NERT Perchlorate Treatment System

Henderson, NV

Operations Manual

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CONFIDENTIALITY STATEMENT

Revisions Log

Revision General Notes:

Manual Revision	Date	Notes/Comments	Apprv. by.
8	7/11/2023	Revised Chapter 12 to encompass the EFS.	MD
7	3/23/2023	Revised Chapter 20 and Chapter 21. Deleted Appendix T which is no longer applicable. Also revised Chapter 9 to encompass TSE use	MD
6	7/22/2018	Revised Chapters 2, 5, 9 and 10 for the use of Alumina Chlorohydrate as a coagulant	MD
5	7/26/2017	Revised manual to add chapter 20 & 21 and Appendix T.	MD
4	3/1/2017	Revised 2015 manual to revise chapters and appendices (see list below). Also added new chapters 18 & 19 and added to appendices to encompass new equipment and more of the plant processes.	MD
3	4/17/2015	Revised 2014 manual to add chapter and appendices on spill control and testing • *Remove and replace previous Cover, Revision Log and Table of Contents* • *Add New Chapter 17 after current Chapter 16* • *Add New Appendices P – S after current Appendix O*	MD
2	04/28/2014	Revised and updated 2006 manual to reflect operations at the NERT facility at the time Envirogen assumed operations of the plant. Shading section of the text are considered obsolete processes or equipment not in use. The text was shaded to preserve for historical reference.	MD
1	Sept 2006	Issued By Veolia/Shaw for AP5 Upgrade	--
0	Nov 2004	Initial Issue	--

See the chapter list below as reference to the revision level of the chapters that comprise the current version of this manual. The current Rev 8 manual consists of the following chapters

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1	4	March 2017
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12	8	July 2023
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15	2	April 2014
16	2	April 2014
17	4	March 2017
18	4	March 2017
19	4	March 2017
20	7	March, 2023
21	7	March, 2023
Appendix A	2	April 2014
Appendix B	2	April 2014
Appendix C	2	April 2014
Appendix D	2	April 2014
Appendix E	2	April 2014
Appendix F	4	January 2017
Appendix G	4	March 2017
Appendix H	4	March 2017
Appendix I	4	January 2017
Appendix J	2	April 2014
Appendix K	3	May 2016
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Chapter	*Rev*	*Date Issued*
Appendix R	3	April 2015
Appendix S	3	April 2015
Appendix T	N/A	DELETED

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APPENDICES

CHAPTER 12
UTILITY SYSTEMS

AIR COMPRESSOR SYSTEM

Overview

Compressed air for the system is supplied by two Ingersoll Rand Air Compressors, (P-801 & P-802) that are located in the Filter Press building. The system has a 660- gallon air receiver tank (T-801), and an Instrument Air Dryer (T-802), two Oil Removal Filters (F-802 & F-803) and one Particulate Filter (F-804). One compressor will be on line while the other compressor will be in AUTO START MODE. While the unit is on line, the compressor motor will run continuously and the compressor will automatically load and unload as required to maintain 80 psig (+ or – 5 psi) air pressure in the air receiver tank. If the compressor that is on line does not maintain the 80 psig, the other compressor will automatically start and go on line. Compressor oil level should be checked regularly. Use the type of lubricating oil recommended by the manufacturer. The oil removal and particulate filters should be cleaned periodically as well.

Air from the two air compressors (P-801 & P-802) is fed through two 2 – inch CSTP40 carbon steel lines through a check and ball valve to the Compressed Air Receiver Tank (T-801). Air flow out of the tank is through a 1.5 – inch CSTP40 carbon steel line through a ball valve to the oil removal filter (F-802) through the Instrument Air Dryer (T- 802) to the particulate filter (F-804), out of the filter through a 1.5 – inch CSTP40 carbon steel line through a ball valve to a pressure control valve (PCV – 803) set at 100 PSI with a pressure indicator (PI-803). There is a low pressure switch (PSL - 802) set at 80 PSIG installed in 1.5 – inch CSTP40 carbon steel line that goes to the instrument air header. This switch is monitored by the PLC.

