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0	02/03/05	Added new formats.
1	12/01/07	Added Revision Table. Divided "Introduction" and "Description" Sections. Updated Master Pages. Revised Appendix Sections 4.2.5.3.1.1, 4.2.3.1.6.3, 4.2.5.1.2, 4.2.3.1.6.6, and 4.2.3.3.1.4. Updated "Operation" and "Maintenance" Sections for the fire system. Updated Section 4.0.1, Equipment PM Index. Double sided Vol. 1. Added new binder cover sheets.

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INTRODUCTION

This manual is intended to provide a single source of reference on the systems and equipment installed in the Wastewater Treatment Facilities (Building 199 & 200).

This manual is an introduction to the operation & maintenance (O&M) of building-specific systems and equipment and is not meant to supersede the manufacturers' specifications or information. The drawings and references contained within this text may or may not be “As-Built” records edited from original construction documents depending on the condition of the reference materials used at the time. The intent is to reflect the actual, or as close as possible, to the installed condition of building systems and equipment. Original manufacturers' drawings, schematics, specifications, and information have been used to the fullest extent.

This manual is divided into four (4) major sections:

- Section 1 — **DESCRIPTIONS**: Plain language descriptions of the building infrastructure and various systems contained within the building.
- Section 2 — **OPERATIONS**: Basic overview of the operational characteristics of the building, equipment, and systems.
- Section 3 — **MAINTENANCE**: Specific maintenance requirements for equipment and systems.
- Section 4 — **APPENDICES**: Provides manufacturers' O&M data, drawings, schematics, wiring diagrams, parts identification, and contractor information.

Italic and **bold** entries indicate switches positions, panel positions, or indicators the operator must use to run facility equipment or systems.

This manual should be considered a living document, and as such it should be enhanced throughout the life of the building. Therefore, operational characteristics, maintenance procedures, and O&M data for building equipment and systems will be updated as equipment / systems are developed, deleted, modified, and / or upgraded.

Danger, Warning, Caution, Note and Notice

Danger, Warning, Caution, Note and Notice, as deemed necessary by the documentation department, appear at appropriate intervals throughout this manual. Below are explanations for each:

Danger - Warns of hazards that **WILL** cause serious personal injury, death or major property damage.

Warning - Warns of hazards that **CAN** cause serious personal injury, death or major property damage.

Caution - Warns of hazards that **CAN** cause personal injury or major property damage.

Note and Notices - Indicates special instructions which are very important and must be followed.

Manufacturer / vendor warnings and notices as they appear in their documentation are re-produced in this manual.

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1 DESCRIPTIONS

1.1 GENERAL BUILDING DESCRIPTIONS

1.1.1 Building Design

The Waste Water Treatment Plant provides year-round waste treatment for all the habitants at McMurdo. The plant is a 10,500 sq. foot, two floor, wide-span structure. The two floors are connected by enclosed stairwells. The building is elevated up off the ground 4 feet and is accessed from the outside using precast concrete stairs and landings.

The three main process tanks are located in the center of the building. The tanks can be viewed from the observation area located on the second floor. Operators and maintenance personnel can access tank systems using grating walkways located around the tanks.

The structure has a foot print of approximately 75' by 140'. Interior space is divided for a variety of uses.

1.1.2 Building Occupancy

In accordance with the Uniform Building Code, the Waste Water Treatment Plant is classified as a mixed occupancy structure. A summary of the Occupancy classifications is as follows:

LABORTORY	B
LOW HAZARD FACTORY	F2
CONSTRUCTION TYPE	2C

1.1.3 Building Site and Utilities

The WWTP site is located approximately latitude 77°50'44.47549" South and Longitude 166°38'19.61671" East. (See drawing C1.0 - C4.0, Appendix 4.1.1).

Electrical, plumbing, and communications utilities are routed to the WWTP from the various of facilities located at McMurdo.

In the event of a disruption of services from the Power Plant Bldg. 196, emergency power lighting and heating are incorporated in the WWTP's design.

1.1.4 Building Room Schedule

FIRST FLOOR	
ROOM NAME	ROOM #
LOADING AREA	RM107
LOADING AREA	RM109
STAIRWELL	SW108
BOILER ROOM	RM101
STAIRWELL	SW102
COORIDOR	RM103
JANITOR CLOSET	RM110
ELECTRICAL ROOM	RM104
UV ROOM	RM105

SECOND FLOOR	
ROOM NAME	ROOM #
DEWATERING ROOM	RM210
STAIRWELL	SW211
BLOWER ROOM	RM212
MECHANICAL ROOM	RM201
STAIRWELL	SW202
CONTROL ROOM	RM204
TOLIET ROOM	RM203
VESTIBULE	RM208
LABORATORY	RM205
STORAGE	RM207
COMMUNICATION CLOSET	RM206

Boiler Room

The boiler room is located on the first floor. The boiler is used to provide heat to the building. The boiler also acts as an energy source for other equipment or systems. Example would be the Boiler Mate™ Water Heaters used to supply heated domestic and process water.

Blower Room

Heated air provided by the blowers is used for the aeration tanks. The outside air is heated using a hot water coil located between the blower and the outside wall of the building.

Loading Areas

One loading area is located below the dewatering room and the other one is located below the blower room. Each loading area has overhead access hatches and 1/2 Ton monorails for passing equipment to the blower and dewatering rooms. Outside access to each loading area is through motorized coiling overhead doors. The loading area below the dewatering room contains the storage container for the biosolid cake. The other loading area below the blower room provides an influent waste pipe used to empty the pig.

Laboratory

The laboratory is used to test the processed water to make sure it is within specifications and to perform other biological testing.

Vestibule

The vestibule is used as a viewing area overlooking the first floor process equipment. Large panes of glass (store front) were installed for this purpose.

Control Room/Mezzanine

The control room contains the control console used to monitor and run all the operations.

UV Room

Contains the ultra-violet system used to kill any remaining bacteria before the water is routed to the outfall.

Electrical Room

The electrical room is the center point for all the power panels and is the main power-in entry point for the plant.

Janitor Closet

The janitor close on the first floor has a mop sink and storage for janitor supplies.

Communication Closet

The communication closet contains the communication equipment.

DeWatering Room

The DeWatering Room houses the belt filter press equipment used to separate the solid materials from the liquids.

1.2 ARCHITECTURAL / STRUCTURAL SYSTEMS

1.2.1 Building Systems

1.2.1.1 Foundation System

The foundation system is a series of steel, grade-beam, strip footings founded on compacted snow. Where the required width of the footing exceeds the width of the grade beam, the beams sit on wood footing pads. The grade beams are rigidly connected to pipe support columns that extend up to the first level framing. The top of each support column is provided with a combination bearing seat and future-column-extension flange.

The flange allows for the installation of support column extensions if raising the building eventually becomes necessary. The bearing seat facilitates intermediate leveling of the superstructure by adding or removing shims between the superstructure framing and the support columns.

1.2.1.2 Floor Framing / Precast Concrete System

A two-way truss platform spans the vertical support columns at the first floor level. Double trusses run perpendicular to the long axis of each pod wing. The double-truss design places a truss on each side of the support columns. This allows for the addition of support column extensions without disturbing the trusses, and for the installation of a spreader beam and jack on top of the column to accomplish raising of the superstructure.

Typical floor framing consists of wide-rib, steel decking resting on open-web, steel joists. The steel decking is sheathed with $\frac{7}{8}$ " of fiber-reinforced-cement board (FCB) to provide a flat underlayment for finish-floor surfaces.

1.2.1.3 Roof Framing System

The roof framing uses insulated, prefabricated panels spanning over the top of open-web, steel joists. The joists, in turn, span between steel, wide-flange beams.

1.2.1.4 Building Structure

Wide-flange, steel columns extend upward from the first-level trusses and are rigidly connected to the framing at the second level and roof. These connections provide a lateral-load-resisting space frame in each direction.

The exterior prefabricated building panels are attached to the columns but are not part of the lateral-force-resisting system.

1.2.2 Windows and Doors

Window types, sizes and details are shown on the “Window Detail” Sheet [A5](#) of the design drawings located in Appendix 4.1.2.

Door types, functions, sizes, and required resistive fire ratings for the WWTP are as indicated on the “*Door Schedule*” details referenced in the WWTP design drawings [A3](#) of Appendix 4.1.2.

The WWTP’s exterior doors are thermally insulated, hollow metal-type doors with steel frames. Interior doors are typically engineered-core, or hollow, metal doors with metal frames.

1.2.3 Thermal Envelope

The WWTP is raised above the snow surface to provide a thermal break between the cold snow and warm structure and to avoid snow drifting against the building. The insulated panels that form the roof, exterior walls, and soffit consist of an expanded polystyrene (EPS) core with oriented-strand board (OSB) on both sides. Design insulation values for the premanufactured panels are R-70 for roofs and soffits and R-50 for exterior walls. A self-sealing (healing) type vapor barrier is applied to the interior surface of the insulated panels. Foamed-in-place insulation is utilized to fill small gaps and openings.

1.2.4 Exterior Finishes

The exterior finish material of the WWTP is composed of pre-finished, aluminum-faced, composite insulated metal panels. The exterior facing is factory finished with a siliconized-polyester coating.

1.2.5 Interior Finishes

Floor types/finishes are as indicated on the “Room Finish Schedule” (See Drawing [A4](#), Appendix 4.1.2).

Wall finishes are also detailed in the “Room Finish Schedules” on Drawings [A4](#) of Appendix 4.1.2.

1.2.6 Interior Specialties / Fixtures

1.2.6.1 Graphic Display Board

A variety of information, caution and warning signs are used throughout the WWTP. The graphic display board is located on the second floor in one corner of the Vestibule Room.

1.2.6.2 Fire Extinguishers and Cabinets

A variety of fire extinguishers are located throughout the WWTP:

- Dry chemical extinguishers are typically used in mechanical areas such as fan and mechanical rooms.
- Carbon Dioxide extinguishers are typically used in areas containing electronic and computer equipment.
- Charged stream (water) extinguishers are typically used in berthing areas.

1.2.6.3 Toilet, Utility and Washroom Accessories

A lavatory, mirrors, towel and tissue holders, and other accessories are available in the toilet and janitor spaces. Technical data on these accessories can be found in Appendix Section [4.2.3.3.2.3](#) of this manual.

1.3 CONVEYING SYSTEMS

1.3.1 Monorail Hoist Systems

To simplify the task of moving heavy and/or bulky items into and out of the DeWatering and Blower Rooms, an electrically powered, trolley mounted, cable hoist is provided. Hoist operation is operated using a pendant control system. The hoist is insulated and electrically heated. It is designed to operate at temperatures as low as -20° F.

The hoist trolley is motorized and has a maximum rated travel speed of 30 feet-per-minute. The trolley mounting system incorporates a “festooned cable” electrification system which supplies 480-Volt, 3-Phase power to the hoist.

The hoist has a maximum lift distance of 21 feet, a maximum rated capacity of 1 ton, and a lifting speed of 16/5 feet-per-minute (FPM).

