are in the "OFF" position. Verify that the breakers in panel DP-2 are in the proper position before energizing any switches. If the generator is running, verify that control switches are in the appropriate positions for the equipment that is operating (i.e., extraction well disconnect is on during extraction).
4. Energize power to the control panel by actuating the main disconnect switches (on the generator, disconnects DP-2 and the Main-MCC, the MCP, and the MCP transformer) and the control power switch(es) to equipment to be started.
5. Energize power to 110V ac system for level controls and programmable logic controller (PLC).

6. Reset the MBV control switches at the influent skid.

NOTE: Table 2-1 is provided to document these steps.

2.2 START EXTRACTION WELL PUMP, P-1

1. Verify that the following lights on the annunciator panel are not illuminated:
 - LSH-1 Influent Storage Tank Level "High"
 - LSL-1 Extraction Well Level "Low"
 - LSHH-1 Influent Storage Tank Level "High-High"
2. Position the following BVs before startup of the Extraction Well Pump. All valves should be closed except the following: Open BV-1 and BV-2 on the well manifold and valves BV-6 or BV-7 and BV-8 on the Influent Tank manifold.
3. Open BV-4 on the well manifold about 25%.
4. Open MBV-1 (if applicable) by setting MBV-1 "OPEN-CLOSE-AUTO" switch to "OPEN."

NOTE: When the MBVs are set to the "AUTOMATIC" mode, a series of interlocks are put in place that will provide protection of equipment and help keep the Influent Tank from overflowing.

5. Verify the Extraction Well Pump disconnect is "ON." Start the Extraction Well Pump by holding in the "START" pushbutton until flow is established. Watch for flow on flow indicating transmitter (FIT)-1 and makeup of FS-1, then release the pushbutton.
6. Switch MBV-1 selector switch (if applicable) to "AUTO," which brings in the Interlocks for shutting off the pump as shown in the Interlock Checklist in Section 4.0.
7. Verify that the following light on the annunciator panel is not illuminated:
 - FS-1 No Flow From Extraction Well

NOTE: Influent Storage Tank shall be filled up only to the "High" level switch LSH-1 for daily operations, and the test engineer or field superintendent will be contacted in order to fill the tank up to the "High-High" level switch LSHH-1. **Do not fill the tank higher than "High-High" without authorization.**

NOTE: Table 2-2 is provided to document these steps.

2.3 ESTABLISH FLOW FROM INFLUENT STORAGE TANK TO THE PROCESS SYSTEM

NOTE: The Influent Storage Tank must have liquid in the tank above the interlocking and priming levels before starting the Influent Pump.

1. Verify that the following lights on the annunciator panel are not illuminated:
 - LSL-2 Influent Storage Tank Level "Low"
 - LSH-2 Effluent Storage Tank Level "High"
 - LSHH-2 Effluent Storage Tank Level "High-High"
2. Verify that 3-way valves BV-49, BV-67A, and BV-67F are in position for normal flow operation.
3. Verify that the following BVs are to be positioned before startup of the Influent Pump(s).

NOTE: This assumes that all valves were either closed or the alternate pump was previously used.

- If running Influent Pump P-2A and F-1 set of filters for extraction, open: BV-10, BV-30, BV-32, BV-33, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70.
- If Influent Pump P-2A and filter F-2 are to be used to establish process flow, open: BV-10, BV-30, BV-32, BV-33, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70.
- If Influent Pump P-2A and filters F-1 and F-2 are to be used to establish process flow, open: BV-10, BV-30, BV-32, BV-33, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70.
- If running Influent Pump P-2B and filter F-1 for process flow, open: BV-10, BV-30, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70.
- If running Influent Pump P-2B and filter F-2 for process flow, open: BV-10, BV-30, BV-34, BV-35, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70.

- If Influent Pump P-2B and filters F-1 and F-2 are to be used to establish process flow, open: BV-10, BV-30, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70.
4. When the Influent Storage Tank liquid level is physically above the influent pumps, open MBV-2 (if applicable) by setting MBV-2 "OPEN-CLOSE-AUTO" switch to "OPEN."
 5. Start either Influent Pump P-2A or P-2B by holding in the "START" pushbutton until flow is established. Verify flow on FIT-2 and makeup of FS-2, FS-3, and FS-4. Throttle flow with BV-33 or BV-35 in order to set flow at 25 gal/min for pumps P-2A or P-2B, respectively.
- NOTE:** Contact test engineer or field superintendent to adjust the process flow rate.
6. Switch MBV-2 to "AUTO" when flow is established and open MBV-5 (if applicable) in the "OPEN" mode to allow flow from the Influent Pumps through the Filters and ion exchange/GAC Columns to the Effluent Storage Tank.
 7. When flow starts to fill the Effluent Storage Tank, switch MBV-5 (if applicable) to "AUTO" which brings in the interlocks as described in the Interlock Checklist in Section 4.0.
 8. Verify that the following lights on the annunciator panel are not illuminated:
 - FS-2 No Flow From Influent Storage Tank
 - FS-3 No Flow From Influent Pump Skid
 - FS-4 No Flow From Process System

When flow has been established through the system and is at steady state, on the daily data log sheets, record flow, pressure, and pressure differential of filters and ion exchange/GAC Columns. Record the start time in the field logbook.

NOTES:

- Effluent Storage Tank will be filled up only to the "High" level switch LSH-2 for daily operations and the test engineer or field superintendent will be contacted in order to fill the tank up to the "High-High" level switch LSHH-2. **Do not fill the tank higher than "High-High" without authorization.**
- If pressure or differential pressure readings exceed 80 lb/in² and 60 lb/in², respectively, press the emergency "STOP" button to stop all pumps and contact the test engineer and field superintendent.
- Pressure differential alarm is set to alarm (illuminate annunciator light) at 30 lb/in² differential. This is an alarm only and is not an interlock.

NOTE: Table 2-3 is provided to document these steps.

2.4 START EFFLUENT PUMP

When the Effluent Storage Tank has sufficient volume of treated effluent, an Effluent Pump is started to discharge the treated effluent into the effluent holding tank, a tanker truck for transport to the disposal well site, or by flexible hose to the disposal well.

1. Verify that the following alarm lights on the annunciator panel are not illuminated:
 - LSH-2 Disposal Well Level "High"
 - LHL-3 Effluent Storage Tank Level "Low"
2. Position the following BVs before startup of the Effluent Pump(s).
 - If Effluent Pump P-5A and F-3 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-92, BV-93, BV-98, BV-99, BV-100, BV-101, and BV-108.
 - If Effluent Pump P-5A and F-4 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-92, BV-93, BV-100, BV-101, BV-102, BV-103, and BV-108.
 - If Effluent Pump P-5A and F-3 and F-4 sets of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-92, BV-93, BV-98, BV-99, BV-100, BV-101, BV-102, BV-103, and BV-108.
 - If Effluent Pump P-5B and F-3 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-94, BV-95, BV-98, BV-99, BV-100, BV-101, and BV-108.
 - If Effluent Pump P-5B and F-4 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-94, BV-95, BV-100, BV-101, BV-102, BV-103, and BV-108.
 - If Effluent Pump P-5B and F-3 and F-4 sets of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-94, BV-95, BV-98, BV-99, BV-100, BV-101, BV-102, BV-103, and BV-108.
3. Open the following BVs if the treated effluent is to be transported via flexible hose to the disposal well: BV-115, BV-117, BV-118, BV-120, BV-121, BV-122, BV-123, and BV-124.
4. Ball valve BV-119 should be opened until flow has been initiated.

5. Open MBV-6 (if applicable) by setting MBV-6 "OPEN-CLOSE-AUTO" switch to "OPEN."
6. Start either Pump P-5A or P-5B by holding in the "START" pushbutton until flow is established. Watch for flow on FIT-3 and makeup of FS-5. Throttle with BV-93 or BV-95 if pump P-5A or P-5B is used, respectively.
7. After flow is established, switch MBV-6 (if applicable) to the "AUTO" position, which brings in the Interlocks for shutting off the pump as described in the Interlock Checklist in Section 4.0.
8. Verify that the following alarm lights on the annunciator panel are not illuminated:
 - FS-5 No Flow From Effluent Storage Tank
9. Compare flow on FIT-3 with FI-2. Push the "STOP" pushbutton to stop effluent pump after flow has been established.
10. When flow has been established through the system and is at steady state, on the daily data log sheets, record flow, pressure, and pressure differential of filters. Record the start time on the field logbook.

NOTES:

- Pressure differential alarm is set to alarm (illuminate annunciator light) at 30 lb/in² differential. This is an alarm only and is not an interlock.
- If pressure or differential pressure readings exceed 80 lb/in² or 60 lb/in², respectively, press the emergency "STOP" button to stop all pumps and contact the test engineer.

NOTE: Table 2-4 is provided to document these steps.

2.4.1 Metering Pump, Acid

This pump/system is currently not in place, but may be added at a later date; therefore, it will not be described until it is determined to be necessary. After completion of laboratory tests and after sufficient operational data has been gathered, a determination on the need will be made.

2.4.2 Metering Pump, Caustic

See Section 2.4.1.

2.4.3 Metering Pump, Oxygen Scavenger Chemical

See Section 2.4.1.

2.5 TREATED WATER TO DISPOSAL WELL

If water is to be discharged from the tanker truck directly into the disposal well, bypassing the disposal well tank (TNK-11), the disposal well tank will be bypassed because of freezing or other conditions and the lack of generator to provide power for interim winterization.

1. Haul purgewater tanker truck to disposal well 699-49-55A. Connect tanker drain valve to quick disconnect at BV-115 with 2-in. flexible hose.
2. Open BV-115, BV-117, and BV-118. Verify that BV-119 is closed and SC-9 is capped.
3. Throttle the flow into the well using BV-120. Open truck drain valve. Begin by opening the valve 50% and adjust flowrate indicated by FI-2 (rotameter) to no more than 25 gal/min. Flow rate may be increased with written direction from the test engineer and Record flow rate on daily log sheets.
4. Operator will monitor well water level by noting groundwater table elevations at start of injection and at regular intervals using the data logger. Record disposal well level and level changes on daily log sheets.
5. When tanker truck is drained, close the tanker truck valve and carefully disconnect hose from truck over a container to avoid spilling water, and cap truck. Gravity drain hose by elevating it and walking it toward wellhead to ensure hose is drained, and cap hose. Close BV-115, BV-117, BV-118, and BV-120.