MAJOR COMPONENTS

Air Compressors (P-801 & P-802)

Ingersoll Rand Model EP50-PE with a capacity of 215 ICFM @ 125 PSIG Rotary Screw type with a 50HP 460VAC 3-phase motor.

Each Air Compressor has its own control panel on the front of the unit. These systems have the Intellisys Control & Instrumentation option. The touchscreen is used to start & stop the unit as well as for setup, displaying status and troubleshooting. See the Operation manual for additional information.

Compressed Air Receiver Tank (T-801)

The storage tank for the Air system a steel 660 gallon 42”OD x 120”HT with a maximum pressure of 137 PSIG. Both compressors feed the air tank. The tank has a local pressure indicator (PI-801) and a pressure relief valve (PSV-803) set at 150 PSI.

Instrument Air Dryer (T-801)

The instrument Air Dryer is a Regenerable Desiccant Dryer with an inlet flow rating of 160 SCFM (100PSIG) and a purge rating of 238 SCFM.

Oil Removal Filters (F-802 & F803)

The oil removal filters are rated for 275 SCFM 2 100 PSIG and a wet pressure drop of 6 PSI for liquid removal of 99.99% oil.

Particulate Filters (F-804)

The particulate filter is rated for 275 SCFM 2 100 PSIG and a wet pressure drop of 3 PSI for liquid removal of 100% water.

SERVICE WATER SYSTEM

Overview

The plant effluent filtration system provides a pressurized water supply for a variety of functions throughout the plant that do not require a potable water supply. It provides seal flush water for many of the plant pumps, flush water for the filter press feed pump, make up water for the separator tanks, mixing water for the polymer feed systems, dilution water for the nutrient feed system, dilution water for the phosphoric acid feed system, as well as supplying water for the plant emergency showers, hose stations and wash down connections.

PLANT WATER PUMPS AND EFFLUENT TANK

New plant water pumps P-1251 A/B/C pump water from new effluent tank T-1201 into the plant water system. Control of the pump will be automated to keep a constant pressure in the plant water system of 100-120 psi using pressure transmitter PIT-1252. Pumps P-1251 A/B/C have variable speed drives that will allow for pressure control in the plant water system. The pumps will be configured in a Duty/Standby/Off configuration. The duty pump will run and the standby pump will come on if the pressure drops below the low-level alarm point.

The effluent water tank (T-1201) has a level control system to keep the tank level at approximately 85% full. The level control will adjust the speed of the membrane feed pumps (P-2000A/B) to send enough water through the UF membranes to achieve the set level. The UF feed pumps are configured in a duty/standby configuration so the standby pump will run if the duty pump fails or cannot maintain the required level in the tank.

Set points for level control of T-1201 are adjustable in the UF HMI.

UF MEMBRANE FILTRATION SYSTEM

Ultra-filtration (UF) units will treat process water to remove suspended solids and reduce the turbidity to provide feed water quality for the service water system. Prior to entering the unit, the feed water will have passed through a filtration stage to protect the UF membranes.

The unit consists of the following components:

- An ultra-filtration bank of hollow fiber membranes with a pore size of 15nm. The filtration bank contains 4 ultra-filtration modules. The modules

are positioned vertically in a rack and connected by a common header, which collects the extracted filtrate and delivers it to the downstream effluent tank, T-1201.

- Feed pumps that are inverter driven centrifugal pumps for feeding process water to the UF membranes.
- A plant water system that includes an 8,000-gallon storage tank, and plant water pumps that are inverter driven centrifugal pumps for pumping treated filtrate to the plant water system.
- Backwash pumps that are inverter driven centrifugal pumps that are used to transfer the filtrate through the membrane for all the backwash and CEB cleaning sequences.
- Three Chemical Dosing Pumps that will dose: sodium hydroxide, sodium hypochlorite and citric acid during the CEB sequence.