The hoist mechanism consist primarily of an aluminum alloy frame and gear case cover which houses an automatic load brake and gear train. An electric driving motor and external motor brake are mounted on the rear of the frame Electrical control components are mounted on front of the gear case cover and encased by aluminum alloy end cover. An upper hook or lug bracket for suspending the hoist is attached to the top of the frame. Either a special nickel steel roller load chain or high strength low alloy coil load chain with lower block assembly is employed to raise and lower loads. A block and chain operated limit stop lever is mounted on the bottom of the hoist frame and is connected, by linkage, to a limit switch. Hoist operation is controlled by a pendant push-button station.

The hoist is equipped with an overload clutch that is designed to help guard against excessive overloads. The clutch is built into the load brake gear. It is a cone-friction clutch that connects the first reduction gear (load brake gear) to the load brake output pinion shaft. A belleville disc spring provides clutch pressure between the gear and its cone shaped gear center. An excessive overload causes the load brake gear to rotate without turning the gear center and output pinion shaft. The clutch is located between the load brake and the motor, thus allowing both load brake and motor brake to function in their normal manner.

WARNING:

Equipment covered herein is not designed, or suitable, as a power source for lifting or lowering persons. Do not use as an elevator.

The man-guard overload clutch is a protective device that will permit operation of your hoist within its rated load and will prevent lifting of excessive overloads which can cause permanent deformation or weakening of a properly maintained hoist and/or its suspension.

1.4 MECHANICAL SYSTEMS

1.4.1 Heating Generation and Distribution Systems

1.4.1.1 Waste Heat Connection and Distribution

Heated air provided by the blowers is used for the aeration tanks. The outside air is heated using a hot water coil located between the blower and the outside wall of the building.

1.4.1.2 Perimeter Heating System

The perimeter heating system uses heat transferred from the New Power Plant waste heat loop to provide air tempering, to heat domestic hot water, and to provide hydronic heat throughout the WWTP.

The system uses a glycol/water solution (60 percent ethylene glycol / 40 percent water) as the primary heat transfer medium. In each pod, duplex pump sets circulate the glycol solution to air tempering coils in the air handling units, reheating coils in the ventilation ducts, finned-tube heaters in corridors and berthing spaces, radiant ceiling panels in hard-to-heat areas, and cabinet unit heaters in vestibules and mechanical spaces.

The heating system is equipped with air separators that purge gas bubbles from the glycol stream. Expansion tanks allow the heated glycol to expand without overflowing the system. A glycol make-up system is provided in each pod to keep the perimeter heating system filled to the optimum level.

1.4.2 Ventilation and Air Systems

1.4.2.1 Exhaust Systems

The aeration tanks are covered with 4 inch interlocking metal covers to reduce the amount of gases escaping from the tanks. Flex hoses drop down from a fan located on the second floor to port openings on the covers. The fans suck the exhaust air from the tanks and vents it to the outside. The fans run continuously to provide a positive air flow.

1.4.2.2 Make-up Air/Supply Systems

The venting system is located on the second floor in the fan room above the boiler room. An air handler unit and heat exchanger take in outside air, heats it, and blows it out into the building for comfort heating.

1.4.3 Plumbing Systems

1.4.3.1 Domestic Water System

The 3 inch domestic fresh water line enters the East side of the plant with a main shut off located in the Mechanical Room. Fresh water is supplied from the Water Plant Building #198. Domestic water is heated by water heater WH-1.

1.4.3.2 Waste/Vent System

Vent piping for the plumbing fixtures and storage tanks is combined to the extent feasible to limit roof penetrations while maintaining the minimum required venting area. The combined vents are routed through the roof of the WWTP.

1.4.4 Fuel System

1.4.4.1 Fuel Storage Tank

A separate fuel tank is used to feed the boiler. Pump located next to the boiler supplies heated water to existing water heaters and heat exchangers in the plant. heated water is also supplied to the belt filter press, several sinks, showers, wash stations, and a janitor sink.

1.4.5 Control Systems

1.4.5.1 Direct Digital Control Systems

Control Valves

The TCV-1 Belimo B349B is a 2 inch, 3-way Ball Valve, Cv=46. This ball valve serves the AHU-1/HC-1 Belimo AF24-SR us Actuators.

The TCV-2 Belimo B222B is a 1 inch, 2-way Ball Valve, Cv=7.4. This ball valve serves the AHU-2/HC-2 Belimo NF24-SR us Actuator.

The TCV-3 Belimo B317B is a ¾ inch, 3-way Ball Valve, Cv=4.7. This ball valve serves the HC-3 Belimo NF24-SR us Actuator.

The TCV-4 Honeywell V5011A-1767 is a 2 inch, 2-way Globe Valve. The TCV-4 Honeywell V5011A serves HX-3 Cogen Heat Recovery Side. Actuator Honeywell M7284Q-1017 Linkage Q5001D-1018.

Damper Operators

The DM-1 Belimo AF120-S is a 133in.lb., 120vac, 2-position spring return with auxiliary contacts damper control actuator.

If F-1 is ON, D-1 is Open. If F-2 is On, D-2 is Open.

The DM-2 Belimo NF120-Sis a 60in. lb., 120vac, 2-position spring return with auxiliary contacts damper control actuator.
If F-3 is ON, D-5 is Open. If F-4 is ON, D-4 is Open.

Input/Output Sensors

The CS-x Veris H-608 Current Switch is a single pole, single throw (SPST), normally open (NO), 1-250 amp switch.

The IR1-x IDEC RH2B-UL24VAC/SH2B-05 Control Relay with Base is a double pole, double throw (DPDT), 24vac 10amp relay.

The IR2-x Functional Devices RIBU1S Interface Relay is a single pole, double throw (SPDT), 10-30vac/dc, 10amp relay with LED and a Hand/Off/Auto (HOA) switch.

The LTC Siemens 134-1504 Low Temperature Cutout Switch is a double pole, double throw (DPDT) switch with a manual reset.

The PE Grainger P10BC7 Pressure Electric Switch is a single pole, double throw (SPDT).

Air Providing Switch Blower Indicator.

The R1-x IDEC RH2B-UL120VAC/SH2B-05 Control Relay with Base is a double pole, double throw (DPDT), 120vac, 10amp relay.

The R1-x IDEC RH2B-UL120VAC/SH2B-05 Control Relay monitors status input of various line voltage stand alone systems.

S1-x Alerton TS-1050-BT Temperature Sensor Wall Mount (Space) 10K type 2 with Set-point Adj. space temperature.

S2-x Alerton TS-2008-BT Temperature Sensor 8' Duct Averaging 10K type 2 duct temperature.

S3-x Alerton TS-3200-BT Temperature Sensor Outside Air 10K type 2 outside air temperature.

S5-x Alerton TS-2115-BT Temperature Sensor 6" Immersion 10K type 2 Stainless Steel fluid temperature pipe.

Transmitters

PT1 Kele P100BTE-05 Pressure transmitter 4-20mA signal, 0-30PSI.
Blower Air Pressure Monitor.

Further information on the control valves is available in Appendix Section [4.2.3.5.5.1](#) of this manual.

1.4.5.2 Process Instrumentation and Control Systems

BTI Alerton BTI Bactalk Integrator and Global Controller.

The BTI Alerton BTI Bactalk Integrator and Global Controller executes global direct digital control (DDC) algorithms. These algorithms orchestrate the operation of the field controllers. The Bactalk Integrator and Global Controller also has host control features for scheduling, trendlogs, and alarms.

The VLC1-x Alerton VLC-1188C3 Programmable Visual Logic Controller has 11 universal inputs, 8 binary outputs, and 8 analog outputs. BACNET Class 3.

The VLC1-x Alerton VLC-1188C3 Programmable Visual Logic Controller can operate in a stand alone mode or as part of site-wide system on a Bacnet MS/TP Lan. Applications include Air Handling Units, Central Plants, Clean Rooms and Fume Hoods.

The VLC2-x Alerton VLC-853C3 Programmable Visual Logic Controller has 8 universal inputs, 5 binary outputs, and 3 analog outputs. BACNET Class 3.

The VLC2-x Alerton VLC-853C3 Programmable Visual Logic Controller can operate in a stand alone mode or as part of site-wide system on a Bacnet MS/TP Lan. Applications include Air Handling Units, Central Plants, Large Terminal Units and Similar Controls.

Further information on the controllers is available in Appendix Section [4.2.3.5.6](#) of this manual.

1.5 ELECTRICAL SYSTEMS

1.5.1 Interior Distribution System

1.5.1.1 Panelboards

Distribution panelboards typically use 3-phase, 4-wire input. Both 277/480-Volt and 120/208-Volt panelboards are used. Panelboards are typically solid neutral, separate ground bus, circuit breaker/branch circuit types equipped with bolt-on circuit breakers.

1.5.1.2 Motor Control Centers

Motor control centers (MCC) are the primary locations of motor starters for the equipment within the WWTP. The motor control centers are front accessible and are rated at 277/480 Volts, 3-phase, with a short circuit rating of 100,000 Amperes (root-mean-square) symmetrical at 480 volts.

Motor controllers combined with motor-circuit-protection type circuit breakers (in lieu of fused disconnects) are contained in common enclosures. Locking disconnect handles for electrical maintenance safety are also provided. Half-size, full voltage, non-reversing (FVNR) motor starters are typical for all motor loads not requiring variable frequency drives (VFD) or soft start controllers. For motors rated at or above 5 horsepower, soft-starting motor starters are used unless a FVNR controller is recommended by the manufacturer.

1.5.1.3 Transformers

Interior

There are four dry-type transformers (T-1 thru T-4) used in the MCC tied directly to the panel's main bus. All four transformers are physically located in the Electrical Room (RM 104). All four transformers are of the step-down type, lowering the voltage from 480V on the primary side to 208V on the secondary side.

Exterior

Power to the plant comes from the secondary windings of a 300 KVA, pad mounted, transformer. The transformer is a 3 phase, 60 Hertz, Class GA-H, 150° C rise, with a rated primary volts of 4160 delta (30 KV BIL) and secondary volts of 480y/277 (10 BV BIL).

The transformer has dry type coils with nitrogen seal. The primary coils are fused to reduce the risk of damage from voltage surges or lightning strikes. Protective coverings protect the transformer from the elements.

1.5.2 Lighting

Lighting within the WWTP is typically provided by fluorescent luminaries using T8 lamps. Wherever possible, fluorescent luminaries are equipped with 277-Volt, energy conserving, magnetic ballasts.

Due to limitations on the use of T8 fluorescent lighting at temperatures below approximately 60° F, exterior stairways, landings, and decks are provided with incandescent lighting:

Fixtures in these areas are typically equipped with vapor-tight globes and cast-metal guards. Incandescent lighting is normally 120-Volt with 130-Volt light bulbs installed to increase bulb life expectancy.

Surface or pendent mounted high pressure sodium lighting will be provided in industrial atmospheres for interior locations. Industrial strip fluorescent lighting will be provided in the electrical room and in the mechanical room. General purpose lighting shall be 120V. Lighting levels will be designed to meet or exceed Illuminating Engineering Society (IES) recommended levels. Lighting fixtures types will be specified as appropriate for the areas of installation that are classified as a hazardous, corrosive, or wet locations.