NOTE: Table 2-5 is provided to document these steps.

2.6 PROCESS WATER TANK

The Process Water Tank is a 10,000 gal tank containing clean "process water" that may be used for backwashing the columns and for makeup water. In addition, treated water may also be used for backwashing depending on status and arrangement of equipment and availability of treated water. The Process Water Tank will be filled from a water truck with potable water on an as needed basis, and water use will be manually controlled via a BV and flowmeter. Hoses will be used to connect to appropriate equipment as required.

2.7 BACKWASH OF ION EXCHANGE COLUMNS

When new ion exchange resin or GAC is loaded into the process columns and before it is placed into service, it must be backwashed to remove fines and color bodies. When a backwash is to be done, the Treatment System will be shut down. Two pumps are available for use for backwashing: Pumps P-2B and P-3. Pump P-2B (located on the Influent Pump skid) may be closer to the Process Water Tank; if that is the case, P-2B may be used to pull water from the Process Water Tank. Pump P-3 (located on the Process System skid) has a rotameter and BV for controlling the backwash flow that is not as readily available for Pump P-2B. Alternatively, if sufficient treated or clean water

exists in the Effluent Storage Tank, it may also be used for backwashing. Backwashing is performed manually; to set up for backwash perform the following.

NOTES:

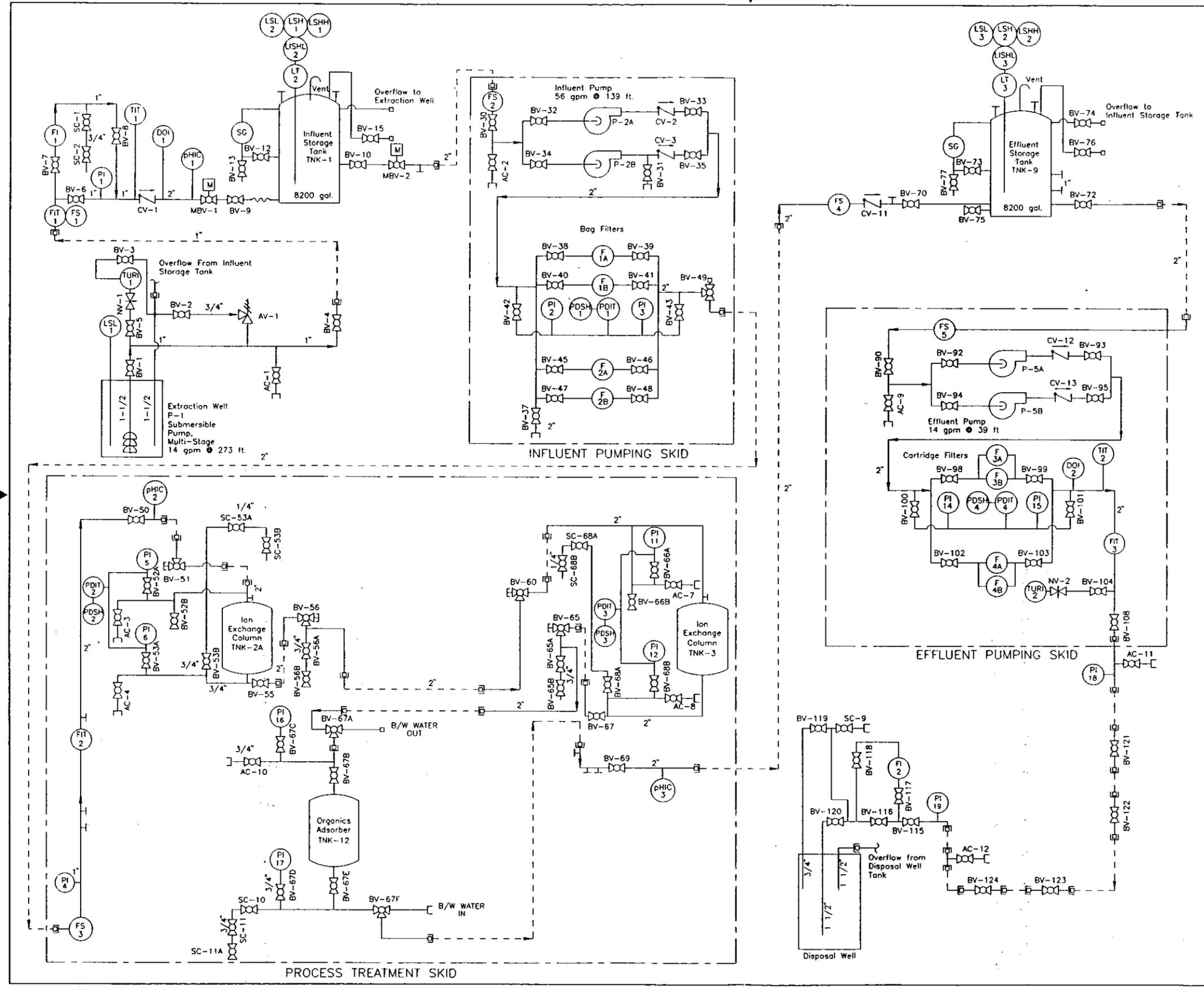
- The backwash will require nominally 1,000 to 3,000 gal/column depending on size amount of media. Sufficient backwash water must be available.
 - The GAC column should be filled 50% with GAC. The column should then be filled with water from the bottom of the tank and allowed to soak overnight before backwashing operations begin.
1. Connect a hose from the Process Water Tank to the suction side of Pump P-2B at air connector (AC)-2 (the female quick disconnect used for air blowdown), and open BV-34.
 2. Connect a hose from the discharge of Pump P-2B at BV-31 to a quick disconnect at the bottom of the column to be backwashed.
 3. The backwash solution will be sent through the Influent Filters to remove the solids and then back to the Influent Storage Tank. Connect a hose from a quick disconnect at the top of the ion exchange column being backwashed to BV-37 at the top of the Influent Filters and a hose from BV-49 to the inlet to the Influent Storage Tank at BV-15.
 4. A portable rotameter will need to be temporarily installed in the hose from the column being backwashed to the Influent Filters. This is needed for controlling flow and for indicating disappearance of color and whether any resin or carbon escapes the column.
 5. An alternative to that described in Section 2.7, steps 3 and 4 is to use the inlet manifold on the Influent Storage Tank. Disconnect the hose coming from the well to the Influent Tank inlet manifold, then connect the hose from BV-49 to that inlet manifold. This will provide flow control and a rotameter for monitoring backwashing as described above.
 6. If treated water is to be used as the water supply for the backwash, close BV-72 at the Effluent Storage Tank outlet manifold and disconnect the hose to the Effluent Pump skid. Then connect a hose from BV-72 the process pump P-3 to the bottom of the column being backwashed. Then follow Section 2.7, steps 3 and 4, or 5 for conducting the backwash.
 7. Backwash new media in each column until the colored backwash solution turns clear (carbon fines, fractured resin beads, or color bodies contribute to the color). As stated above this may require approximately 1,000 to 3,000 gal/column, and may take approximately 1 to 2 hours. Backwashing should take place at approximately 20 gal/min for both the ion exchange resin and the GAC.

8. When backwash is complete, secure hoses and valves and make correct hose connections to allow establishing normal processing water flow as described in Section 1.3.

NOTE: Table 2-6 is provided to document these steps.

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Figure 1-1. Process Flow Diagram, BY-Cribs Pilot-Scale Groundwater Treatment System, 200-BP-5, Plume No. 2.



LEGEND

MECHANICAL

- BALL VALVE
- CHECK VALVE
- AIR VACUUM VALVE
- MOTOR OPERATOR
- SUBMERSIBLE PUMP
- FLEXIBLE CONNECTOR
- SIGHT GLASS
- FILTER
- PIPING
- FLEXIBLE HOSE
- FLEXIBLE HOSE CONNECTION
- FITTING
- SAMPLING CONNECTION
- AIR CONNECTION
- PUMP

INSTRUMENTATION

- FI FLOW INDICATOR
- FS FLOW SWITCH
- FIT FLOW INDICATING TRANSMITTER
- PI PRESSURE INDICATOR
- PIT PRESSURE INDICATING TRANSMITTER
- PDI PRESSURE DIFFERENTIAL TRANSMITTER
- PDSH PRESSURE DIFFERENTIAL SWITCH HIGH
- DOI DISSOLVED OXYGEN INDICATOR
- TIT TEMPERATURE INDICATING TRANSMITTER
- pHIC pH INDICATOR CONTROLLER
- LT LEVEL TRANSMITTER
- LSL LEVEL SWITCH LOW
- LSH LEVEL SWITCH HIGH
- LSHH LEVEL SWITCH HIGH HIGH
- LISHL LEVEL INDICATING SWITCH HIGH LOW
- TURI TURBIDITY INDICATOR

| | | | | | |
|-----|---------|-------------|-----|-----|------|
| REV | DATE | DESCRIPTION | BY | CHK | DATE |
| 1 | 1/31/95 | AS-BUILT | CAB | ALM | |

SCALE: NOT TO SCALE

U.S. DEPARTMENT OF ENERGY
DOE FIELD OFFICE, RICHLAND
HANFORD ENVIRONMENTAL RESTORATION PROGRAM

BECHTEL HANFORD INC. (RICHLAND, WASHINGTON) | **IT HANFORD INC.** (RICHLAND, WASHINGTON)

200-BP-5, BY-CRIBS, PLUME 2
PILOT GROUNDWATER TREATMENT SYSTEM
PROCESS FLOW DIAGRAM

| | | |
|-----------------|-------------------|---------------|
| BECHTEL JOB NO. | DOE CONTRACT NO. | CADD FILENAME |
| 22192 | DE-AC06-93RL12367 | 2EDJ0006.DWG |

DRAWING NO. **0200E-DD-J0006**

BHI-DIS-001-13108

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Table 2-1. Electrical Power Checklist.