Filtration

Water will be pumped from the existing aeration tank (T-401) using new UF feed pumps P-2000A and B, and enter the inside of the UF membrane fiber. UF filtrate will be discharged from the outside of each membrane and combined in the common filtrate header. The membrane will reject suspended solids with a molecular weight greater than 150kDa and viruses and bacteria, making the filtrate suitable for use in the plant service water system. The water flow will be directed to the effluent tank (T-1201) by the position of the actuated valves.

Typically, the UF modules will be fed with feed water from the bottom side port and exit via the filtrate port at the top of the module, but if the actuated valves are redirected, the feed can also enter the UF module through the top side port.

During the filtration step, clean filtrate is produced by applying a pressure difference between the raw water side and the filtrate side of the membrane (Transmembrane pressure or TMP). The TMP will gradually increase as a result of accumulation of particles on the membrane surface in a process known as fouling, which has a direct effect on the membrane permeability. The value of the TMP should be ideally kept under 14.5 psi during filtration and must not exceed 45 psi at any moment. Depending on the feed water quality and the membrane type, the typical flux rate during filtration is 30-60 GFD and the typical duration of the filtration mode is 10-60 minutes.

There will be two separate, identical membrane filtration racks, UF Rack1 and UF Rack 2. The racks will be configured in a DUTY/STANDBY mode where the duty rack will run based on plant water usage and level in T-1201. If the duty rack cannot keep up with the required water production and the level in T-1201 drops below the low limit, the standby rack will go into production. Once the level in T-1201 is high enough, the initial duty rack will move into standby with the initial standby rack staying in production mode. The racks will also switch from standby to duty on a daily basis or when the duty rack enters a chemically enhanced backwash.

Backwash

After a certain volume of water has passed through the membrane the accumulated solids will cause the TMP to increase across the membrane.

To prevent the larger suspended particles from blocking the membrane lumen, a backwash will be automatically initiated after the TMP has exceed a user defined setpoint. This will remove the suspended solids and will disturb and remove the gel later inside the membrane fiber.

A periodical backwash is required to maintain the membrane permeability at a sustainable level.

During regular backwashes, the direction of flow through the membrane will be reversed and filtrate water will be pumped by the backwash pump through the membranes in the opposite direction: from the outside of the membranes to the inside, pushing the foulants away from the membrane surface, which are diverted to the drain.

The TMP will be monitored during backwash, and the operation will be shut down if the TMP exceeds 45 psi, to avoid membrane damage.

The backwash filtration flux rate is generally higher than that of the service flow, within a range of 60-150 gfd. The backwash pump speed will be adjustable at the HMI and will operate at a user defined setpoint. The duration of the backwash needs to be sufficient to remove all the dirt from the membrane module and membrane system.

As a standard, the duration of the backwash is between 30-60 seconds and is a user defined setpoint that is adjustable on the HMI.

Forward Flush

A forward flush will be initiated prior to a backwash to flush out any solids that lie on top of the membrane surface reducing the quantity of filtrate required for the backwash. This improves the overall system recovery rate.

The forward flush is carried out using the feed pump typically at a volume flow rate equivalent to the filtration flux rate for a duration between 10 and 30 seconds depending on the quality of the feed water. The forward flush sequence time is a user definable setpoint that can be adjusted at the HMI.

A forward flush will also be initiated prior to UF production when the module is starting up, to ensure that any collected solids in the module are flushed to drain.

Chemically Enhanced Backwash

If a backwash is insufficient to remove all foulants and a continuous increase in TMP is observed, the backwash effectiveness can be enhanced by adding chemicals into the backwash feed with to remove organic material and scale forming ions. This is known as a chemically enhanced backwash (CEB).

A CEB sequence consists of the following:

- Phase 1: An Alkaline CEB (Caustic + Hypochlorite dosing).

Immediately followed by,

- Phase 2: An Acid CEB (Acid dosing).