Emergency lighting consists primarily of ballast-channel-mounted, emergency lighting units (back-up ballasts) installed in fluorescent luminaries. In unheated areas, the incandescent fixtures that provide normal lighting are connected to an uninterruptible power supply (UPS) that provides approximately 90 minutes of back-up lighting.

Exit signs within the WWTP are typically low-energy-consumption, fluorescent type, equipped with lead calcium, back-up batteries. Exit signs in the Vertical Tower are self-luminous. Self-illumination is provided by tritium gas encapsulated within the signs.

Building exterior lighting consist of high pressure sodium fixtures controlled through time clocks and lighting contactors with hand-off-automatic selector switches. Wall pack fixtures provide lighting for the perimeter of the building.

1.5.3 Heat Trace

Heat trace within the WWTP is provided for exterior doors, vent-thru-roof piping, and for waste piping and drains. Typically all water supply piping is double traced while drains are single traced. Self-regulating, self-limiting cabling with thermoplastic insulation, parallel conductors, and a nominal output of 3.28 watts per linear foot is utilized.

Heat trace is provided with 120-Volt electrical power and supplied via branch circuit distribution panelboards.

1.5.4 Signal Systems

1.5.4.1 Telephone

The telephone system uses conventional analog transmission to provide voice communications within the WWTP, and to other sites. Individual telephone extensions are provisioned from the station PABX to provide feature selections; and to control access to off-station telephone circuits.

1.5.4.2 Public Address System

The WWTP has no dedicated public address system.

1.5.4.3 Local Area Network (LAN)

Computer workstations throughout the WWTP are interconnected via a Local Area Network (LAN). The LAN backbone is composed of fiber optic transmission lines. Drops to individual workstations utilize cat-5e (copper) transmission lines and are capable of 1 gigabyte (1 billion bytes-per-second) throughput. The LAN system has a capacity of 100 megabytes (100 million bytes-per-second) per workstation.

LAN transmission lines throughout the WWTP typically incorporate copper, multi-mode fiber optic, and single-mode fiber optic cable to provide adequate capacity and versatility for all projected needs.

Selected multi-outlets in the Laboratory and Control Room have fiber-optic outlets for high-speed connectivity to external networks.

1.5.4.4 Fire Detection and Alarm Systems

The WWTP fire detection and alarm system is a microprocessor-based, addressable-type system, which is interconnected with the plant's Communications Center. This system permits simple, station-wide interconnection while maintaining addressability. The use of an addressable system also enhances the ability to provide the required pre-discharge alert for the carbon dioxide (CO₂) fire suppression system.

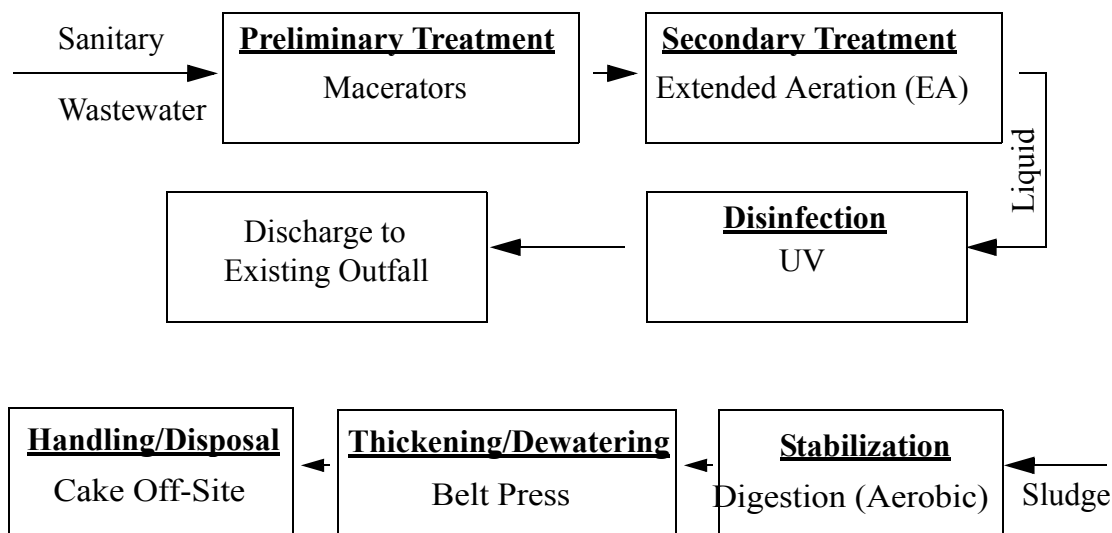
The Fire Alarm Control Panel (FACP) is located in the Communications Center (RM 206). The control panel's annunciation features are augmented with a graphic display that uses light-emitting diodes to indicate the alarmed zone. Annunciator panels are provided on each floor in both pods of the WWTP.

The FACP reports trouble/alarm signals to the Direct Digital Control (DDC) system. The FACP is also interconnected with discharge valves on both the CO₂ fire-suppression system and the fire sprinkler system to facilitate automatic discharge and annunciation.

Manual pull stations are located at all exits and at other strategic locations throughout the WWTP. Heat detectors and photoelectric-type smoke detectors are used throughout the facility, particularly in spaces that are relatively inaccessible or infrequently occupied, such as air ducts and soffit spaces.

Combination audible/visual (horn/strobe) alerting devices are used throughout the WWTP to provide emergency notification to the occupants.

1.6 WASTE WATER TREATMENT PROCESS SYSTEMS



1.6.1 Preliminary and Secondary Treatment

The Wastewater Treatment Plant uses a system of solids removal and liquid purification (See diagram above) based on activated sludge type, specifically known as “Complete Mix/Extended Aeration Activated Sludge”, designed for treating a total of 131,000 gallons per day of 354 mg/l BOD₅, Ammonia Nitrogen (NH₃-N), lbs./day, 18,204 mg/l TSS, 4,500 mg/L Mixed Liquor Suspended Solids (MLSS), lbs. BOD₅/1,000 cubic feet, 15, 2.0 mg/L Residual Dissolved Oxygen in Aeration zone, 6-9 pH, domestic sewage.

Wastewater enters the Aeration Zones, where it is mixed with micro-organisms (sludge) and aerated for a given period of time. Combined sludge and water (Mixed liquor) flows from the Aeration Zone into the Clarifier for separation. In the Clarifier, sludge is allowed to settle for returning to the Aeration Zone. Returned sludge is mixed with more raw sewage to repeat the process. Water separated from Mixed Liquor flows over a weir and into the Ultraviolet Light Disinfection Tanks. Ultraviolet lamp banks disinfect the treated water prior to discharge into the existing outfall. A sludge holding tank is used to hold excess sludge that must be occasionally removed from the Clarifier to maintain a suitable degree of treatment.

1.6.1.1 Macerators

Raw sewage enters the building where it will pass through one of two (1 duty, 1 standby) in-line macerators (Muffin Monsters) which grind materials within the sewage and discharge the ground material into the wastewater stream. The macerators are installed in parallel and are re-settable using a hand switch to reset after an alarm condition. A hand switch is provided with hand-off-auto (H-O-A) capabilities. An operating light and operating alarm is provided with each macerator. Hand switches, lights, and alarms are located on a unit control panel (UCP) located adjacent to the macerator. A common alarm signal is sent to the MCR. The alarm signal designates an alarm condition exists within the Preliminary and Secondary Treatment area of the plant. Motor control components are located in the UCP. Isolation eccentric plug valves are used to isolate each macerator. This will also reduce the organic load to the extended aeration reactor.

1.6.1.2 Influent Flow Metering

Macerated flow is then routed through a Parshall Flume measuring device. This flume measures total flow entering the WWTP. A ultrasonic flow meter transducer provides a local readout as well as a readout at the MCR.

1.6.1.3 Raw Sewage Bypass and Secondary Treatment Bypass

The influent system is equipped with bypass pipeline and isolation eccentric plug valves located just before the macerators for complete system bypass, and after the macerators for secondary treatment bypass.

1.6.1.4 Anoxic Basin Mixing

An influent flow splitter box, manually operated by the operator, can feed one basin or a combination of basins depending on input levels. The splitter box can be set to route waste into one basin, and at peak input times route the overflow to additional basins. The influent flow splitter is equipped with four (4) 90° V-notch weirs, leading to four (4) 6" standard diameter pipe flange connections leading to each aeration basin.

The purpose of the anoxic basins (one for each aeration basin) is to remove nitrogen. There is a solid baffle separating the anoxic basin from the aeration basin with an opening located at the bottom of the baffle. An anoxic mixer is used to push the waste material downward further into the process allowing it to enter the aeration basin through the baffle opening.

The extended aeration system is classified as a low-loaded, activated sludge system where diffusers provide oxygen and mixing to the basin contents. The heated air helps maintain the water temperature between 68 - 75 degrees. Each tank has an oxygen sensor mounted in the tank to measure the oxygen available to the bacteria. Considerable process flexibility is allowed.

The extended aeration process provides carbonaceous BOD5 removal and nitrification with the same sludge system. In addition, an anoxic zone equipped with mixers is provided to denitrify the wastewater and restore some alkalinity to assist in the nitrification process.

Pumps in the tanks under DDC control are used to pump some of the waste mixture back into the anoxic basin to further facilitate the bacteria.

Three inch drains, located on the end of the tank, are used to drain the tank for cleaning purposes. Pumps and a series of manually operated valves move the waste out to the sea or to one of the other tanks.

As described below, supernatant from the aerobic digester and filtrate from the belt filter press will be discharged to the aeration basin.

Contents from the aeration basin flows by gravity to the final clarifiers.

An anoxic zone at the head end of the basin provides for denitrification and alkalinity recovery. The anoxic zone is equipped with a submerged mixer to mix the contents. The mixers are controlled by a H-O-A switch located within a UCP. An operation alarm light is located at the UCP and MCR.

Internal mixed liquor recycle pumps are responsible for returning mixed liquor from the aeration basin to the anoxic zones. The pumps are equipped with a magnetic flow meter with local readout and readout at the MCR. A totalizer value is provided. The pumps are equipped with an H-O-A switch operating lights and alarms at a UCP and the MCR.

1.6.1.5 Mixed Liquor Recycle Pumping

Internal mixed liquor recycle pumps are responsible for returning mixed liquor from the aeration basin to the anoxic zones. The pumps are equipped with a magnetic flow meter with local readout and readout at the MCR. The pumps are equipped with an H-O-A switch operating lights and alarms at a UCP and the MCR.

1.6.1.6 Return Activated Sludge and Waste Activated Sludge Pumping

Three clarifiers are used to settle activated sludge from the mixed liquor suspended solids (MLSS). MLSS enters the clarifier by a 12"x12" cutout in the aeration baffle located between the aeration basins and the clarifiers. Scum, being lighter than the treated liquid, floats to the surface leaving the sludge to settle towards the bottom.

The flow is then directed outward with MLSS to the bottom while effluent proceeds towards the overflow weir. Effluent flows to the outboard weir and into the effluent trough. From here effluent is conveyed to the UV disinfection system.

The weirs are provided with a scum baffle to avoid overflow of scum and floatables. The scum and floatables are then removed by a scum skimmer. Settled activated sludge is collected and conveyed to the RAS/WAS air lift pumps.