| | | |
|-------------------|---|----------------------|
| Date: | | |
| Operators: | | |
| | Electrical Power Checklist | Verified/Date |
| 1. | Verify that the disconnect switches on the generator, the DP-2 disconnect, the Main-MCC disconnect, the MCP disconnect, and the MCP transformer disconnect are off and that the electrical connectors are properly connected. Disconnect on the generator, and the DP-2 disconnect may be left on 24 hours/day during cold weather. | |
| 2. | If the generator is not running and before start of operations, verify that the 480V ac power control switches to equipment (pumps, etc.) are in the "OFF" position. Verify that the breakers in panel DP-2 are in the proper position before energizing any switches. If the generator is running, verify that control switches are in the appropriate positions (i.e., extraction well disconnect is on during extraction). Before starting operation, start the generator. | |
| 3. | Energize power to the control panel by actuating the main disconnect switches (on the generator, disconnects DP-2 and the Main-MCC, the MCP, and the MCP transformer) and the control power switch(es) to equipment to be started. Disconnects on the generator and DP-2 may be left on 24 hours/day during cold weather. | |
| 4. | Energize power to 110V ac system for level controls and PLC. | |
| 5. | Reset MBV control switches at the influent skid. | |

Table 2-2. Extraction Well Checklist.

| Date: | | | |
|----------------------------------|--|--|----------------------|
| Operators: | | | |
| Extraction Well Checklist | | | Verified/Date |
| 1. | <p>Verify the following lights on the annunciator panel are not illuminated:</p> <ul style="list-style-type: none"> • LSH-1 Influent Storage Tank Level "High" • LSL-1 Extraction Well Level "Low" • LSHH-1 Influent Storage Tank Level "High-High" | | |
| 2. | <p>Verify that all BVs are closed except the following: BV-1 and BV-2 on the well manifold, and valves BV-7, BV-8, and BV-9 (if the rotameter is to be used) or BV-6 and BV-9 (if rotameter will not be used) on the Influent Tank manifold.</p> | | |
| 3. | <p>Open BV-4 on the well manifold about 25%.</p> | | |
| 4. | <p>Open MBV-1 (if applicable) by setting MBV-1 "OPEN-CLOSE-AUTO" switch to "OPEN."</p> | | |
| 5. | <p>Verify the Extraction Well Pump disconnect is "ON." Start the Extraction Well Pump by holding in the "START" pushbutton until flow is established. Watch for flow on FIT-1 and makeup of FS-1, then release the pushbutton.</p> | | |
| 6. | <p>Switch MBV-1 selector switch (if applicable) to "AUTO."</p> | | |
| 7. | <p>Verify the following light on the annunciator panel is not illuminated:</p> <ul style="list-style-type: none"> • FS-1 No Flow From Extraction Well <p>NOTE: Influent Storage Tank shall be filled up only to the "High" level switch LSH-1 for daily operations, and the test engineer or field superintendent will be contacted in order to fill the tank up to the "High-High" level switch LSHH-1. Do not fill the tank higher than "High-High" without authorization.</p> | | |

Table 2-3. Process Flow Checklist. (2 sheets)

| Date: | | |
|-------------------------------|--|----------------------|
| Operators: | | |
| Process Flow Checklist | | Verified/Date |
| 1. | <p>Verify that the following lights on the annunciator panel are not illuminated:</p> <ul style="list-style-type: none"> • LSL-2 Influent Storage Tank Level "Low" • LSH-2 Effluent Storage Tank Level "High" • LSHH-2 Effluent Storage Tank Level "High-High" | |
| 2. | <p>Verify that 3-way valves BV-49, BV-67A, and BV-67F are in position for normal processing flow operation.</p> | |
| 3. | <p>Verify that the following BVs are to be positioned before startup of the Influent Pump(s).</p> <p>NOTE: This assumes that all valves were either closed or the alternate pump was previously used.</p> <ul style="list-style-type: none"> • If running Influent Pump P-2A and F-1 set of filters for extraction, open: BV-10, BV-30, BV-32, BV-33, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70. • If Influent Pump P-2A and filter F-2 are to be used to establish process flow, open: BV-10, BV-30, BV-32, BV-33, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70. • If Influent Pump P-2A and filters F-1 and F-2 are to be used to establish process flow, open: BV-10, BV-30, BV-32, BV-33, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70. • If running Influent Pump P-2B and filter F-1 for process flow, open: BV-10, BV-30, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70. | |

Table 2-3. Process Flow Checklist. (2 sheets)

| Process Flow Checklist | Verified/Date |
|---|---------------|
| <ul style="list-style-type: none"> • If running Influent Pump P-2B and filter F-2 for process flow, open: BV-10, BV-30, BV-34, BV-35, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70. • If Influent Pump P-2B and filters F-1 and F-2 are to be used to establish process flow, open: BV-10, BV-30, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-42, BV-43, BV-45, BV-46, BV-47, BV-48, BV-50, BV-51, BV-52A, BV-53A, BV-55, BV-56, BV-60, BV-66A, BV-68B, BV-67, BV-65, BV-67C, BV-67B, BV-67E, BV-67D, BV-69, and BV-70. | |
| <p>4. When the Influent Storage Tank liquid level is physically above the influent pumps, open MBV-2 (if applicable) by setting MBV-2 "OPEN-CLOSE-AUTO" switch to "OPEN."</p> | |
| <p>5. Start either Influent Pump P-2A or P-2B by holding in the "START" pushbutton until flow is established. Verify flow on FIT-2 and makeup of FS-2, FS-3, and FS-4. Throttle flow with BV-33 or BV-35 in order to set flow at 25 gal/min for pumps P-2A or P-2B, respectively.</p> <p>NOTE: Contact test engineer or field superintendent to adjust the process flow rate.</p> | |
| <p>6. Switch MBV-2 to "AUTO" when flow is established and open MBV-5 (if applicable) in the "OPEN" mode to allow flow from the Influent Pumps through the Filters and ion exchange/GAC Columns to the Effluent Storage Tank.</p> | |
| <p>7. When flow starts to fill the Effluent Storage Tank, switch MBV-5 (if applicable) to "AUTO."</p> | |
| <p>8. Verify that the following lights on the annunciator panel are not illuminated:</p> <ul style="list-style-type: none"> • FS-2 No Flow From Influent Storage Tank • FS-3 No Flow From Influent Pump Skid • FS-4 No Flow From Process System | |
| <p>9. When flow has reached steady state, record readings on the data log sheets of flow, pressure, and pressure differential of filters and ion exchange/GAC Columns.</p> <p>NOTE: Effluent Storage Tank will be filled up only to the "High" level switch LSH-2 for daily operations and the test engineer or field superintendent will be contacted in order to fill the tank up to the "High-High" level switch LSHH-2. Do not fill the tank higher than "High-High" without authorization.</p> | |

Table 2-4. Effluent Pump Checklist. (2 sheets)

| Date: | | | |
|-------------------------|---|--|---------------|
| Operators: | | | |
| Effluent Pump Checklist | | | Verified/Date |
| 1. | Verify that the following alarm lights on the annunciator panel are not illuminated: | | |
| | <ul style="list-style-type: none"> • LSH-2 Disposal Well Level "High" • LHL-3 Effluent Storage Tank Level "Low" | | |
| 2. | Position the following BVs before startup of the Effluent Pump(s). | | |
| | <ul style="list-style-type: none"> • If Effluent Pump P-5A and F-3 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-92, BV-93, BV-98, BV-99, BV-100, BV-101, and BV-108. | | |
| | <ul style="list-style-type: none"> • If Effluent Pump P-5A and F-4 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-92, BV-93, BV-100, BV-101, BV-102, BV-103, and BV-108. | | |
| | <ul style="list-style-type: none"> • If Effluent Pump P-5A and F-3 and F-4 sets of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-92, BV-93, BV-98, BV-99, BV-100, BV-101, BV-102, BV-103, and BV-108. | | |
| | <ul style="list-style-type: none"> • If Effluent Pump P-5B and F-3 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-94, BV-95, BV-98, BV-99, BV-100, BV-101, and BV-108. | | |
| | <ul style="list-style-type: none"> • If Effluent Pump P-5B and F-4 set of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-94, BV-95, BV-100, BV-101, BV-102, BV-103, and BV-108. | | |
| | <ul style="list-style-type: none"> • If Effluent Pump P-5B and F-3 and F-4 sets of filters are to be used for pumping effluent to the effluent holding tank, tanker truck, and to the disposal well, open: BV-72, BV-90, BV-94, BV-95, BV-98, BV-99, BV-100, BV-101, BV-102, BV-103, and BV-108. | | |
| 3. | Open the following BVs if the treated effluent is to be transported via flexible hose to the disposal well: BV-115, BV-117, BV-118, BV-120, BV-121, BV-122, BV-123, and BV-124. | | |
| 4. | Ball valve BV-119 should be opened until flow has been initiated. | | |

Table 2-4. Effluent Pump Checklist. (2 sheets)

| Effluent Pump Checklist | Verified/Date |
|--|---------------|
| 5. Open MBV-6 (if applicable) by setting MBV-6 "OPEN-CLOSE-AUTO" switch to "OPEN." | |
| 6. Start either Pump P-5A or P-5B by holding in the "START" pushbutton until flow is established. Watch for flow on FIT-3 and makeup of FS-5. Throttle with BV-93 or BV-95 if pump P-5A or P-5B is used, respectively. | |
| 7. After flow is established, switch MBV-6 (if applicable) to the "AUTO" position. | |
| 8. Verify that the following alarm lights on the annunciator panel are not illuminated: <ul style="list-style-type: none"> • FS-5 No Flow From Effluent Storage Tank | |
| 9. Compare flow on FIT-3 with FI-2. Push the "STOP" pushbutton to stop effluent pump after flow has been established. | |
| 10. When flow has reached steady state, record readings on the data log sheets of flow, pressure, and pressure differential of filters. | |

Table 2-5. Disposal Well Checklist.