A CEB will be initiated after a certain number of backwash sequences have taken place or when a TMP setpoint is reached when UF production is re-started following a backwash, indicating that the backwash has not reduced the TMP. It is anticipated that a CEB will be required daily.

When a CEB sequence is initiated, caustic + hypochlorite followed by acid are dosed into the backwash feed to complete low and high pH routines at certain flux rate using filtrate water. The CEB mode sequence consists of:

- an initial normal backwash,
- a backwash with chemicals,
- a soak period, and
- a chemical-free backwash to flush-out the chemicals from the module.

The first backwash without chemicals is intended to remove most of the foulants from the membrane surface which have not penetrated the membrane structure, also known as reversible fouling. When the backwash with chemicals is initiated, the chemicals are exposed only to the hard-to-remove foulants. The

modules are then filled with chemicals in the required concentration and with a long enough soaking time.

In most applications, alkaline CEB's have shown the best results for removing organic build-up (fouling) and CEB's using acid are the best solution for removing inorganic fouling (scaling, metals, coagulants/polymers). The CEB Alkaline sequence will be completed using caustic (NaOH) at pH 12, and sodium hypochlorite (NaClO), at 100-20 ppm, to reach a pH value of approximately 11-12. Due to the possibility of precipitation during an CEB alkaline sequence, a CEB acid sequence must always be carried out after the alkaline sequence. The CEB acid is dosed to reach a pH of 2-3. The necessity, frequency, duration, and concentration used for a CEB strongly depend on the application and on a detailed review of the data collected on-site.

All the timed setpoints in the CEB are user definable and adjustable on the HMI.

Chemical Dosing Pumps

Addition of chemicals during the CEB process will be automatic using chemical dosing pumps P-2030, P-2040, and P-2050. Dosing rates will be set up during initial start up to achieve a specified concentration of chemical in the water during a CEB. The chemical feed pumps will have HAND/OFF/AUTO switches for control of chemical addition.

The following P&IDs should be referenced for the service water system

- 1373-PID04, Rev. 5, Effluent Filtration System Fluidized Bed Perchlorate Treatment System
- 1373-PID12A, Rev. 6A, Effluent Filtration System Utility Systems
- 1373-PID18, Rev. 2, Effluent Filtration System Membrane Filtration Rack 1
- 1373-PID19, Rev. 2, Effluent Filtration System Membrane Filtration Rack 2
- 1373-PID20, Rev. 2, Effluent Filtration System Membrane Filtration Pumps

ELECTRICAL SYSTEM

Overview

The FBR System motor control center is fed from an 800 Amp breaker located in the existing substation located to the west of Building D-1. Power to this process can be locked out at the substation breaker or at the MCC main circuit breaker. The equalization area equipment is fed from MCC-3, located in Building D-1 Electrical

Room. MCC-3 is fed from a circuit breaker located in MCC-1 in the D-1 building electrical room. MCC-3 can be locked out at the feeder breaker in MCC-1.

Motor Control Center (MCC)

The FBR System motor control center controls the operation of all the system equipment with the exception of the Equalization Area equipment and the Building D-1 ISEP and raw water sumps and the booster pumps all of which receive power feed from the Building D-1 MCC. The MCC contains control transformers, motor starters, indicating lights and circuit switches for the various pieces of electrical equipment located throughout the plant. All of the equipment is provided with a disconnect switch safety lockout at the MCC. The operator must make certain that the power supply is disconnected at the motor control center or panel before any maintenance or repair is attempted on electrical equipment. This is necessary since many pieces of equipment are designed to start automatically or may be started remotely, and serious injury or death could occur if the circuits should be closed while the equipment is being serviced.