Return Activated Sludge (RAS) from each clarifier is returned by use of a 4" diameter airlift return assembly and pump, to the extended aeration basin.

The RAS/WAS air lift pumps are capable of returning sludge at rates of 50 percent to 150 percent of the maximum average daily flow as well as the required wasting amounts.

The discharge line is equipped with a magnetic flow meter with local readout as well as remote digital readout at the MCR. It is also equipped with a totalizer located at the MCR.

RAS is pumped on a continuous basis at a manually controlled rate.

The RAS/WAS air lift pumps also pump waste activated sludge (WAS) to the aerobic digester. The WAS discharge header is equipped with a magnetic flow meter capable of local readout of flow as well as a signal being sent to the MCR for a digital readout. The WAS line is operated on a timer control system allowing start/stop cycles. The flow meter is equipped with a totalizer located at MCR.

1.6.1.7 Scum Removal System

The scum and skimming recirculation system consists of a airlift skimming device and a 2" scum return line. The skimming device is of the positive airlift pump type, located in a position to skim and return floating material. The scum is collected and transferred to either the WAS discharge line or the RAS discharge line for conveyance to the aerobic digester or recycled back to the aeration basins.

1.6.2 Tertiary Treatment

1.6.2.1 Ultraviolet Light Disinfection

Secondary effluent from the clarifiers flows by gravity to the ultraviolet (UV) light disinfection system. A dual UV channel system provides continuous disinfection. Flow enters the UV system and is directed into the channels containing the UV lamps. The disinfected flow is then routed through a Parshall Flume measuring device. A ultrasonic flow meter transducer provides a local readout as well as a readout at the MCR. The disinfected liquid then flows to the outfall.

The UV unit is supported by the following instrumentation and control:

- The UCP enclosure is of a NEMA 4X design and houses all the electrical components, i.e., meters, lamp monitoring system, on/off switch and breakers, ballasts, time indicators, etc. A plexiglas window is provided to allow viewing of system indicators and monitoring devices.

- Contact closure for remote annunciation at the MCR is used to indicate lamp rack failure due to ground fault interruption and is designated as an alarm condition in the Tertiary Treatment area.
- Each bank of UV lamps is equipped with an ultraviolet intensity sensor. The sensor transmits a signal to an intensity meter located in the UCP. The meter provides a percent UV output reading indicating the amount of UV light available at a representative location within the bank of lamps. For remote monitoring purposes the UV intensity meter provides a 4-20 mA output, for indication at the MCR.
- The UV intensity meter has only one fully adjustable alarm set point. Contact closure occurs at the preset level for remote alarm annunciation at the MCR, designated by an alarm condition in the Tertiary Treatment area.
- A solid state digital elapsed time counter is used for each bank of lamps or each section of lamps within a bank. The counter is located in the UCP.
- Each module is equipped with an electronic lamp monitoring system. This system indicates the geometric location of each individual lamp and the operating status of each lamp by means of a neon light. Upon lamp failure, the corresponding neon light brightly illuminates and a contact closes signaling a remote alarm annunciation at the MCR. This alarm annunciation is designated as an alarm condition in the Tertiary Treatment Area.
- A single beam UV filter photometer with front panel and 100% transmittance control adjustment is used to measure the UV transmittance of the effluent. The range limit is 0 - 100% transmittance with a wavelength accuracy of 0.16 half band width.

1.6.3 Digestion

1.6.3.1 Blower System

Low pressure blowers provide air to a coarse bubble diffuser grid on the bottom of the aeration basins; and the aerobic digesters as well as the air for the airlifts in the aerobic digesters and secondary clarifiers. Blowers are controlled by a UCP with local alarms, local operating light, and start-stop switches. A common alarm signal is sent to the MCR as an alarm condition in the Preliminary and Secondary Treatment area. The blower discharge line is equipped with a high pressure alarm signal, and butterfly valves to control the amount of air being supplied to the aeration basins and the aerobic digester. The inlet lines are equipped with pre-heaters, intake filters, silencers, actuators, and butterfly valves.

1.6.3.2 Aeration and Digestion Air Supply System

Blowers supply oxygen to the wastewater in the aerobic zone of the aeration tank through submerged diffusers. The amount of air delivered to the aeration basins by the blowers is controlled automatically. Dissolved oxygen (D.O.) probes are mounted in the aeration basins. The D.O. probes send a 4-20 mA signal to a Programmable Logic Controller (PLC). The PLC has an operator input set point for the desired D.O. value to maintain in the aeration basins. The PLC then outputs a signal which automatically controls the blowers to maintain the desired D.O. level in the aeration basins.

1.6.4 Biosolids Handling

1.6.4.1 Digested Sludge Pumping, Polymer and Belt Filter Press Operation

1.6.4.1.1 Sludge Pumping

Periodically the air supplied to the digester is shut to allow the contents of the tank to settle. After a sufficient amount of time, clean supernatant from the digester is removed by air lift pumps and pumped to the aeration basins. Digested sludge is then removed by submersible pumps valves and pumped to the belt filter press. Each digested sludge pump has a discharge check valve, a discharge plug valve, and a pressure gauge. The pumps are submersible non-clog type pumps. The pumps are provided with a UCP equipped with a lock-out-stop-switch, local operating light, local operating alarm, and an H-O-A switch. A common alarm signal is sent to the MCR and is designated as an alarm condition in the Digestion Area. The discharge line is equipped with a magnetic flow meter which sends a readout to the MCR. In the automatic mode, these pumps are controlled on a timer control system allowing start/stop cycles based on a total daily amount of flow pumped as indicated on the flow meter.

1.6.4.1.2 Klampress KP05 Belt Filter Press

General Mechanical Description

The Klampress KPO5 Belt Filter Press is made from quality materials with tough, corrosion-resistant coatings, which results in years of dependable service and minimal maintenance.

The Klampress system of liquid solid separation is a continuous operation. Biosolids and polymer are mixed in the variable orifice in line mixer, then introduced to the gravity section of the Klampress. In the gravity section, the slurry is turned over by chicanes which expose open area on the belt for gravity drainage.

As the slurry thickens near the end of the gravity section, the slurry is then introduced to the wedge section, where the two belts come together. In the wedge section, the slurry is sandwiched between the two belts which begin to slowly add pressure. The two belts will go over two curved grids, which slowly increases pressure and wipe water away from the belts. The slurry, which is still between the two belts, will then enter the high pressure section, where the two belts make successive wraps around rollers in an “S” pattern. This “S” pattern applies high pressure to the sandwiched sludge between the belts, and will extract the liquid.

At the end of the pressure section, the two belts separate, and the dried solids are scraped and discharged from the machine. Each belt will then go through a wash station that will remove the small amount of solids remaining on the belt, prior to starting the process all over again.

The Klampress belt filter press continuously de-waters through the use of two porous filter belts which allow gravity dewatering and pressure filtration. There are four specific processes in a belt filter press: slurry conditioning, gravity drainage, wedge pressure, and high pressure sections.

Conditioning:

Usually the slurry must be conditioned in order to cause the solid particles to flocculate. Conditioning involves the addition of polymer, inorganic salt, etc., to the slurry, causing clumping of the solid particles and the separation of free water, which is necessary prior to adding any pressure to the slurry. The characteristics of the flocculated slurry vary depending upon the slurry type and conditioning agent, and therefore performance numbers (cake dryness, throughput, etc.) vary with each specific slurry.

Different conditioning agents vary in molecular weight, functional group, charge density, etc. The Ashbrook in line variable orifice mixer and injection ring are designed to be placed into the feed line upstream of the press. The amount of time the conditioning agent is in contact with the slurry before dewatering (retention time) effects the formation of the floc. To allow for changes in slurry characteristics, feed piping should be designed to allow for 15 second, 30, and 45 seconds retention times.

The amount of mixing energy applied to the slurry to thoroughly mix the conditioning agent affects the formation of the floc. Different conditioning agents in combination with different slurries require different mixing energies. The Ashbrook in line variable orifice mixer is designed to allow the operator to vary and set the mixing energy.

Gravity Drainage:

The slurry enters the gravity drainage zone from the belt press feed inlet, and here the solids and the water begin to be physically separated. The solid-water mixture sits on the porous belt allowing the free water to drain through it. The water from the gravity drainage section is collected in drain pans and routed to a sump, or away from the belt press.

As the slurry moves along the length of the gravity drainage section, the slurry is turned over by chicanes. The chicanes greatly enhance the dewatering process by turning the solid mass over and clearing places for the free water to drain through the porous belt. The slurry is restricted from running off of the sides of the belt by restrainers. At the end of the gravity drainage section, the slurry is a loosely structured cake with little or no free water present.

Wedge Section:

The loosely structured cake falls onto the bottom belt and begins to be compressed between the bottom belt and the top belt forming a wedge. The converging belts apply dual pressure to the sludge, forming the sludge into a compressible shape that can receive higher pressures.

Pressure Section:

The sandwiched slurry passes over a radius grid as it enters the pressure section of the belt filter press. The radius grid begins to slowly add pressure to the slurry, and wipes water away from the belts. The slurry then passes over a series of rollers that begin to increase pressure. The amount of pressure is done at a gradual rate to allow the maximum loading into the pressure section without extruding the slurry out the sides of the belt. Some rollers are also designed to produce a shearing type motion on the solids between the belt. The shearing motion is a result of the outermost belt on the roller moving faster than the belt that is on the roller (angular velocity). The shearing motion applied to the slurry exposes wet inner cake to the belt and allows more water to be removed. At the end of the pressure section, the two belts separate, and the cake is discharged off the end of the unit, and the belts are scraped clean.

The belts move past the scrapers to the wash boxes, which wash the belts of the cake that has been forced into the pores of the belt weave. The wash boxes clean the belt of any material which may blind the belt.

For description purposes, the Belt Filter Press is broken down into functional groups as indicated below:

- Main Frame
- Rollers
- Bearings
- Tensioning Assemblies
- Hydraulic Power Unit
- Feed System
- Gravity Drain Section
- Wash Stations
- Scrapers
- Drive Train
- Dewatering Belts
- In-Line Mixer

Main Frame

The main frame is a semi-rigid, self-contained, steel structure consisting of side frames and cross members. The frame resolves the dewatering pressures into vertical loads that are transferred to the foundation. While the frame maintains the structural integrity of the machine, it relies on the foundation to hold the machine level and preserve the alignment.

Rollers

The rollers are fabricated assemblies supported by bearings which provide surface to support and direct the belts. The roller shafts (journals) are machined on both ends to accept the roller bearings. All rollers are coated externally for corrosion resistance; perforated rollers are also coated internally. The rollers may be any of the following two types:

- Drive Roller: typically covered with 1/4" Buna-N rubber, used to pull the dewatering belts.
- Plain Roller: any roller of various diameters with nylon coating. Used as the tensioning rollers, as pressure rollers or as idler rollers to change belt direction.

Bearings

Support the rollers on both ends and maintain parallel roller alignment. All bearing housings incorporate a grease fitting for maintenance purposes. All bearings are direct mount, cylindrical bore, ball bearings.