| | | |
|-------------------|---|----------------------|
| Date: | | |
| Operators: | | |
| | Disposal Well Checklist | Verified/Date |
| 1. | Haul purgewater tanker truck to disposal well 699-49-55A. Connect tanker drain valve to quick disconnect at BV-115 with 2-in. flexible hose. | |
| 2. | Open BV-115, BV-117, and BV-118. Verify that BV-119 is closed and SC-9 is capped. | |
| 3. | Throttle the flow into the well by using BV-120. Open truck drain valve. Begin by opening the valve 50% and adjust flowrate indicated by FI-2 (rotameter) to no more than 25 gal/min. Record flow rate on daily log sheets. | |
| 4. | Operator will monitor well water level by noting groundwater table elevations at start of injection and at regular intervals using the data logger. Record disposal well level and level changes on daily log sheets. | |
| 5. | When tanker truck is drained, close the tanker truck valve and carefully disconnect hose from truck over a container to avoid spilling water, and cap truck. Gravity drain hose by elevating it and walking it toward wellhead to ensure hose is drained, and cap hose. Close BV-115, BV-117, BV-118, and BV-120. | |

Table 2-6. Backwash of Ion Exchange Columns Checklist.

| | | |
|---|---|----------------------|
| Date: | | |
| Operators: | | |
| Backwash of Ion Exchange Columns Checklist | | Verified/Date |
| 1. | <p>Verify that sufficient backwash water is available for backwashing.</p> <p>NOTE: The backwash will require nominally 1,000 to 3,000 gal/column depending on size amount of media. Sufficient backwash water must be available.</p> | |
| 2. | <p>Connect a hose from the Process Water Tank to the suction side of Pump P-2B at AC-2 (the female quick disconnect used for air blowdown), and open BV-34.</p> | |
| 3. | <p>Connect a hose from the discharge of Pump P-2B at BV-31 to a quick disconnect at the bottom of the column to be backwashed.</p> | |
| 4. | <p>Connect a hose from a quick disconnect at the top of the ion exchange column being backwashed to BV-37 at the top of the Influent Filters and a hose from BV-49 to the inlet to the Influent Storage Tank at BV-15.</p> | |
| 5. | <p>Connect a portable rotameter temporarily, in the hose from the column being backwashed to the Influent Filters. This is needed for controlling flow and for indicating disappearance of color and whether any resin or carbon escapes the column.</p> | |
| 6. | <p>An alternative to that described in step 4 to eliminate the need for temporary rotameter is to use the inlet manifold on the Influent Storage Tank. Disconnect the hose coming from the well to the Influent Tank inlet manifold, then connect the hose from BV-49 to that inlet manifold. This will provide flow control and a rotameter for monitoring backwashing as described above.</p> | |
| 7. | <p>If treated water is to be used as the water supply for the backwash, close BV-72 at the Effluent Storage Tank outlet manifold and disconnect the hose to the Effluent Pump skid. Then connect a hose from BV-72 the process pump P-3 to the bottom of the column being backwashed. Then follow steps 3 and 4, or 5 for conducting the backwash.</p> | |
| 8. | <p>Backwash new media in each column until the colored backwash solution turns clear (carbon fines, fractured resin beads, or color bodies contribute to the color). As stated above this may require approximately 1,000-3,000 gal/column, and may take approximately 1 to 2 hours.</p> <p>NOTE: Sufficient backwash water must be available.</p> | |
| 9. | <p>When backwash is complete, secure hoses and valves and make correct hose connections to allow establishing normal processing water flow as described in Section 1.3.</p> | |

3.0 LEVEL AND FLOWSWITCH INTERLOCK

This Section describes testing of level and flowswitch interlocks. The interlocks shall be tested at least every 120 days. The interlock test sheets will be kept in the Interlock Checklist Logbook and recorded in the field logbook upon completion of the interlock tests together with any discrepancies or items that need to be corrected.

Each interlock will be tested by shorting out the appropriate relays (or if sufficient treated or potable water is available for filling and emptying each tank to conduct this test, use the water) and verifying that each will stop the appropriate pump or close the appropriate valve.

NOTE: There is a difference between the tank "High" and "High-High" level alarm logic. On "High" level alarm the appropriate filling pump is shut off and annunciated, but the pump may be restarted. On "High-High" alarm the appropriate pump is shut off and annunciated, but the pump **cannot be restarted.**

| | | | | |
|----|---|-------------|--------|---------------|
| 1. | Start extraction well pump; restart after each test. | | Accept | Not Accept |
| | • LSL-1 "Low" Level, Extraction Well | Stop P-1 | _____ | _____ |
| | • LSH-1 "High" Level, Influent Tank ¹ | Stop P-1 | _____ | _____ |
| | • LSHH-1 "High-High" Level, Influent Tank ¹ | Stop P-1 | _____ | _____ |
| | • FS-1 "Low" Flow, Extraction Pump | Stop P-1 | _____ | _____ |
| 2. | Start Influent Pumps P-2A or P-2B, restart after each test. | | Accept | Not Accept |
| | • LSL-2 "Low" Level, Influent Tank | Stop P-2A/B | _____ | _____ |
| | • LSH-2 "High" Level, Effluent Tank ¹ | Stop P-2A/B | _____ | _____ |
| | • LSHH-2 "High-High" Level, Effluent Tank ¹ | Stop P-2A/B | _____ | _____ |
| | • FS-2 "Low"/No Flow, Influent Pumps | Stop P-2A/B | _____ | _____ |
| | • FS-3 No Flow, Hose to Process System Skid | Stop P-2A/B | _____ | _____ |
| | • FS-4 No Flow, Hose to Effluent Tank | Stop P-2A/B | _____ | _____ |
| 3. | Start Effluent Pumps P-2A or P-2B, restart after each test. | | Accept | Not Accept |
| | • LSH-3 "High" Level, Disposal Well | Stop P-5A/B | _____ | _____ |
| | • FS-5 No Flow, Hose to Effluent Skid | Stop P-5A/B | _____ | _____ |
| | • FS-6 No Flow, Hose to Well | Stop P-5A/B | _____ | _____ |
| | • LSL-3 "Low" Level, Effluent Tank | Stop P-5A/B | _____ | _____ |

NOTE: Table 3-1 is provided to document these steps.

¹See **NOTE** above.

Table 3-1. Level and Flowswitch Interlock Checklists.

| | |
|-------------------|--|
| Date: | |
| Operators: | |

| Extraction Well Pump Interlock Checklist | | Result | Verified/Date |
|---|----------------------------------|---------------|----------------------|
| LSL-1 | "Low" Level, Extraction Well | Stop P-1 | |
| LSH-1 | "High" Level, Influent Tank | Stop P-1 | |
| LSHH-1 | "High-High" Level, Influent Tank | Stop P-1 | |
| FS-1 | "Low" Flow, Extraction Pump | Stop P-1 | |

| Influent Pump Interlock Checklist | | Result | Verified/Date |
|--|--------------------------------------|---------------|----------------------|
| LSL-2 | "Low" Level, Influent Tank | Stop P-2A/B | |
| LSH-2 | "High" Level, Effluent Tank | Stop P-2A/B | |
| LSHH-2 | "High-High" Level, Effluent Tank | Stop P-2A/B | |
| FS-2 | "Low"/No Flow, Influent Pumps | Stop P-2A/B | |
| FS-3 | No Flow, Hose to Process System Skid | Stop P-2A/B | |
| FS-4 | No Flow, Hose to Effluent Tank | Stop P-2A/B | |

| Effluent Pump Interlock Checklist | | Result | Verified/Date |
|--|--------------------------------|---------------|----------------------|
| LSH-3 | "High" Level, Disposal Well | Stop P-5A/B | |
| FS-5 | No Flow, Hose to Effluent Skid | Stop P-5A/B | |
| FS-6 | No Flow, Hose to Well | Stop P-5A/B | |
| LSL-3 | "Low" Level, Effluent Tank | Stop P-5A/B | |

4.0 FAILSAFE MOTOR-OPERATED BALL VALVE INTERLOCK

NOTE: MBV-5 and MBV-6 are not yet available; therefore, part of the procedure is not applicable until installation of the MBVs.

The Failsafe MBVs are located on the inlet and outlet of both the Influent and Effluent Storage Tanks. They are interlocked to close on a series of conditions and will close on loss of power. The failsafe feature of MBV-1, MBV-2, MBV-5, and MBV-6 is to prevent spilling of tank contents to the ground or back into a well or process equipment in the event of a power failure.

4.1 MBV-1, MANUAL MODE

1. Set MBV-1 "OPEN-CLOSE-AUTO" switch to "OPEN."
2. Verify that valve is open, then close panelboard circuit breaker for MBV-1.
3. Verify closure of valve on loss of power.

4.2 MBV-1, AUTOMATIC MODE

1. Set MBV-1 "OPEN-CLOSE-AUTO" switch to "AUTO."
2. Open the manual BVs as noted in Section 4.2, step 1, then start Pump P-1 (Well Pump) and watch for MBV-1 to open.
3. Open panelboard circuit breaker for MBV-1 and verify closure of valve on loss of power.
4. Close panelboard circuit breaker to open the valve, then shut off Well Pump P-1 and verify that the valve closes when P-1 shuts down.

4.3 MBV-2, MANUAL MODE

1. Set MBV-2 "OPEN-CLOSE-AUTO" switch to "OPEN."
2. Verify that the valve is open, then close the panelboard circuit breaker for MBV-2.
3. Verify closure of valve on loss of power.

4.4 MBV-2, AUTOMATIC MODE

1. Set MBV-2 "OPEN-CLOSE-AUTO" switch to "AUTO."
2. Open the manual BVs as noted in Section 2.3, step 1, for the respective Pump P-2A or P-2B to ensure flow can be established, then start Influent Pump P-2A or P-2B and watch for valve to open.

NOTE: These pumps are wired so that both cannot be started at the same time.

3. Open panelboard circuit breaker for MBV-2 and verify closure of valve on loss of power.
4. Close panelboard circuit breaker to open the valve, then shut off whichever pump is running, P-2A or P-2B, and verify that the valve closes when the pump shuts down.

4.5 MBV-5, MANUAL MODE (IF APPLICABLE)

1. Set MBV-5 "OPEN-CLOSE-AUTO" switch to "OPEN."
2. Verify that the valve is open, then close the panelboard circuit breaker for MBV-5.
3. Verify closure of valve on loss of power.