The control center is divided into smaller compartments containing the specific controls or switches for particular pieces of electrical equipment. Each compartment and every control switch are marked with a nameplate describing the function of the device and its identification. The MCC controls the power supply to the following equipment and circuits:

- First Stage FBR Fluidization Pump No. 1 (P-1011)
- First Stage FBR Fluidization Pump No. 2 (P-101A)
- First Stage FBR Fluidization Pump No. 3 (P-1012)
- First Stage FBR Fluidization Pump No. 4 (P-1013)
- First Stage FBR Fluidization Pump No. 5 (P-102A)
- First Stage FBR Fluidization Pump No. 6 (P-1014)
- Second Stage FBR Fluidization Pump No. 1 (P-3015)
- Second Stage FBR Fluidization Pump No. 2 (P-301A)
- Second Stage FBR Fluidization Pump No. 3 (P-3016)

- Second Stage FBR Fluidization Pump No. 4 (P-3017)
- Second Stage FBR Fluidization Pump No. 5 (P-302A)
- Second Stage FBR Fluidization Pump No. 6 (P-3018)
- Bed Height Control Pump No 1. (P-1021)
- Bed Height Control Pump No 2. (P-1022)
- Fluidized Bed Containment Area Sump Pump No 1 (P-1101)
- Bed Height Control Pump No 3. (P-1023)
- Bed Height Control Pump No 4. (P-1024)
- Thickener Underflow Pump (P-603)
- Scraper / Rake (M-611)
- Media Return Pump No 1 (P-2011)
- Media Return Pump No 2 (P-2012)
- Media Return Pump No 3 (P-3011)
- Media Return Pump No 4 (P-3012)
- Air Compressor Control Panel No 1 (P-801)
- Filtrate Recycle Pump (P-903)
- Aeration Blower (B-401)
- Sludge Conditioning Tank Agitator (M-901)
- DAF Pressure Pump No 1 (P-501)
- DAF Pressure Pump No 2 (P-551)
- Fluidized Bed Containment Area Sump Pump No 2 (P-1102)
- DAF Skimmer Drive No 1 (M-503)
- DAF Skimmer Drive No 2 (M-553)
- DAF Screw Conveyor Drive No 1 (M-502)

- DAF Screw Conveyor Drive No 2 (M-552)
- Ferric Chloride Feed / Mix Pump (P-751)
- Hydrated Lime Silo Control Panel (T-752)
- Effluent Pump No 1 (P-601)
- Effluent Pump No 2 (P-602)
- (Spare Breaker)
- Air Compressor Control Panel No 2 (P-802)
- Flocculation Mixer No 1 (M-612)
- Flocculation Mixer No 2 (M-613)
- Electron Donor Booster Pump No 1 (P-739A)
- Branch Circuit Panel board BCP-A (BCP-A)
- Control Panel Raychem HTPG (HPCP)
- Filter Press Control Panel No 1 (X-901)
- Filter Press Control Panel No 2 (X-902)
- DAF Float Pump No 1 (P-502)
- DAF Float Pump No 2 (P-552)
- (Spare Size 2 Starter)
- Electron Donor Booster Pump No 2 (P-739B)
- (Spare Size 1 Starter)
- Biofilter Control Panel
- (Spare Breaker)
- Branch Circuit Mini Power Zone BCP-B (BCP-B)
- (Spare Breaker)

Remote Safety Disconnects

Safety disconnect switch or field mounted lockout control station are located near each piece of electrical equipment. These devices may consist of HAND-OFF-AUTO switches for turning off the equipment. However, whenever it is necessary to work on the wiring of a motor or other piece of equipment, the power must be shut-off at the line disconnect at the MCC. The shut-off switches are designed so that they may be locked out with small padlocks to assure that no equipment is started while maintenance procedures are being performed. Detailed wiring schematics of both the remote field-mounted controls and motor control center controls are presented in the construction drawings.