Tensioning Assembly

Consists of hydraulic cylinders and a tensioning yoke. The amount of belt tension is regulated at the pressure valve on the hydraulic power unit. The individual tensioning components are as follows:

Hydraulic Cylinders: Responds to changes in pressure from the hydraulic power unit and pushes on the tensioning yoke to increase the belt tension. There is one hydraulic cylinder on each end of both tensioning yokes.

Tensioning Yoke: A fabricated steel assembly supporting the tensioning roller. The tensioning yoke has a hydraulic cylinder on each end of the yoke that transfers the force from the cylinders to the belt by moving the tensioning roller farther away from the frame. The tensioning yoke maintains equal belt tension across the entire width of the machine.

Hydraulic Power Unit

A self-contained unit that provides all hydraulic power for operation of the tensioning assemblies. The unit consists of a 1-gallon reservoir with externally mounted pressure gauge. The pressure gauge is dual scaled for hydraulic pressure in pounds per square inch (psi) and dewatering pressure in pounds per linear inch (pli). A constant speed motor powers the variable displacement hydraulic pump. The hydraulic pressure is adjusted by regulating the pressure valve on the pump. Hydraulic oil is filtered through the externally mounted suction filter.

Feed Assembly

The feed inlet has a standard ANSI flange for connecting to the sludge feed line. The feed inlet distributes the flocculated sludge across the belt to begin gravity dewatering.

Gravity Drain Section

Consists of the horizontal drainage grids, the Ashbrook patented chicanes, the drainage trays and piping, and the sludge restrainers.

Drainage Grids: Series of polyethylene strips arranged in a chevron pattern that support the dewatering belts. The strips are installed on the grid above the drainage trays. The polyethylene provides a low friction wear surface for the belts.

Chicanes: Ashbrook Corporation's patented plows that turn the sludge and provide clear openings for the free water to drain into the drain pans. The chicanes pivot independently on the support bar, which allows them to float directly on the belt and ride smoothly over the belt seam. This minimizes belt wear and prevents obstructions from blocking the sludge flow.

Drainage Trays: Assortment of pans that collect the filtrate. The filtrate then follows through piping to the machine sump. The piping is designed to be self-venting to provide maximum drainage flow.

Sludge Restrainers: Stainless steel guide that prevents sludge from running off the sides of the dewatering belts. The sludge restrainers are fitted with a neoprene strip at the bottom to maintain the seal between the belt and the sludge restrainer.

Wash Stations

Two steel boxes containing the wash tube. The wash tubes generate an overlapping spray pattern from the jet nozzles to blast embedded and surface particles from the belt. The wash tube has an internal brush for cleaning the nozzles while the machine is running. Each wash box is drained individually.

Scraper (Doctor) Blades

Steel assemblies fitted with polyethylene blades that remove the dewatered sludge cake from the dewatering belts. The scrapers are spring tensioned for pre-load adjustment.

Drive Train

The drive train powers the Klarnpress KP05 by turning the drive roller that pulls the dewatering belts through the press. The drive train components are the motor and gearbox. See the Drive Section of this manual for more detailed information on the drive motor and gearbox provided with this unit. Belt speed will depend upon the type of dewatering process desired.

Dewatering Belts

The dewatering belts are made from a Polyester woven mesh joined by a stainless steel clip to form an endless band.

In-Line Mixer

The in-line mixer is a self-cleaning variable orifice venturi mixer used to condition the sludge prior to dewatering. The mixing energy may be varied independently of the flocculation by moving the mixer ann and counterweight. This independent adjustment results in the lowest polymer usage of any belt press on the market.

Slurry Mass

At the end of the gravity section, the slurry is a loosely structured cake ready for pressure dewatering.

Pressure Dewatering

The first half of the pressure section is the wedge section. At this point the two belts begin to converge compressing the slurry. The belts pass over the downward curving wedge grid and then under the pressure grid which extracts the remaining free water. The belts then take a serpentine path around 5 solid faced rollers.

As the belts continue around these rollers the slurry cake between the belts is subjected to increasing pressure and shear action as the belts approach the drive roller. The shearing action in this section turns the slurry mass within the belts exposing the wet inner cake to the belts and expelling the remaining water. At the end of these rollers the belts separate and the slurry cake is discharged from the machine.

Belt Cleaning

The belts continue past scrapers which remove any residual cake and prepare the belts for cleaning. The belts are washed in separate washboxes which remove any particles that may have embedded into the porous belt. The belts must be continually cleaned to prevent belt blinding and a loss of dewatering ability. The clean belts exit the wash boxes to begin the process again.

1.6.4.2 Biosolids loading Station

Dewatered biosolids are dropped into the containers until they are full. Manual inspection of the container is required to determine when the container must be replaced. When full, the container is removed using a “forklift” and transported to the waste storage area to await transport to the United States.

1.6.5 Waste Station Unloading / Transfer

It is anticipated that the containers will freeze at the storage site and that they would be refrigerated on the transport vessel during retrograde to the U.S. to minimize any gas production.



2 OPERATIONS

2.1 GENERAL BUILDING OPERATIONS

The Wastewater Treatment Plant (WWTP) and the Lift Station (Buildings 199 & 200) houses a testing laboratory, water treatment tanks, and related support systems for water purification at the McMurdo Facility. These structures contain various mechanical and electrical systems required to maintain the building infrastructure and support the activities within. A basic overview of the operational characteristics of the building elements, equipment and systems is contained in these sub-sections.

2.2 ARCHITECTURAL / STRUCTURAL SYSTEMS

2.2.1 Building Systems

The Waste Water Treatment Plant provides year-round waste treatment for all the habitants at McMurdo. The plant is a 10,500 sq. foot, two floor, wide-span structure. The two floors are connected by enclosed stairwells. The building is elevated up off the ground 4 feet and is accessed from the outside by the use of precast concrete stairs and landings.

The three main active process tanks are located in the center of the building, with space allowed for a future fourth tank. The tanks can be viewed from the observation area located on the second floor. Operators and maintenance personnel can access tank systems using removable grating walkways located around the tanks.

2.2.1.1 Removable Guardrails

The guardrail system is constructed from 1 1/2" OD schedule 40 painted steel pipe. The removable guardrails provide easy access to system components, such as valves, by operators and maintenance personnel.

(For additional information regarding the guardrails, see Appendix Section [4.2.1.1.1](#) of this manual.).

2.2.2 Windows and Doors

2.2.2.1 Windows / Process Observation Area Viewing Glass

The high-efficiency exterior windows used in the WWTP employ a four-element glazing unit that combines two lites of glass with two suspended films of uncoated Polyethylene Terephthalate (PET) plastic. The interior lite is clear, 6-millimeter (mm), annealed glass with a low-emissivity (Low E) coating.

The exterior lite is gray-tinted, 6-mm, heat-strengthened glass, also with Low E coating. Window frames are constructed of clear-anodized, mill-finish, extruded aluminum with integral, fiberglass-reinforced-nylon thermal breaks. All lites are fixed (non-opening).

Interior windows typically employ steel frames with wire-glass lites.

(Additional information about specific window design, including size, finish, and framing details can be found in the Window Schedule, on Sheet [A4](#), located in Appendix Sections 4.1.2 and 4.2.1.2.1 of this manual.)

2.2.2.2 Doors

A variety of door types used throughout the Wastewater Treatment Plant.

Type A: This type of door is a solid insulated steel door.

Types H, J, K: These types of doors have different sizes of viewing glass. Glazing for labeled doors uses welded wire glass and all other glazing is 1/4" tempered glass.

Because of fire and safety regulations, all exterior doors swing outward.

Interior windows typically employ steel frames with wire-glass lites.

(Additional information about specific door design, including size, finish, framing details, and hardware set can be found in the Door Schedule, on Sheet [A3](#), located in Appendix Sections 4.1.2 and 4.2.1.2.2 of this manual.)

2.2.2.3 Overhead Coiling Doors

The overhead coiling doors are operated by use of a 24V, three-button (OPEN, CLOSE, STOP) controller. Adjustable helical torsion springs are provided to assist in opening and closing of the door should the electric opener fail.

(Additional information about door design, specifications, finish, framing details, and operator set can be found in Appendix Sections [4.2.1.2.2](#) and [4.2.1.2.3](#) of this manual.)

2.2.3 Interior Specialties / Fixtures

2.2.3.1 Miscellaneous Specialties

2.2.3.1.1 Graphic Display Board

The graphic display board provides a graphic representation of the wastewater treatment process for visitors.

2.2.3.1.2 Fire Extinguishers

Handheld, manual fire extinguishers are available for putting out small fires before they trigger the sprinkler system. The extinguishers are typically 9.5 lb. agent capacity, dry-chemical units, rated 1-A: 10-B: C. As such, they are suitable for all three types of common fires:

- Class A (Combustible materials such as trash, wood and paper)
- Class B (Flammable Liquids and Grease)
- Class C (Electrical Equipment)

To properly use a portable fire extinguisher, the operator should follow a 4-step procedure known by the acronym **PASS**:

PULL the safety pin completely out of the extinguisher valve.

AIM the discharge nozzle at the base of the fire.

SQUEEZE the discharge lever to release the extinguishing agent.

SWEEP the discharge from side-to-side across the base of the fire.

All personnel who may need to use the fire extinguishers in an emergency situation should be trained in their application.

Primary fire extinguisher locations can be found on Sheets [A1](#) and [A2](#), located in Appendix Sections 4.1.2

(Additional information regarding fire extinguishers can be found in Appendix Section [4.2.1.4.1.2](#) of this manual.)

2.3 CONVEYING SYSTEMS

2.3.1 Monorail Hoist Systems

To simplify the task of moving heavy and/or bulky items into and out of the DeWatering and Blower Rooms, electrically powered, trolley mounted, cable hoists are provided. Each hoist is operated using a pendant style control station. The hoists are insulated and electrically heated. They are designed to operate at temperatures as low as -20° Fahrenheit (F).

Each hoist trolley is motorized and has a maximum rated travel speed of 30 feet-per-minute. The trolley mounting systems incorporate a “festooned cable” electrification system which supplies 480-Volt, 3-Phase power to the hoist.

Each hoist have a maximum lift distance of 21 feet, a maximum rated capacity of 1 ton, and a lifting speed of 16/5 feet-per-minute (FPM).

Operation of the hoists are controlled by a push-button station suspended from the hoist’s electrical compartment. The station has a built-in mechanical interlock to prevent depressing both buttons simultaneously. Jogging the push-buttons will give “hairline” load movement. The quickness of the depressing motion determines the amount of movement.

NOTE:

Excessive use of the jogging feature will cause premature burning of contact points, motor overheating, and rapid motor brake wear.

WARNING:

Equipment covered herein is not designed, or suitable, as a power source for lifting or lowering persons. Do not use as an elevator.

NOTICE:

Always know the load to be lifted. The manufacturer does not recommend lifting loads greater than the rated load of your hoist.

(For additional information on operating the hoist systems, see Appendix Section [4.2.2.1](#) of this manual.)

2.4 MECHANICAL SYSTEMS

2.4.1 Heat Generation and Distribution Systems

Hot water heating (HHW) components for the Wastewater Treatment Plant consist of the boiler (B-1), circulating pumps (P-1 and P-2), and heat exchanger (HX-3).