4.6 MBV-5, AUTOMATIC MODE (IF APPLICABLE)

1. Set MBV-5 "OPEN-CLOSE-AUTO" switch to "AUTO."
2. Open the manual BVs as noted in Section 2.3, step 1, then start Influent Pump P-2A or P-2B and watch for valve to open.

NOTE: These pumps are wired so that both cannot be started at the same time.

3. Open panelboard circuit breaker for MBV-5 and verify closure of valve on loss of power.
4. Close panelboard circuit breaker to open the valve, then shut off whichever pump is running, P-2A or P-2B, and verify that the valve closes when the pump shuts down.

4.7 MBV-6, MANUAL MODE (IF APPLICABLE)

1. Set MBV-6 "OPEN-CLOSE-AUTO" switch to "OPEN."
2. Verify that the valve is open, then close the panelboard circuit breaker for MBV-6.
3. Verify closure of valve on loss of power.

4.8 MBV-6, AUTOMATIC MODE (IF APPLICABLE)

1. Set MBV-6 "OPEN-CLOSE-AUTO" switch to "AUTO."
2. Open the manual BVs as noted in Section 2.4, step 1, for the respective Pump P-5A or P-5B to ensure flow can be established; start Effluent Pump P-5A or P-5B and watch for the valve to open.

NOTE: These pumps are wired so that both cannot be operated at the same time.

3. Open panelboard circuit breaker for MBV-6 and verify closure of valve on loss of power.
4. Close panelboard circuit breaker to open the valve, then shut off whichever pump is running, P-5A or P-5B, and verify that the valve closes when the pump shuts down.

NOTE: Table 4-1 is provided to document these steps.

Table 4-1. Failsafe Motor-Operated Ball Valve Interlock Checklists. (2 sheets)

| | |
|-------------------|--|
| Date: | |
| Operators: | |

| MBV-1, Automatic Mode Checklist | | Verified/Date |
|--|---|----------------------|
| 1. | Set MBV-1 "OPEN-CLOSE-AUTO" switch to "AUTO." | |
| 2. | Start Pump P-1 (Well Pump) and watch for MBV-1 to open. | |
| 3. | Open panelboard circuit breaker for MBV-1 and verify closure of valve on loss of power. | |
| 4. | Close panelboard circuit breaker to open the valve, then shut off Well Pump P-1 and verify that the valve closes when P-1 shuts down. | |

| MBV-2, Automatic Mode Checklist | | Verified/Date |
|--|---|----------------------|
| 1. | Set MBV-2 "OPEN-CLOSE-AUTO" switch to "AUTO." | |
| 2. | Start Influent Pump P-2A or P-2B and watch for valve to open. NOTE: These pumps are wired so that both cannot be started at the same time. | |
| 3. | Open panelboard circuit breaker for MBV-2 and verify closure of valve on loss of power. | |
| 4. | Close panelboard circuit breaker to open the valve, then shut off whichever pump is running, P-2A or P-2B, and verify that the valve closes when the pump shuts down. | |

Table 4-1. Failsafe Motor-Operated Ball Valve Interlock Checklists. (2 sheets)

| MBV-5, Automatic Mode Checklist | | Verified/Date |
|--|---|----------------------|
| 1. | Set MBV-5 "OPEN-CLOSE-AUTO" switch to "AUTO." | |
| 2. | Start Influent Pump P-2A or P-2B and watch for valve to open. NOTE: These pumps are wired so that both cannot be started at the same time. | |
| 3. | Open panelboard circuit breaker for MBV-5 and verify closure of valve on loss of power. | |
| 4. | Close panelboard circuit breaker to open the valve, then shut off whichever pump is running, P-2A or P-2B, and verify that the valve closes when the pump shuts down. | |

| MBV-6, Automatic Mode Checklist | | Verified/Date |
|--|---|----------------------|
| 1. | Set MBV-6 "OPEN-CLOSE-AUTO" switch to "AUTO." | |
| 2. | start Effluent Pump P-5A or P-5B and watch for the valve to open. NOTE: These pumps are wired so that both cannot be operated at the same time. | |
| 3. | Open panelboard circuit breaker for MBV-6 and verify closure of valve on loss of power. | |
| 4. | Close panelboard circuit breaker to open the valve, then shut off whichever pump is running, P-5A or P-5B, and verify that the valve closes when the pump shuts down. | |

5.0 EMERGENCY SHUTDOWN SWITCHES

The emergency shutdown switches will shut down the Treatment System in case of an emergency. Equipment that will be shut down with this emergency switch include the Extraction Well Pump, Influent Pumps, Effluent Pumps, and Failsafe MBV-1 and MBV-2 (MBV-5 and MBV-6, when installed). The emergency shutdown system will be tested quarterly.

NOTE: The emergency shutdown switches are not to be used for routine starting/stopping of pumps/equipment; use the normal "START/STOP" pushbuttons for this.

1. Verify system is operating: Well Pump (P-1), Influent Pump (P-2A or 2B), and Effluent Pump (P-5A or 5B), and chemical metering pumps and mixers (if applicable) are running, and that Failsafe MBVs are open.
2. Actuate Emergency Shutdown Switch(es) and verify shutdown of pumps and closure of valves.

| | | |
|--------------------|-------|-------|
| P-1 | _____ | _____ |
| P-2A/B | _____ | _____ |
| P-5A/B | _____ | _____ |
| MBV-1 | _____ | _____ |
| MBV-2 | _____ | _____ |
| MBV-5 ¹ | _____ | _____ |
| MBV-6 ¹ | _____ | _____ |

NOTE: Table 5-1 is provided to document these steps.

¹After installation.

Table 5-1. Emergency Shutdown Switch Checklist.

| | |
|---|--|
| Date: | |
| Operators: | |
| Actuate Emergency Shutdown Switch(es) and verify shutdown of pumps and closure of valves. | |

| Influent Emergency Shutdown Switch Checklist | Verified/Date |
|--|---------------|
| P-1 | |
| P-2A/B | |
| P-5A/B | |
| MBV-1 | |
| MBV-2 | |
| MBV-5 | |
| MBV-6 | |

| Effluent Emergency Shutdown Switch Checklist | Verified/Date |
|--|---------------|
| P-1 | |
| P-2A/B | |
| P-5A/B | |
| MBV-1 | |
| MBV-2 | |
| MBV-5 | |
| MBV-6 | |

| Main Panel Emergency Shutdown Switch Checklist | Verified/Date |
|--|---------------|
| P-1 | |
| P-2A/B | |
| P-5A/B | |
| MBV-1 | |
| MBV-2 | |
| MBV-5 | |
| MBV-6 | |

6.0 TROUBLE SHOOTING

6.1 INOPERABLE PUMP

1. Extraction Well Pump will not operate. Check the following:
 - Influent Storage Tank level is "High" or "High-High."
 - Extraction Well level is "Low."
 - Flowswitch FS-1 not satisfied; there is no flow in the line from the well to the Influent Storage Tank.
 - Contact the test engineer if the pump is still inoperable.
2. Either Pump P-2A or P-2B will not operate. Check the following:
 - Flowswitches FS-2, FS-3, or FS-4 not satisfied; there is no flow in the lines to the Influent Pumps, to the inlet manifold on the Process System skid, or the line to the Effluent Storage Tank.
 - Influent Storage Tank level is "Low."
 - Effluent Storage Tank level is "High."
 - Contact the test engineer if the pump is still inoperable.
3. Either Pump P-5A or P-5B will not operate. Check the following:
 - Disposal Well level is "High."
 - Effluent Storage Tank level is "Low."
 - Flowswitch FS-5 is not satisfied; there is no flow in the lines from the Effluent Storage Tank to the Effluent Pumps, or from the Effluent Pump(s) to the Disposal Well.
 - Contact the test engineer if the pump is still inoperable.

6.2 FROZEN LINE

1. Frozen pipe(s) or fitting(s):
 - If piping or fitting will not allow flow, check the heat tracing by feeling an exposed cable for warmth. If cable is not warm check to see if the appropriate breaker has tripped and contact the test engineer or field superintendent.

- Thaw piping or fitting by correcting the heat tracing fault or applying a heat gun or other heater to the affected area.
 - Verify that fittings have not been damaged by expanding ice before restarting the process.
2. Frozen hose:
- Check hose for flexibility. Stiff hoses should be disconnected, capped, and placed into the process tent to thaw. Thawed water should be collected and the hose should be reconnected once thawed.

7.0 SYSTEM SHUTDOWN

The general strategy for operating the Pilot-Scale Treatment System is to operate the well pump 24 hours/day to fill the Influent Storage Tank, and operate the Treatment System 6 to 8 hours during day shift to fill the Effluent Storage Tank. Because of the long distance (2,000 ft) to the disposal well, the treated effluent will be pumped from the Effluent Storage Tank via the Effluent Pump(s) to an effluent holding tank, tanker truck, or via hose directly into the Disposal Well. The tanker truck will either transfer the treated water to the Disposal Well Tank at the Disposal Well site or directly into the Disposal Well. The Disposal Well Tank and the tanker truck will rely on gravity flow only. The following procedure describes the steps to shut down the Treatment System. In general, after the pump(s) are shut down the hoses and process equipment may be emptied of water via the air compressor. The water is directed either to the wells or the Influent and Effluent Storage Tanks. This is of particular importance during winter to keep equipment from freezing.

System shutdown starts by stopping the Influent feed pump (P-2A or P-2B). In the event the Effluent Storage Tank reaches a "High" or "High-High" level, the feed pump(s) may already be shut down. (The extraction well pump P-1, keeps filling the Influent Tank until the Influent Storage Tank reaches a "High" or "High-High" level.) The following section ensures a safe shutdown.

7.1 SYSTEM SHUTDOWN

1. If the Treatment System is running, shut down the Influent Feed Pump(s), either P-2A or P-2B by pressing the "STOP" button. Watch for flow to cease on FIT-2, FS-2, and FS-3.
2. If water is not to be drained from the system, secure MBV-2, BV-10, and BV-70. Close all BVs between the Influent and Effluent Storage Tanks, including sight glass valves.
3. If Extraction Well Pump P-1 is to be shut down, stop the pump by pushing in the "STOP" button. Watch for flow to cease on FIT-1 and FS-1.
4. If water is not to be drained from the system, secure MBV-1 and BV-9. Close all BVs between the Extraction Well and Influent Storage Tank including the sight glass valves.
5. If either Effluent Pump P-5A or P-5B are to be shut down, stop the pump by pushing the "STOP" button. Watch for flow to cease on FIT-3 and FS-5.
6. If water is not to be drained from the system, close BV-72 and BV-108. Close all BVs between the Effluent Storage Tank and the end of the Disposal Well.