EQUIPMENT PAD SUMPS

Overview

The equipment pad has two sumps with one pump installed in each sump (P-1101 & P-1102). These pumps are used for the removal of liquids from the equipment area. One sump is located between FBR – 1 Tank and FBR – 5 Tank and the other located by the Aeration Tank (T-401). There is a third existing sump pump adjacent to the D-1 Building (P-1202). The sump pumps (P-1101 & P-1102) are submersible centrifugal with a capacity of 85 GPM @ 27' TDH driven by a 1 HP 460VAC 3- Phase 60 Hertz motor. Fluids are pumped from the pad sumps to the Existing D – 1 sump, which transfers the water to GW-11 pond. The sump pumps in the equipment pad area have a level switch (LS -1101 & LS -1102), a High Level Alarm (LAH-1101 & LAH-1102) and Local Indicator (YI -1101 & YI -1102).

Liquids from the sumps are automatically pumped through a 3–inch CVCP line through a check valve and a ball valve to the ISEP sump outside the D-1 building. The ISEP pumps are controlled using the Building D-1 Allen Bradley System.

Safety Showers

There are 5 safety showers on the equipment pad (SS – 1202, SS – 1203, SS - 1204, SS – 1205 & SS – 1206) and 2 existing showers in the D -1 Building. Each shower is equipped with a pull chain to activate the shower, a handle to activate the eyewash, a temperature valve, an event alarm and SS-1202 through 1206 contain an alarm output to the PLC to indicate they are in use. The safety showers in Building D-1 do not have an alarm output. Stabilized lake water is fed to each safety shower through a 1.5 – inch CVPC line through a ball valve. The safety shower drains to the equipment pad sumps.

Fire Suppression System (Ethanol Storage)

The Ethanol Storage Vessel is provided with a fire protection system in accordance with NFPA and the following guidelines from Factory Mutual for water-spray application for “spill” hazard control and dilution.

The fixed fire protection uses a deluge control valve operating automatically by “pilothead” detection. The detection system consists of standard sprinkler devices installed on a closed network of pressurized pipe (air pressure supplied by a compressor in valve house). If a fire occurs, the heat from the fire should “fuse” (or

melt) the mechanical linkage (bulb) within the detecting sprinkler allowing the pressurized air to escape and mechanically tripping the deluge valve to open and water to flow through the main pipe system and discharge uniformly around the vessel with a specific design density application (0.30 gpm/sq. ft.).

The control valve can also be manually operated by actuating the “emergency pull” that is located on the valve trim.

Devices associated on the deluge control trim to allow for monitoring the system condition are wired to the local control panel in the MCC Area (refer to Simplex Panel Model 4010). The devices include:

- A tamper switch mounted on the main isolation valve in the valve house below the deluge control valve to show position of open (normal) or closed (supervisory trouble).
- A pressure switch mounted on the deluge control trim to indicate a “flow” condition if the valve is operated or if a “test” is performed on switch to simulate flow.
- A pressure switch on the “pilot-detection” line to monitor that sufficient pressure is maintained on the system.

The monitoring of the system functions are wired from the valve enclosure to the Simplex panel mounted within the MCC Room. Should an alarm or trouble condition occur with the ethanol fixed water system, alarms will be annunciated locally at panel and also be directed through the Simplex panel to a monitor station that is serviced 24-hours a day.

Recommendations for weekly visual inspections, quarterly, and annual inspections are outlined within NFPA documents. The system operating personnel shall determine any planned maintenance program. Routine housekeeping and monitoring of power interruptions or physical damage to the system components is necessary to be included in a comprehensive maintenance schedule.

Information regarding the resetting of valves after operation is described within the equipment brochures. Should any condition arise that may warrant service work, please contact the local SimplexGrinnell office.

Fire Suppression System (D-1 Building MCC Room)

The D-1 Building MCC Room area is protected by a Dry Pre-Action Sprinkler System. Activation of two smoke detectors, simultaneously sets off the water sprinkler system and the fire alarm. The Simplex 4010 automatically calls in the fire alarm.

Fire Suppression System (D-1 Building Control Room)

The wet riser sprinkler system protects the D-1 Control Room and the remainder of the D-1 Building except for the MCC Room. This is a simple, single action system, which is activated by heat. If a single sprinkler is heated, the sprinklers in the control room and the building are activated. The Simplex 4010 automatically calls in the fire alarm.