2.4.1.1 Fuel-Fired Boilers

The Wastewater Treatment Plant has one boiler serving the entire plant. The boiler is a fuel-oil-fired, hydronic unit configured to burn JP-5 heating fuel. The boiler is constructed of 81-1" steel tubes. It has a sectional design and is equipped with pressure-atomized oil burner. The burner flame is visible through a hinged flame-inspection port.

WARNING:

Do not attempt to operate or maintain the burner equipment without first familiarizing yourself with these instructions! Improper operation or maintenance of the equipment may result in injury to persons or loss of life and damage to equipment.

Do not operate this equipment unless guides, shields, or covers are in place for moving components, rotating equipment, mechanically automated devices, and electrically and pneumatically operated control components.

Wiring for the fuel oil solenoid valve must meet applicable electrical codes and ordinances. Be sure the power circuit is properly connected and grounded before operating the valve.

If the products of combustion are being emitted into the room (venting system is not operating correctly), the boiler must not be operated until proper adjustments or repairs are made to assure adequate draft through the venting system.

CAUTION:

If operating with a single pipe system, the motor will stall and possibly damage the pump, motor and coupling.

NOTE:

At least the following protection equipment will be necessary when operating this equipment:

- 1. Steel-toed shoes,**
- 2. Hard hat,**
- 3. Ear protection,**
- 4. Gloves, and**
- 5. Eye protection.**

Refer to the personal protection equipment requirements of the operator and owner and the regulatory authorities (such as OSHA) to determine the personal protection equipment appropriate for the work being performed.

A three-way, two-position, control valve diverts flow through the boiler when enabled and bypasses it at other times. A two-way, modulating, shock-prevention valve re-circulates heated glycol back to the boiler to prevent boiler return temperature from falling below 140° F. The Direct Digital Control (DDC) System generates an alarm if boiler outlet temperature falls below an adjustable set point of 140° F during boiler operation. (For boiler piping details, refer to drawings M4 and M5, located in Section 4.1.2 of this manual.)

The boiler system is controlled by a microprocessor-based integrated system. Non-volatile controller memory is used to retain data after a power failure. Inputs and outputs include a data entry keyboard, an 80-character display panel, and self-diagnostics.

The integrated system controls burner operation, boiler warm-up, low and high fire operation, and shutdown. A low-water cut-off prevents boiler operation when boiler water (glycol solution) falls below a safe operating level.

A high-limit temperature control, with manual reset for the burner, prevents the glycol from exceeding safe system temperatures. The flame is monitored continuously during burner operation. If a combustion failure occurs, manual reset of the control is necessary. When a safety shutdown occurs, the control will display a message indicating "Lockout" and the reason for the lockout. The manual reset button is located on the face of the Flame Monitor, mounted inside the burner control cabinet. The control panel cabinet is mounted on the burner head above the blower motor and fan.

Once proof of flow is established, the DDC system enables boiler B-1. The boiler operates between low and high fire through its own self-contained operating controller as required maintaining the hot water supply temperature.

Status of the boiler burner and the boiler supply temperature is monitored by the DDC system. Once the boiler has been enabled, a low temperature alarm is generated at the DDC system (after sufficient time delay) if the supply temperature falls below 140° F (adj.).

(For additional information on the boiler, see Appendix Sections 4.2.3.1.1 and 4.1.2 (Page M6 - Boiler Schedule) of this manual.)

2.4.1.2 Terminal Heat Transfer Units

Terminal units are devices used to transfer heat out of the circulated glycol into the air for space heating.

To compensate for differing flow requirements in various branches of the hydronic heating loop, flow control valves are used throughout the plant. Flow control valves limit the volume of liquid moving through a specific piece of equipment.

(For more specific information on flow controls, see “*Flow Controls*” in Section 4.2.3.1.6.3 of this manual.)

2.4.1.2.1 Unit Heaters

Horizontal Hydronic (Hot Water) Unit Heaters (UH) are used in the treatment plant. Type UH-1 through UH-14 Unit Heaters are horizontal discharge models.

All units have propeller-type fans and adjustable discharge louvers. These units heat air with a single-row, copper coil with aluminum fins. The coil tubes are induction-brazed to steel-pipe headers. The propeller-type fan is driven by a 115-Volt motor and furnished with fan guards. Typically, unit heaters are ceiling-hung. Heated glycol solution is circulated through the unit-heater tubes continuously. The DDC System monitors the room temperature. When the sensed temperature falls below the programmed set point, the DDC system energizes the fan (and control valve if applicable) to deliver heated air to the room.

Using local space temperature sensors and comparing these to the default set point of 55° F (adjustable), the hot water unit heater is cycled on and off to maintain constant space temperature.

Heater locations can be obtained from Drawing Sheet M7 in Appendix Section 4.1.2 of this manual.

(For piping details, refer to Drawing M5 in Appendix Section 4.1.2. of this manual. For additional information concerning unit heaters, refer to Appendix Section 4.2.3.1.2.1 of this manual.)

2.4.1.2.2 Electric Unit Heaters

Electric Unit Heaters (EUH) are used in the treatment plant for comfort heating. Type EUH-1 through EUH-3 Unit Heaters are horizontal discharge models.

All have propeller-type fans and adjustable discharge louvers. The propeller-type fan is driven by a 115-Volt motor and furnished with fan guards. Typically, unit heaters are ceiling-hung.

Each unit is controlled by a local thermostat. Using local space temperature sensors and comparing these to the default set point of 68° F (adjustable), the electric unit heater cycles on and off to maintain constant space temperature.

Unit heaters EUH-1 and EUH-2 are located in the Electrical Room, and EUH-3 is located in the Communications Closet.

(For additional information on the electric unit heaters, refer to Drawing Sheets [M5](#) through [M7](#) in Appendix Section 4.1.2., and Section [4.2.3.1.2.2](#) of this manual.)

2.4.1.2.3 Baseboard Radiation Heaters

Baseboard radiation type heaters R-1 through R-6 uses a 60% solution of propylene glycol solution to heat areas such as the control room, toilet room, laboratory, vestibule, and the storage room.

Temperature controls are independent of the DDC system. When the in-let valve is open, it allows hot glycol solution to circulate through the tubes, heating the air in the room. No fan is used; air flows by natural convection. To maintain heat delivery in the event of a partial power outage, the zone valves are designed to be open when de-energized (normally-open).

Room temperature is adjusted by a conventional, wall-mounted thermostat. When the room thermostat calls for heat, it de-energizes the normally-open zone valve. When room temperature reaches the set point, the thermostat energizes (closes) the valve.

Using local space temperature sensors and comparing these to the default set point of 55° F (adjustable), the radiation heater is cycled on and off to maintain constant space temperature.

(For specification details, refer to Drawing Sheets [M5](#) through [M7](#) in Appendix Section 4.1.2., and Section [4.2.3.1.2.3](#) of this manual.)

2.4.1.3 Heating Coils / Duct Reheat Coils

Three heating coils (HC-1 through HC-3) are being used at the Wastewater Treatment Plant to heat incoming outside air.

A single heating coil is used to temper (raise the temperature of) air passing through the Air Handling Units (AHU-1 and AHU-2). Each AHU is equipped with an air heating coil (AHC) HC-1 and HC-2 respectively. The AHC coils draw heat energy from the glycol solution. Temperature control valve TCV-1 regulates the heated supply water to HC-1, and TCV-2 regulates supply water to HC-2.

Air Handler AHU-1 is located in the Mechanical Room and AHU-2 is in the Boiler Room. Each AHU blends the outside air with “return air” from within the plant to produce “mixed air” used for ventilation. The AHC re-temper the mixed air. After the mixed air leaves the AHC and enters the ventilation ductwork, the air is considered “discharge air” or “supply air.”

Each branch of the ventilation ductwork has at least one associated temperature sensor which reports to the DDC. The DDC uses the temperature sensor output to determine a control valve setting that maintains the desired output air temperature.

Heating coil HC-3, located in the Blower Room, is used to supply heated fresh outside air to the blowers, which in turn supply air to the process systems. Heated air supplied by the blower system is not used for ventilation purposes. Like heating coils HC-1 and HC-2, HC-3 also draws heat energy from the glycol solution.

(For additional information on heating coils, refer to Drawing Sheets [M5](#) and [M6](#) in Appendix Section 4.1.2., and Section [4.2.3.1.3](#) of this manual.)

2.4.1.4 Heat Exchangers

Hydronic Heat Exchangers maintain a desirable separation between piping circuits while allowing heat energy to transfer from a relatively cool source in one circuit to a warmer source in the other. Two types of heat exchangers are used at the Wastewater Treatment Plant, HX-1 and HX-2 are air-to-air transfer and HX-3 is of a water-to-water, plate-and-frame construction.

WARNING:

Failure to operate the heat exchanger within the design pressure and temperature on the nameplate may result in damage to plate and/or gasket causing leakage and potential injury to adjacent personnel.

CAUTION:

Fluids must be gradually introduced to the unit. Failure to do so can cause damage to the plate pack.

Treatment processes are supplied with heated air through exchangers HX-1 and HX-2. Outside air is drawn in dampers D-1 and D-4 through heat exchangers HX-1 and HX-2 respectively.

The Waste Water Treatment Plant is supplied with Heated Hot Water (HHW) from Cogen Heat Recovery System through Heat Exchanger (HX-3). The boiler is connected to HX-3 in order to provide additional heat.

The DDC system monitors the inlet and outlet temperatures on each side of the heat exchanges.

(For specification details, refer to Drawing Sheets [M5 - M7](#) in Appendix Section 4.1.2. of this manual. For additional operation information, refer to Appendix Section [4.2.3.1.4](#) of this Manual.)

2.4.1.5 Glycol Pumps

All pumps with A and B suffixes are paired for lead/lag alternating operation. One pump acts as the lead pump while the other is on standby. The standby pump alternates to become the lead pump after every normal on/off cycle. A differential pressure switch is piped across each pump to provide pump status to the DDC System central workstation.

If the pump is commanded on, and pump status is not established, an alarm is generated at the DDC System central workstation and the standby pump is energized. Pumps may have variable speed drives to allow the distribution system to match the connected building loads.

Hot glycol is pumped through Heat Exchanger HX-3 and Boiler B-1 to all heating coils, water heaters, finned tube heaters, radiant heaters, unit heaters and the like, throughout the plant.

The pumps are in-line mounted, centrifugal pumps with 7 ½ horsepower electric motors. The lead pump runs continuously. The DDC System controls the speed of these pumps through variable speed drives (VSD) to maintain sensed differential pressure.

The Heating Hot Water (HHW) loop consists of a Boiler (B-1) and Circulating Pumps (P-1 and P-2). The circulating pumps operate in a hand local mode.

The HHW loop is controlled through the direct digital control (DDC) system to maintain the return water temperature on the load side of heat exchanger HX-3. The boiler is enabled when the entering water temperature of HX-3 falls below 165° F (adj.), and is disabled when the entering water temperature rises above 180° F (adj.).

When the HHW loop is enabled, the DDC system energizes the lead pump as selected by set-to-run select switch. A Current Switch is provided for each pump to provide pump status to the DDC system. If the pump is commanded on, and proof of flow is not established, an alarm is generated at the DDC system and the standby pump is energized.

(Piping details are shown on drawing sheet [M5](#), in Appendix Section 4.1.2 of this manual.)