7. If untreated water is to remain in the Influent Storage Tank, and freezing conditions exist, remove the water from the hoses and manifolds between the Influent Storage Tank and the extraction well. Connect the air compressor to AC-1 and perform the following:
 - Push water from the well manifold into the extraction well by opening BV-1 and verify that BV-4 is closed. Start the air compressor and slowly open the BV at AC-1 to allow air to push the water into the extraction well. Turn compressor off.
 - Push water from the extraction well to the Influent Storage Tank by closing BV-1 and BV-2. Verify that BV-4, BV-6, BV-7, BV-8, BV-9, and MBV-1 are open.
 - Start the air compressor and slowly open the BV at AC-1 to allow air to push the water toward the Influent Storage Tank.
 - After water is removed, close the BV at AC-1, turn compressor off, bleed off the pressure in the air hose, verify that the pressure has been relieved, disconnect air hose, and allow the pressure to bleed off from the system through AC-1. Again, verify that the pressure has been relieved from the line by checking PI-1.
 - After pressure has bled off, secure BV-4, BV-6, BV-7, BV-8, BV-9, and MBV-1, close valve at AC-1 and disconnect air hose.

8. To remove water from the hose (and equipment) between the Influent Pump skid and the Process System skid, verify that the air compressor is connected to the camlock AC at BV-51 and perform the following:
 - Verify that a hose is connected from the top inlet on the Influent Storage Tank at BV-15 to the 3-way BV-49 on the Influent Pump skid.
 - Verify that BV-39, BV-41, BV-43, BV-46, and BV-48 are closed.
 - Verify that BV-50 and BV-15 are open and that 3-way BV-49 is turned 50%.
 - Turn BV-51 so that flow is directed back toward the Influent Storage Tank and **NOT** though the Process System.
 - Start compressor and slowly open BV on the AC to allow air to push the water back toward the Influent Storage Tank.
 - After water is removed, turn compressor off, bleed off pressure in the air hose, verify the pressure has been relieved, and disconnect air hose from the camlock air fitting at BV-51. Bleed off the pressure in the system, verify that the line is not pressurized by reading PI-4, and close the valve on the camlock AC.

- Close BV-50 and BV-15. Turn BV-49 so that all flow will go toward the Influent Storage Tank.
9. To remove water from the hose between the Influent Storage Tank and the Influent Pump skid, leave MBV-2 and BV-10 open. Connect air compressor hose with camlock fitting at AC-2 and perform the following:
- Close BV-32 and BV-34, and verify that BV-30 is open.
 - Start compressor and slowly open BV at AC-2 to allow air to push the water back toward the Influent Storage Tank(s).
 - After water is removed, secure BV-10 and turn compressor off. Bleed off the pressure in the air line and verify that the pressure has been relieved before disconnecting the air hose. Close the BV at AC-2 as well as MBV-2 and BV-30.
 - Reconnect the air compressor hose to the camlock fitting at AC-2. Open BV-15, BV-32, BV-33, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-45, BV-46, BV-47, and BV-48.
 - Verify that BV-30, BV-31, BV-37, BV-42, and BV-43 are closed.
 - Start compressor and slowly open BV at AC-2 to allow air to push the water back toward the Influent Storage Tank.
 - After water is removed, turn compressor off, and bleed off the pressure in the air line, verify that the pressure has been relieved, and disconnect the air hose. Bleed off the pressure in the hose at AC-2, verify that the line is not pressurized by opening BV-43 to read PI-3, and close the BV at AC-2.
 - Secure BV-15, BV-32, BV-33, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-43, BV-45, BV-46, BV-47, and BV-48.
10. To remove water from the hose between the Process System skid and the Effluent Storage Tank, connect the air compressor to AC at BV-67F and perform the following:
- Verify that BV-69 and BV-70 are open, and BV-67E is closed. Start the compressor and slowly open at BV-67F to allow air to push the water toward the Effluent Storage Tank.
 - After the water is removed, secure BV-70 and turn compressor off.
 - Bleed off the pressure in the air line at BV-67F, verify the pressure has been relieved, and disconnect the air hose. Bleed off the pressure in the system at BV-67F, verify that the line is not pressurized, and secure BV-69.

11. If there is no treated water to be drained from the Effluent Storage Tank, and freezing conditions exist, remove the water from the hoses and equipment between the Effluent Storage Tank and the Effluent Pump skid, connect the air compressor to AC-9, and perform the following:
- Push water from the Effluent Pump skid to the Effluent Storage Tank by closing BV-92 and BV-94. Verify that BV-72 and BV-90 are open.
 - Start the compressor and slowly open the BV at AC-9 to allow air to push the water back toward the Effluent Storage Tank.
 - After the water is removed from that section, secure BV-72 and turn compressor off. Bleed off the pressure in the air line, verify the pressure has been relieved, and disconnect the air hose. Bleed off pressure in the system at AC-9, verify that the pressure has been relieved, and close BV-90 and the valve at AC-9.
12. Remove the water from the hoses and equipment between the Effluent Pump skid and Disposal Well by connecting the air compressor to AC-9 and performing the following:
- Push water from the Effluent Pump skid to the Disposal Well opening BV-92, BV-93, BV-94, BV-95, BV-98, BV-99, BV-102, BV-103, BV-108, BV-115, BV-116, BV-117, BV-120, BV-121, BV-122, BV-123, and BV-124. Verify that valves BV-90, BV-100, BV-101, BV-104, BV-119, and SC-9 are closed.
 - Start the compressor and slowly open the BV at AC-9 to allow air to push the water towards the Disposal Well manifold for 5 minutes.
 - After 5 minutes, turn compressor off, allow the pressure to bleed off in the air line, verify that the pressure has been relieved, and disconnect the air hose. Bleed off the pressure in the hose at AC-9, verify the pressure has been relieved. Bled off pressure at AC-11.
 - Close BV-92, BV-93, BV-94, BV-95, BV-98, BV-99, BV-102, BV-103, and BV-108.
 - Reconnect the compressor at AC-11, start compressor and slowly open BV at AC-11. While compressor is on, gravity drain hose by elevating hose to approximately 3 ft above the ground and walk towards the well.
 - After water is removed, turn compressor off, allow pressure to bleed off in the air line, verify pressure has been relieved and disconnect the air hose. Bleed off pressure in hose at AC-11, verify pressure has been relieved, and close the BV at AC-11. Verify pressure has been relieved by checking PI-18 and PI-19.

NOTE: If freezing conditions exist, do not close BV-121, BV-122, BV-123, BV-124, BV-115, BV-116, BV-117, BV-118, and BV-120.

- Open BV at AC-12 over an acceptable receptacle to drain remaining water in hose. Close BV at AC-12.
- After pressure has bled off, secure BV-121, BV-122, BV-123, BV-124, BV-115, BV-116, BV-117, BV-118, and BV-120.

NOTE: Lines should be blown down with pressure no greater than 30 lb/in² with the air compressor. Verify that the pressure has been relieved from all process lines as well as the air line by checking pressure gages before proceeding.

NOTE: Table 7-1 is provided to document these steps.

7.2 PRELIMINARY FREEZE PROTECTION

To facilitate freeze protection of the site before full winterization is completed or due to loss of power, the following procedures will be performed. These procedures can be disregarded once the BV in question and associated piping has been insulated and heat traced.

1. The BVs have a tendency to freeze shut in inclement weather. To prevent this, the following BVs shall be left open after site blowdown:
 - Influent side: BV-1, BV-2, BV-4, BV-6, BV-7, BV-8, BV-15 (cap), BV-30, BV-32, BV-33, BV-34, BV-35, BV-42, and BV-43.
 - Effluent side: BV-74 (cap), BV-76 (cap), BV-90, BV-92, BV-93, BV-94, BV-95, BV-100, BV-101, and BV-108 (only if attached to truck).
 - Disposal well: BV-110 (cap), BV-115, BV-116, BV-117, BV-118, BV-120, BV-121, BV-122, BV-123, BV-124, and BV-125.
2. To maintain containment within the tanks and process system, ensure the following BVs remain closed: BV-9, BV-10, BV-50, BV-69, BV-70, and BV-72.
3. Remove the Effluent filter housings and store in process tent at night.

NOTE: Table 7.2 is provided to document these steps.

7.3 ELECTRICAL SHUTDOWN

1. Verify that all pumps are turned off. De-energize the pumps by turning the disconnects to "OFF."
2. De-energize power to the 110V ac system for level controls and PLC by turning the switch inside the instrument panel off.

3. De-energize power to the 480/110/220 transformer by switching the disconnect to "OFF."
4. De-energize power to the main panel and to the winterization transformer by switching the disconnects to "OFF."
5. Turn off the main breaker at the generator and turn the generator off.

NOTE: Table 7-3 is provided to document these steps.

Table 7-1. System Shutdown Checklist. (5 sheets)

| | | |
|-------------------|--|----------------------|
| Date: | | |
| Operators: | | |
| | System Shutdown Checklist | Verified/Date |
| 1. | If the Treatment System is running, shut down the Influent Feed Pump(s), either P-2A or P-2B by pressing the "STOP" button. Watch for flow to cease on FIT-2, FS-2, and FS-3. | |
| 2. | If water is not to be drained from the system, secure MBV-2, BV-10, and BV-70. Close all BVs between the Influent and Effluent Storage Tanks, including sight glass valves. | |
| 3. | If Extraction Well Pump P-1 is to be shut down, stop the pump by pushing in the "STOP" button. Watch for flow to cease on FIT-1 and FS-1. | |
| 4. | If water is not to be drained from the system, secure MBV-1 and BV-9. Close all BVs between the Extraction Well and Influent Storage Tank including the sight glass valves. | |
| 5. | If either Effluent Pump P-5A or P-5B are to be shut down, stop the pump by pushing the "STOP" button. Watch for flow to cease on FIT-3 and FS-5. | |
| 6. | If water is not to be drained from the system, close BV-72 and BV-108. Close all BVs between the Effluent Storage Tank and the end of the Disposal Well. | |
| 7. | <p>If untreated water is to remain in the Influent Storage Tank, and freezing conditions exist, remove the water from the hoses and manifolds between the Influent Storage Tank and the extraction well. Connect the air compressor to AC-1 and perform the following:</p> <ul style="list-style-type: none"> • Push water from the well manifold into the extraction well by opening BV-1 and verify that BV-4 is closed. Start the air compressor and slowly open the BV at AC-1 to allow air to push the water into the extraction well. Turn compressor off. • Push water from the extraction well to the Influent Storage Tank by closing BV-1 and BV-2. Verify that BV-4, BV-6, BV-7, BV-8, BV-9, and MBV-1 are open. • Start the air compressor and slowly open the BV at AC-1 to allow air to push the water toward the Influent Storage Tank. • After water is removed, close the BV at AC-1, turn compressor off, bleed off the pressure in the air hose, verify that the pressure has been relieved, disconnect air hose, and allow the pressure to bleed off from the system through AC-1. Again, verify that the pressure has been relieved from the line by checking PI-1. | |

Table 7-1. System Shutdown Checklist. (5 sheets)

| System Shutdown Checklist | | Verified/Date |
|---------------------------|--|---------------|
| 7. | Continued: <ul style="list-style-type: none"> After pressure has bled off, secure BV-4, BV-6, BV-7, BV-8, BV-9, and MBV-1, close valve at AC-1 and disconnect air hose. | |
| 8. | To remove water from the hose (and equipment) between the Influent Pump skid and the Process System skid, verify that the air compressor is connected to the camlock AC at BV-51 and perform the following: <ul style="list-style-type: none"> Verify that a hose is connected from the top inlet on the Influent Storage Tank at BV-15 to the 3-way BV-49 on the Influent Pump skid. Verify that BV-39, BV-41, BV-43, BV-46, and BV-48 are closed. Verify that BV-50 and BV-15 are open and that 3-way BV-49 is turned 50%. Turn BV-51 so that flow is directed back toward the Influent Storage Tank and NOT through the Process System. Start compressor and slowly open BV on the AC to allow air to push the water back toward the Influent Storage Tank. After water is removed, turn compressor off, bleed off pressure in the air hose, verify the pressure has been relieved, and disconnect air hose from the camlock air fitting at BV-51. Bleed off the pressure in the system, verify that the line is not pressurized by reading PI-4, and close the valve on the camlock AC. Close BV-50 and BV-15. Turn BV-49 so that all flow will go toward the Influent Storage Tank. | |
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| | | |
| 9. | To remove water from the hose between the Influent Storage Tank and the Influent Pump skid, leave MBV-2 and BV-10 open. Connect air compressor hose with camlock fitting at AC-2 and perform the following: <ul style="list-style-type: none"> Close BV-32 and BV-34, and verify that BV-30 is open. Start compressor and slowly open BV at AC-2 to allow air to push the water back toward the Influent Storage Tank(s). After water is removed, secure BV-10 and turn compressor off. Bleed off the pressure in the air line and verify that the pressure has been relieved before disconnecting the air hose. Close the BV at AC-2 as well as MBV-2 and BV-30. | |
| | | |
| | | |
| | | |

Table 7-1. System Shutdown Checklist. (5 sheets)

| System Shutdown Checklist | | Verified/Date |
|--|--|---------------|
| <p>9. Continued:</p> <ul style="list-style-type: none"> Reconnect the air compressor hose to the camlock fitting at AC-2. Open BV-15, BV-32, BV-33, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-45, BV-46, BV-47, and BV-48. Verify that BV-30, BV-31, BV-37, BV-42, and BV-43 are closed. Start compressor and slowly open BV at AC-2 to allow air to push the water back toward the Influent Storage Tank. After water is removed, turn compressor off, and bleed off the pressure in the air line, verify that the pressure has been relieved, and disconnect the air hose. Bleed off the pressure in the hose at AC-2, verify that the line is not pressurized by opening BV-43 to read PI-3, and close the BV at AC-2. Secure BV-15, BV-32, BV-33, BV-34, BV-35, BV-38, BV-39, BV-40, BV-41, BV-43, BV-45, BV-46, BV-47, and BV-48. | | |
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| <p>10. To remove water from the hose between the Process System skid and the Effluent Storage Tank, connect the air compressor to AC at BV-67F and perform the following:</p> <ul style="list-style-type: none"> Verify that BV-69 and BV-70 are open, and BV-67E is closed. Start the compressor and slowly open at BV-67F to allow air to push the water toward the Effluent Storage Tank. After the water is removed, secure BV-70 and turn compressor off. Bleed off the pressure in the air line at BV-67F, verify the pressure has been relieved, and disconnect the air hose. Bleed off the pressure in the system at BV-67F, verify that the line is not pressurized, and secure BV-69. | | |
| | | |
| | | |
| | | |
| <p>11. If there is no treated water to be drained from the Effluent Storage Tank, and freezing conditions exist, remove the water from the hoses and equipment between the Effluent Storage Tank to the Disposal Well, connect the air compressor to AC-9, and perform the following:</p> <ul style="list-style-type: none"> Push water from the Effluent Pump skid to the Effluent Storage Tank by closing BV-92 and BV-94. Verify that BV-72 and BV-90 are open. Start the compressor and slowly open the BV at AC-9 to allow air to push the water back toward the Effluent Storage Tank. | | |
| | | |
| | | |

Table 7-1. System Shutdown Checklist. (5 sheets)

| System Shutdown Checklist | | Verified/Date |
|---------------------------|--|---------------|
| 11. | <p>Continued:</p> <ul style="list-style-type: none"> After the water is removed from that section, secure BV-72 and turn compressor off. Bleed off the pressure in the air line, verify the pressure has been relieved, and disconnect the air hose. Bleed off pressure in the system at AC-9, verify that the pressure has been relieved, and close BV-90 and the valve at AC-9. | |
| 12. | <p>Remove the water from the hoses and equipment between the Effluent Pump skid and Disposal Well by connecting the air compressor to AC-9 and performing the following:</p> <ul style="list-style-type: none"> Push water from the Effluent Pump skid to the Disposal Well opening BV-92, BV-93, BV-94, BV-95, BV-98, BV-99, BV-102, BV-103, BV-108, BV-115, BV-116, BV-117, BV-120, BV-121, BV-122, BV-123, and BV-124. Verify that valves BV-90, BV-100, BV-101, BV-104, BV-119, and SC-9 are closed. Start the compressor and slowly open the BV at AC-9 to allow air to push the water towards the Disposal Well manifold for 5 minutes. After 5 minutes, turn compressor off, allow the pressure to bleed off in the air line, verify that the pressure has been relieved, and disconnect the air hose. Bleed off the pressure in the hose at AC-9, verify the pressure has been relieved. Bled off pressure at AC-11. Close BV-92, BV-93, BV-94, BV-95, BV-98, BV-99, BV-102, BV-103, and BV-108. Reconnect the compressor at AC-11, start compressor and slowly open BV at AC-11. While compressor is on, gravity drain hose by elevating hose to approximately 3 ft above the ground and walk towards the well. After water is removed, turn compressor off, allow pressure to bleed off in the air line, verify pressure has been relieved and disconnect the air hose. Bleed off pressure in hose at AC-11, verify pressure has been relieved, and close the BV at AC-11. Verify pressure has been relieved by checking PI-18 and PI-19. <p>NOTE: If freezing conditions exist, do not close BV-121, BV-122, BV-123, BV-124, BV-115, BV-116, BV-117, BV-118, and BV-120.</p> <ul style="list-style-type: none"> Open BV at AC-12 over an acceptable receptacle to drain remaining water in hose. Close BV at AC-12. | |

Table 7-1. System Shutdown Checklist. (5 sheets)

| System Shutdown Checklist | Verified/Date |
|--|---------------|
| <p>12. Continued:</p> <ul style="list-style-type: none">• After pressure has bled off, secure BV-121, BV-122, BV-123, BV-124, BV-115, BV-116, BV-117, BV-118, and BV-120. <p>NOTE: Lines should be blown down with pressure no greater than 30 lb/in² with the air compressor. Verify that the pressure has been relieved from all process lines as well as the air line by checking pressure gages before proceeding.</p> | |

Table 7-2. Preliminary Freeze Protection Checklist.

| | | |
|--|--|----------------------|
| Date: | | |
| Operators: | | |
| Preliminary Freeze Protection Checklist | | Verified/Date |
| 1. | <p>The BVs have a tendency to freeze shut in inclement weather. To prevent this, the following BVs shall be left open after site blowdown:</p> <ul style="list-style-type: none"> • Influent side: BV-1, BV-2, BV-4, BV-6, BV-7, BV-8, BV-15 (cap), BV-30, BV-32, BV-33, BV-34, BV-35, BV-42, and BV-43. • Effluent side: BV-74 (cap), BV-76 (cap), BV-90, BV-92, BV-93, BV-94, BV-95, BV-100, BV-101, and BV-108 (only if attached to truck). • Disposal well: BV-110 (cap), BV-115, BV-116, BV-117, BV-118, BV-120, BV-121, BV-122, BV-123, BV-124, and BV-125. | |
| 2. | <p>To maintain containment within the tanks and process system, ensure the following BVs remain closed: BV-9, BV-10, BV-50, BV-69, BV-70, and BV-72.</p> | |
| 3. | <p>Remove the Effluent filter housings and store in process tent at night.</p> | |

Table 7-3. Electrical Shutdown Checklist.

| | | |
|-------------------|---|----------------------|
| Date: | | |
| Operators: | | |
| | Electrical Shutdown Checklist | Verified/Date |
| 1. | Verify that all pumps are turned off. De-energize the pumps by turning the disconnects to "OFF." | |
| 2. | De-energize power to the 110V ac system for level controls and PLC by turning the switch inside the instrument panel off. | |
| 3. | De-energize power to the 480/110/220 transformer by switching the disconnect to "OFF." | |
| 4. | De-energize power to the main panel and to the winterization transformer by switching the disconnects to "OFF." | |
| 5. | Turn off the main breaker at the generator and turn the generator off. | |

8.0 FILTER CHANGEOUT

8.1 INFLUENT/EFFLUENT FILTER CHANGEOUT

Changing of bag filters should occur when the filters become clogged with fines. This is evident by the pressure differences before and after the filters.