2.4.1.6 Hydronic Specialties

2.4.1.6.1 Expansion Tanks

This section covers expansion tanks used in the hydronic heating and process cooling systems. Domestic water system expansion tanks are covered in the plumbing section of this manual.

Expansion tanks compensate for temperature induced volume changes in fluid systems. In bladder-type expansion tanks, a heavy, expandible, rubber container (bladder) is fixed inside a steel pressure tank.

Before being placed into service, the steel tank is pressurized (pre-charged), with air or nitrogen, to the design operating pressure of the hydronic system.

When the hydronic fluid expands, the excess flows into the bladder, expanding it. The pre-charge in the steel tank acts as a counter-force. It controls the expansion of the bladder as fluid pressure builds, and it forces fluid back into the system as pressure drops. The bladder serves to prevent the pre-charge from becoming “waterlogged” (that is, absorbed by the hydronic fluid).

A bladder-type hydronic Expansion Tank (XT-1) is installed in the perimeter heating (GHS/GHR) loop, between Air Separator AS-1 and the suction side of paired pumps P-1A and P-1B. The tank is located in Main Mechanical Room A-201.

2.4.1.6.2 Air Separators

Air trapped in a hydronic system can hamper circulation, damage pumps, and cause noise objectionable to building occupants.

Air separators create a low velocity vortex where air will separate from the circulating glycol. Air floats to the top of the separator chamber and is removed via an automatic air vent. Typically, air separators are located on the suction side of the circulation pump at a high point in the immediate system piping. The air separator chamber also provides the make-up water connection for filling the system with glycol.

Automatic air vents are installed at terminal heat transfer units in the hydronic heating loop throughout the Elevated Station. Normally installed at a high point in the plumbing loop, these devices contain a chamber to accumulate trapped air. As air accumulates in the chamber, a float-controlled valve automatically opens, allowing the air to escape. As the air is exhausted, glycol rises in the chamber, closing the valve and preventing liquid discharge.

Air Separator AS-1 is installed in the perimeter heating (GHS/GHR) loop, between Boiler B-1 and Expansion Tank XT-1. The separator is located in the Main Mechanical Room (Rm A-201).

2.4.1.6.3 Flow Controls

Flow controls are valves, of brass or iron body construction, used to limit liquid flow to within a specific range. The internal mechanism includes a stainless steel spring operating against a perforated piston or regulator cup to control liquid flow within 5% of its rated setting.

These valves are self regulating and require no external power or signal. They are used on hot water piping to unit heaters, duct coils, finned-tube heaters, radiant panels and heating coils to reduce or eliminate the complexities of manual balancing.

They are especially useful in systems with pumps driven by variable speed motors. Variable system flows caused by variable speed pumps can make conventional flow balancing of large systems very complex.

(See Drawing sheet [PL4](#) in Appendix Section 4.1.2 of this manual, for typical use of flow control valves.)

2.4.1.6.4 Balance Valves

Balancing valves are used to maintain flow ratios between parallel hydronic circuits sharing the same source circuit and pumps. The balance valves consist of a brass ball valve with ports for measuring differential pressure across the valve seat area. These valves maintain a specific relationship between pressure difference and flow. By measuring the differential pressure (port-to-port), the flow can be determined from a chart or read on a companion meter.

WARNING:

Check for proper sealing when using the balance valve as an isolation valve. If the seat is not sealing properly, liquid will continue to flow from drain valves. In this case the valve must be isolated from the system and repaired. Failure to follow this instruction can result in serious personal injury and/or property damage.

Hot water leakage can occur from readout valve during probe insertion and during hookup of readout kit. Follow the instruction manuals supplied with readout probes and readout kits for safe use. Failure to follow these instructions could result in serious personal injury and/or property damage.

It is possible, depending on the age or condition of the stem seal, for some liquid to escape during valve adjustments. Do not have eyes or face on a level with the sides of the valve. Failure to follow this warning could result in serious personal injury.

CAUTION:

Avoid excessive pressure drop. Do not throttle the valve to pressure drops above 25 ft. of H₂O (7.6m of water). Failure to follow this instruction may result in valve noise and valve damage which can result in additional property damage.

IMPORTANT:

If the system contains a liquid with a specific gravity and/or viscosity higher or lower than that of water, apply the appropriate correction factor noted in these instructions to obtain the actual GPM for the system liquid.

If balancing at less than 50% stem rise position is required, and this is the primary balance valve, the manufacturer recommends that the impeller be sized to produce design flow. This will reduce electrical energy consumption.

If a high degree of throttling of flow at pump discharge is required, the manufacturer recommends that the pump be sized to produce design flow. This will reduce electrical energy consumption.

Balancing valves are located on all parallel piping circuits. Typically they are set, paint-striped, and locked in position (with a screw) by the test and balance contractor. Once set, they will only need changing if the piping circuit is modified to upset the original flow balance.

Detailed operational steps can be found in Section [4.2.3.1.6.4](#) of this manual.

2.4.1.6.5 Relief Valves

This section covers safety relief valves used in both the hydronic heating system and the domestic water system. Other valves, such as temperature and pressure valves, used in the domestic water system are covered in the Plumbing Section of this manual. Air Pressure safety relief valves are covered in the “Blower” Section of this manual.

WARNING:

Scale buildup from frequent discharging of the safety relief valve can prevent the safety relief valve from being able to discharge its rated capacity. The causes of frequent discharging such as a water logged compression tank must be immediately corrected. Failure to follow these instruction could result in serious personal injury or death and property damage.

Attempts to change safety relief valve setting will prevent it from relieving at rated capacity and thus causing the protected device to explode. Do not attempt to adjust the pressure setting of the safety relief valve. Failure to follow these instructions could result in serious personal injury or death and property damage.

Safety relief valves are designed, tested, and rated to open and vent pressure in the event of an over-pressure condition. They are of bronze body construction with teflon seats and stainless steel stems and springs.

They are rated by capacity (in British Thermal Units per hour [btu/hr.] or pounds-of-steam per hour [lb./hr.]), certified, and labeled for the approved usage by the American Society of Mechanical Engineers (ASME).

Safety relief valves are mounted directly to the vessel protected. The discharge piping size and length is limited according to ASME regulations. Every closed circuit (or circuit that can be closed by changing valve positions) containing a heating and/or pressure source, is required to have a relief valve for over-pressure protection. Relief valves in the hydronic system are installed at the Boiler, at the Heat Exchangers, water heaters and in the Jacket Water heat recovery system.

The table below provides a list of hydronic equipment protected with pressure relief valves and the relative location of each valve.

HYDRONIC PRESSURE RELIEF VALVES	
EQUIPMENT PROTECTED	LOCATION (OR PIPING RUN)
Boiler B-1	Boiler Water Jacket
Heat Exchanger HX-1	(HX-1 outlet to GHS)
Water Heater	WH-1
Water Heater	WH-2

2.4.1.6.6 Valves

Various other valves exist in the hydronic system to isolate parts of the system, control flow, bypass portions of the system, drain water off, and regulate flow based on temperature sensing. Isolation, butterfly, slide gate, check, bypass, and temperature control valves are commonly used in the hydronic system.

WARNING:

Hot water leakage can occur from readout valves during probe insertion and during hookup of readout kit. Follow the instructions in the instruction manuals supplied with readout probes and readout kits for safe use. Keep eyes protected with safety glasses. Make sure that readout valves are not leaking before removing safety cap.

Failure to follow these instructions can result in serious personal injury or death and property damage.

IMPORTANT:

If system balancing at less than 50% stem rise and this is the primary balance valve, ASHRAE Standard 90.1 and the manufacturer recommend trimming the impeller to the necessary system design flow. This will reduce electrical energy consumption and comply with the National Energy Building Code Standard.

To avoid noise problems and possible damage to the valve, do not exceed 25 feet of pressure drop across the valve.

The 16 mesh start-up strainer must be removed from the suction diffuser after the initial circulation and cleaning of the system. A pressure gauge installed in the diffuser will warn of a blockage.

CAUTION:

Potential pump damage. Blockage in the suction diffuser can cause serious damage due to cavitation within the pump. NPSH requirement for the pump must be met and maintained. Check the pressure gauge installed in the suction diffuser periodically to prevent cavitation.

Failure to follow these instructions could result in property damage and/or moderate personal injury.

(Additional operating details and locations for valves used in the hydronic system are shown on drawing sheet [M5](#), in Appendix Section [4.1.2](#) of this manual.)

2.4.1.6.7 Glycol Make-up System

Glycol Make-Up Systems (GMS) are provided to automatically maintain the level of glycol solution in hydronic loops. Each GMS is a complete, packaged system that includes a solution container and lid, make-up pump and motor, pressure tank with pressure control, low-level cut-off and alarm, necessary valves, strainer, reducing valve, and drain.

Once the system has been purged, the GMS will maintain the set make-up pressure automatically.

Make sure the glycol solution level in the translucent solution container is adequate at all times. Should the solution container run dry, the pump will stop and the alarm will be activated. The audible part may be silenced. However, make sure it is turned back on after filling the tank and bleeding has been completed. Always replace the lid to keep the solution clean.

The GMS-1 serves the Boiler (B-1) Loop and the Process Cooling Loop. It is located in the Main Mechanical Room (Rm. A-116).

Glycol make-up systems are controlled through the DDC System to provide make-up to each hydronic loop individually. Pressure transmitters installed in each hydronic loop sense pressure in their individual system.

If a sensor indicates low pressure in a hydronic loop, the DDC System energizes the associated glycol make-up pump. A current switch is installed at the make-up pump to provide pump status to the DDC System.

Once pump operation is established, the DDC System will open the specific make-up valve to replenish the affected system. Once the system pressure rises above the set point of the pressure switch, the make-up valve closes and the make-up pump is de-energized.

If the pump is commanded on and pump operation is not established, an alarm is generated at the DDC Central Workstation. If solution in the make-up container runs low, the low-level cut-off shuts down the pump and activates the alarm circuitry. The glycol make-up systems are furnished with a 1/2" National Pipe Thread (NPT) system connection.

2.4.1.6.8 Air to Air Heat Exchangers

The air-to-air heat exchangers (HX-1 located in the Mechanical Room and HX-2 located in the Boiler Room) take in fresh outside air, heats it, and transfers it on for interior space heating. This transfer of thermal energy from one airstream to the other greatly reduces fuel consumption as well as the equipment capacity required to condition the air.

The exterior covers of the heat exchanger are fabricated of heavy gauge galvanized steel while the air transfer surface is made of Series 1100 aluminum.

(Additional details for the heat exchangers are shown on drawing sheet [M7](#), in Appendix Section 4.1.2 of this manual.)

2.4.2 Ventilation Systems

Ventilation air is provided to all occupied spaces and to replenish exhaust air and combustion air. As an energy conservation measure, minimum outside air ventilation rates were used for design, or planned for operation.

This minimizes the energy required to heat outside air. Ventilation rates provide safe and reasonable quality of indoor air, but are minimized to keep energy use as low as possible. Carbon dioxide monitors are used to deliver the optimum amount of outside air. Variable-air-volume systems and fans with variable-speed drives serve spaces where air requirements are subject to change.