8.1.1 Changing Influent Filters

Changing of the influent bag filters should occur when the pressure differential has reached 30 lb/in² across the filters.

NOTE: A Radiological Control Technician (RCT) must be present whenever system integrity is broken.

1. If the process is operating, follow procedures to shut down the process system.
2. Verify that the following BVs are closed: BV-33, BV-35, BV-37, BV-42, and BV-43.
3. Verify that a hose is connected between BV-49 and the inlet to the Influent Storage Tank at BV-15.
4. Open BV-15 and switch 3-way BV-49 so that flow will go into the Influent Storage Tank.
5. Ensure flow is able to proceed from filters to Influent Storage Tank by opening: BV-38, BV-39, BV-40, BV-41, BV-45, BV-46, BV-47, and BV-48.
6. Attach air compressor to AC coming off of BV-37. Pressurize compressor to 45 lb/in², then open BV-37.
7. Allow air to blow through system for 1 minute, then close BV-47, BV-48, BV-45, BV-46, BV-40, and BV-41 in order to blow down filter F-1A.
8. Blow each filter down separately for 10 minutes to ensure all water is purged from the system.
9. When all filters have been blown down, close BV-37, BV-49, and BV-15.
10. Bleed pressure off of air compressor hose and disconnect.
11. Attach sample hose to AC coming off of BV-37 and bleed off any pressure by opening BV-37.

12. When pressure is relieved, verify the following BVs are closed: BV-37, BV-38, BV-39, BV-40, BV-41, BV-45, BV-46, BV-47, and BV-48.

NOTE: Ensure all pressure is bled out of lines before opening filter housings.

13. Double check that the system is isolated, then replace filters.
14. Return 3-way BV-49 to flow toward the Process System skid.

NOTE: Table 8-1 is provided to document these steps.

8.1.2 Changing Effluent Filters

Changing of the effluent cartridge filters should occur when the pressure differential has reached 30 lb/in² across the filters.

1. If the process is operating, follow procedures to shutdown the effluent pumping system.
2. Isolate Effluent Pump skid from Effluent Storage Tank by verifying that the following valves are closed: BV-72 and BV-90.
3. Attach a hose from the Effluent Pump skid outlet to the Effluent Storage Tank inlet at BV-76 and open BV-76.
4. Verify that the following BVs are open: BV-92, BV-93, BV-94, BV-95, BV-98, BV-99, BV-102, BV-103, and BV-108.
5. Start the air compressor, pressurize to 45 lb/in², and slowly open the BV at AC-9 to allow air to push the water back towards the Effluent Storage Tank.
6. After water is removed, turn compressor off, and let the pressure bleed off to the top of the Effluent Tank. Close the BV at AC-9.
7. Close the following: BV-92, BV-93, BV-94, BV-98, BV-99, BV-102, BV-103, and BV-108.
8. Double check the system is isolated, then replace filters.

NOTE: Ensure all pressure is bled out of lines before opening filter housings.

NOTE: Table 8-2 is provided to document these steps.

Table 8-1. Influent Filter Changeout Checklist.

| Date: | | |
|--|---|----------------------|
| Operators: | | |
| Influent Filter Changeout Checklist | | Verified/Date |
| Changing of the influent bag filters should occur when the pressure differential has reached 30 lb/in ² across the filters. | | |
| NOTE: A RCT must be present whenever system integrity is broken. | | |
| 1. | Verify that the treatment system is not operating. If the process is operating, follow procedures to shut down the process system. | |
| 2. | Verify that the following BVs are closed: BV-33, BV-35, BV-37, BV-42, and BV-43. | |
| 3. | Verify that a hose is connected between BV-49 and the inlet to the Influent Storage Tank at BV-15. | |
| 4. | Open BV-15 and switch 3-way BV-49 so that flow will go into the Influent Storage Tank. | |
| 5. | Ensure flow is able to proceed from filters to Influent Storage Tank by opening: BV-38, BV-39, BV-40, BV-41, BV-45, BV-46, BV-47, and BV-48. | |
| 6. | Attach air compressor to AC coming off of BV-37. Pressurize compressor to 45 lb/in ² , then open BV-37. | |
| 7. | Allow air to blow through system for 1 minute, then close BV-47, BV-48, BV-45, BV-46, BV-40, and BV-41 in order to blow down filter F-1A. | |
| 8. | Blow each filter down separately for 10 minutes to ensure all water is purged from the system. | |
| 9. | When all filters have been blown down, close BV-37, BV-49, and BV-15. | |
| 10. | Bleed pressure off of air compressor hose and disconnect. | |
| 11. | Attach sample hose to AC coming off of BV-37 and bleed off any pressure by opening BV-37. | |
| 12. | When pressure is relieved, verify the following BVs are closed: BV-37, BV-38, BV-39, BV-40, BV-41, BV-45, BV-46, BV-47, and BV-48. NOTE: Ensure all pressure is bled out of lines before opening filter housings. | |
| 13. | Double check that the system is isolated, then replace filters. | |
| 14. | Return 3-way BV-49 to flow toward the Process System skid. | |

Table 8-2. Effluent Filter Changeout Checklist.

| | | |
|--|---|----------------------|
| Date: | | |
| Operators: | | |
| Effluent Filter Changeout Checklist | | Verified/Date |
| Changing of the effluent cartridge filters should occur when the pressure differential has reached 30 lb/in ² across the filters. | | |
| 1. | If the process is operating, follow procedures to shutdown the effluent pumping system. | |
| 2. | Isolate Effluent Pump skid from Effluent Storage Tank by verifying that the following valves are closed: BV-72 and BV-90. | |
| 3. | Attach a hose from the Effluent Pump skid outlet to the Effluent Storage Tank inlet at BV-76 and open BV-76. | |
| 4. | Verify that the following BVs are open: BV-92, BV-93, BV-94, BV-95, BV-98, BV-99, BV-102, BV-103, and BV-108. | |
| 5. | Start the air compressor, pressurize to 45 lb/in ² , and slowly open the BV at AC-9 to allow air to push the water back towards the Effluent Storage Tank. | |
| 6. | After water is removed, turn compressor off, and let the pressure bleed off to the top of the Effluent Tank. Close the BV at AC-9. | |
| 7. | Close the following: BV-92, BV-93, BV-94, BV-98, BV-99, BV-102, BV-103, and BV-108. | |
| 8. | Double check the system is isolated, then replace filters. | |
| <p>NOTE: Ensure all pressure is bled out of lines before opening filter housings.</p> | | |

9.0 SAMPLING

9.1 SAMPLING FREQUENCY AND LOCATIONS

Sampling points are provided to monitor the various stages in the treatment system. Sampling should be performed in accordance with an appropriate Sampling Analysis Plan (SAP). Samples will be taken a minimum of once a week while the system is operating. Additional sampling may take place during the first two weeks of operation as well as during events such as ion exchange column breakthrough. Sampling points are located at the following locations:

| Sampling Connections | Location |
|----------------------|--------------------------------------|
| AC-1 | Well Manifold |
| AC-2 | Influent Pump Skid |
| SC-2 | Influent Storage Tank Inlet |
| AC-3 | Top of Ion Exchange Column TNK-2A |
| AC-4, SC-53A/B | Bottom of Ion Exchange Column TNK-2A |
| AC-7 | Top of Ion Exchange Column TNK-3 |
| AC-8, SC-68A/B | Bottom of Ion Exchange Column TNK-3 |
| AC-9 | Effluent Pump Skid |
| SC-9 | Disposal Well Manifold |
| AC-10 | Top of Organic Adsorber TNK-12 |
| SC-10, SC-11 | Bottom of Organic Adsorber TNK-12 |

Additional sampling locations may be designated as needed as portable sampling ports are available. Sampling locations will change as needed and determined by operations and the SAP. Samplers shall be appropriately trained to perform sampling.

9.2 SAMPLING PROCEDURE

1. Attach sampling apparatus to predetermined sampling point after flow has been established.
2. Open appropriate sampling BV slowly and purge at least three tubing volumes (approximately one gal) into a five gal bucket. Place purged groundwater into holding drum.
3. Collect samples.
4. Verify that sampling valves are closed after use.

NOTE: A Health Physics Technician (HPT) may be required for sampling. Refer to the Radiation Work Permit (RWP) for specific requirements.

NOTE: Table 9-1 is provided to document these steps.

Table 9-1. Sampling Checklist.

| | | |
|-------------------|---|----------------------|
| Date: | | |
| Operators: | | |
| | Sampling Checklist | Verified/Date |
| 1. | Attach sampling apparatus to predetermined sampling point after flow has been established. | |
| 2. | Open appropriate sampling BV slowly and purge at least three tubing volumes (approximately one gal) into a five gal bucket. Place purged groundwater into holding drum. | |
| 3. | Collect samples. | |
| 4. | Verify that sampling valves are closed after use. | |
| | NOTE: A HPT may be required for sampling. Refer to the RWP for specific requirements. | |

10.0 DAILY DATA LOG TABLES

The Daily Data Logs are to be completed on approximately an hourly basis each day that the system is operational. The Daily Data Logs consist of the Influent Pumping Station Data Log (Table 10-1), the Treatment System Data Log (Table 10-2), the Effluent Pumping Station Log (Table 10-3), and the Weekly Operational Status Log (Table 10-4).

Table 10-4. 200-BP-5, Unit #2 Treatability Test Weekly Operational Status Log.
(Week Ending _____)

| Operational Parameters | Mon | Tue | Wed | Thur | Fri | Sat | Weekly Total | Running Total |
|------------------------|-----|-----|-----|------|-----|-----|--------------|---------------|
| Hours of Operation | | | | | | | | |
| Hours of Treatment | | | | | | | | |
| Volume Extracted | | | | | | | | |
| Volume Treated | | | | | | | | |
| Volume Injected | | | | | | | | |

Operational Difficulties: _____

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