The DDC System monitors the status of the intake fans and the exhaust fans. DDC increases outside air intake as exhaust fans are turned on and decreases intake when the fans are turned off.

Two ventilation systems exist at the Wastewater Treatment Plant. The first ventilation system is comprised of dampers D-1 and D-2, heat exchanger HX-1, fans F-1 and F-2, and air handler unit AHU-1. The second ventilation system is comprised of dampers D-4 and D-5, heat exchanger HX-2, fans F-3 and F-4, and air handler unit AHU-2.

2.4.2.1 Air Handling Units

The air handling units (AHUs) provide cooling and fresh air to building spaces. Typically, an AHU is built-up of air-tight sections, and contains an air preheating coil, a mixing box with dampers, air filters, a heating coil, and a fan. Access doors are provided on both sides of the sections for service. The fan is fitted with a differential pressure switch piped from the suction side to the discharge side to sense fan operation.

Fans are variable speed. They are set either to maintain a specific down-stream static pressure in the duct or for a schedule of 100% (full speed) in the summer and 75% otherwise. In applications where the fan is set to maintain duct static pressure, Variable Air Volume (VAV) boxes are typically used to control the air volume flowing through individual branches of the ductwork.

As air passes through the ventilation system, it undergoes a series of processes that prepare it to meet the heating, cooling and ventilation load of the conditioned space. After each process, the terminology used to describe the air changes:

Outside Air as its name implies, is air that is being drawn into the system directly, from outside of the building.

Return Air is air that is drawn back into the ventilation system after circulating through the conditioned space.

Mixed Air is a combination of outside and return air, as it leaves the mixing box.

Supply Air is mixed air that has passed through the fan (and possibly through a cooling, heating and/or reheating coil, whether or not it is cooled or heated) and is ready for delivery to the conditioned space.

Outside, return, mixed, and discharge air are all sensed for temperature conditions. The DDC System controls AHU operation.

The system uses temperature sensors mounted in areas served to calculate the appropriate AHU discharge temperature. As a safety measure, if discharge air temperature or mixed air temperature falls below 36° F, the DDC System will turn the AHU fan off.

Whenever the fan is off, the DDC System will generate an alarm, close the outside air damper, open the return air damper, and the heating valve will go to an adjustable 10% open position. The fan will also be turned off in the event of a fire alarm or if smoke is detected.

Heating valves and the discharge temperature from AHU-1 are regulated by the DDC System based on readings from temperature.

AHU-1 is located in the Mechanical Room and AHU-2 is located in the Boiler Room. Below is an explanation of how each of the air handling units operate:

NOTE:

The Tracer ZN520 controller operates the supply fan continuously when the controller is in the occupied and occupied standby modes, for either heating or cooling. The controller only cycles the fan off with heating and cooling capacity in the unoccupied mode.

Heating and cooling setpoint high and low limits are always applied to the occupied and occupied standby set points.

The economizer standby minimum position using Rover service tool.

Economizer dampers and modulating valves are only available on units with the Tracer ZN520 controller. Two-position dampers are only available on units with Tracer ZN010 and ZN510.

Unit diagnostics can affect the controller operation, causing unit operation to be defined as abnormal. Refer to the Troubleshooting Section for more information about abnormal unit operation.

If the unit is in the unoccupied mode, the dehumidification routine will not operate.

The generic binary input can be used with a Tracer Summit® building automation system only.

Only units with ZN510 or ZN520 can receive a communicated setpoint from Tracer or other building automation system. Rover Service Software can communicate with all Tracer ZN controllers.

Fan belt tension should be checked at least 3 times during the first days of operations after the belt has been replaced.

Sequence of Operations for AHU-1 McMurdo Research Station WWTP

The supply fan operates continuously as set by the *Hand-Off-Auto* Switch. If AHU-1 Fan status does not agree with mode selected, then an alarm is generated at the workstation.

When AHU-1 is in *Auto* and the EMCS sets it to Occupied:

1. When F-I is given its start, exhaust damper (0-2) is opened by the electrical circuit in the F-1 control station. F-I will not start until the end switch in D-2 is closed when the damper is full open.
2. When F-I is started then the EMCS sends a start to the supply fan (F-2).
3. When F-2 receives its start signal, the outside air intake damper (D-I) is opened by the electric circuit in the F-2 control station. F-2 will not start until the end switch in D-1 is closed and the damper is full open.

4. When F-2 fan starts, the EMCS sends a start signal to AHU-1.

When AHU-1 is in *Auto* and the EMCS sets it to Recirculation Mode:

When AHU-1 is started by the EMCS in Recirculation Mode, and if fans F-1 and F-2 are in *Auto* mode at their respective H-0-A switches, then they will remain off and their associated dampers (D-1 and D-2) remain closed.

Heating Hot Water Coil control When AHU-1 is running:

Output of valve TCV-1 is modulated to control AHU-1 supply temperature at the set point. The supply set point is reset between 55° F and 110° F based on the heating set point compared to the needs of the single space temperature set point (Room 106).

When Unit (AHU-1, F-1 or F-2) is placed in Hand:

Only the associated unit will run, for example if AHU-1 is placed in Hand and F-1 and F-2 are left in Auto, then only AHU-1 shall run. The same will be true for either the Exhaust (F-1) or Supply (F-2) Fans.

When AHU-1 is in Auto and EMCS sets it to unoccupied:

1. The supply fan (F-2) turns off and its associated outside air intake damper (D-1) closes by spring action.
2. The exhaust fan (F-1) turns off and its associated exhaust damper (D-2) closes by spring action.
3. Finally, AHU-1 stops and the heating coil valve (TCV-1) opens.

Safety Conditions:

Freeze protection - when HX-1 supply air temp to AHU-1 goes below 37° F:

1. Shutdown both supply fan (F-2) and its associated Damper (D-1); and exhaust fan (F-1) and its associated damper (D-2).
2. Then Shutdown AHU-1 and open TCV-1 to HC-1
3. Signal Alarm

Smoke Detection:

1. Shutdown both supply fan (F-2) and its associated Damper (D-1); and exhaust fan (F-1) and its associated damper (D-2).
2. The shutdown AHU-1 and shut TCV-1 to XC-1
3. Signal Alarm

Sequence of Operations for AHU-2:

The supply fan operates continuously as set by the Hand-Off-Auto Switch. If air handler AHU-2 fan status does not agree with mode selected, then an alarm is generated at the workstation.

When AHU-2 is in Auto and the EMCS sets it to Occupied:

1. When F-3 is given its start, exhaust damper (D-5) is opened by the electrical circuit in the F-3 control station. F-3 will not start until the end switch in D-5 is closed and the damper is fully open.
2. When F-3 is started, the EMCS sends a start to supply fan (F-4).
3. When F-4 receives its start signal, outside air intake damper (D-4) is opened by the electric circuit in the F-4 control station. F-4 will not start until the end switch in D-4 is closed and the damper is fully open.
4. When F-4 fan starts, the EMCS sends a start signal to AHU-2.

When AHU-2 is in *Auto* and the EMCS sets it to Recirculation Mode:

When AHU-2 is started by the EMCS in Recirculation Mode, and fans F-3 and F-4 are in Auto at their respective H-0-A switches; then they will remain off and their associated dampers (D-4 and D-5) remain closed.

Heating Hot Water Coil control when AHU-2 is running:

Output of valve TCV-2 is modulated to control AHU-2 supply temperature at set point. The Supply set point is reset between 55° F and 110° F based on the heating set point compared to the needs of the single space temperature set point (Room 204).

When Unit (AHU-2, F-3 or F-4) is placed in Hand:

Only the associated unit will run; for example if AHU-2 is placed in *Hand* Mode, and F-3 and F-4 are left in *Auto*, then only AHU-2 operates. The same will be true for either the exhaust (F-3) or supply (F-4) fans.

When AHU-2 is in Auto and EMCS sets it to unoccupied:

1. The supply fan (F-4) turns off and its associated outside air intake damper (D-4) closes by spring action.
2. The exhaust fan (F-3) turns off and its associated exhaust damper (D-5) closes by spring action.
3. AHU-2 stops and the heating coil valve (TCV-2) opens.

Safety Conditions:

Freeze Protection -When HX-2 supply air temp to AHU-2 goes below 37° F:

1. Shutdown both supply fan (F-4) and it associated Damper (D-4), and exhaust fan (F-3) and its associated damper (D-5).
2. Then shutdown AHU-2 and open TCV-2 to HC-2.
3. Signal Alarm

Smoke Detection:

1. Shutdown both supply fan (F-4) and it associated damper (D-4), and exhaust fan (F-3) and its associated damper (D-5).
2. The shutdown AHU-2 and shut TCV-2 to HC-2.
3. Signal Alarm

2.4.2.2 Intake-Exhaust Fans

Intake fans draw fresh air in from the outside and use it for various heating systems. Exhaust fans remove air from a particular area and transfer it outside the building envelope. Exhaust fans typically exhaust downward, through the building soffit.

Fans F-1 through F-4 are 480-Volt, 3-Phase units of in-line, centrifugal design and incorporate belt drive. They are sized to move in excess of 1,000-CFM. Other fans, such as the F-5 toilet room exhaust fan, are typically 120-Volt, 1-Phase, units of standard centrifugal design, direct drive, and sized to move less than 1,000 CFM.

The table below gives a general overview of fan identification, fan location, and purposes for the fans in the Wastewater Treatment Plant:

WASTEWATER INTAKE/EXHAUST FANS		
DESIGNATION	LOCATION	SERVICE
F-1	Mechanical Room	Exhaust
F-2	Mechanical Room	Outside Air
F-3	Boiler Room	Return/Exhaust
F-4	Boiler Room	Outside Air

WASTEWATER INTAKE/EXHAUST FANS		
DESIGNATION	LOCATION	SERVICE
F-5	Toilet Room	Exhaust

(Additional information about individual fans is available in the Fan Schedule on Drawing [M6](#) in Appendix Section 4.1.2 of this manual.)

2.4.2.3 Exhaust Hoods

The exhaust hoods are 22 gauge, spiral poly-coated, metal hoods covering the process tanks. Fumes and odors are sucked from the three process tanks by use of a 4,000 CFM fan (F-1) and exhausted out damper D-2 to the outside.

2.4.2.4 Air Outlets and Inlets

There are three types of diffusers used in the Wastewater Treatment Plant; Supply, Return, and Exhaust. Even though all three are tied to the plant's ventilation system, each one performs a different function.

Supply diffusers (identified as A, B, C, and G) control air volume, direction and velocity of ventilated air into a room to optimize comfort, appearance and noise level.

The table below lists the architectural identification tags, basic design characteristics, and airflow controls common to Supply diffuser types used in the Wastewater Treatment Plant:

WASTEWATER VENTILATION SUPPLY DIFFUSERS		
TAG	DIFFUSER STYLE	CONTROL
A	Perforated Ceiling Diffuser	Volume Control Damper
B	Perforated Ceiling Diffuser	Volume Control Damper
C	Perforated Ceiling Diffuser	Volume Control Damper
G	Drum louver Diffuser	Volume Control Damper

Return diffusers (identified as D and E) provide a return path for room air back to the ventilation system.

The table below lists the architectural identification tags, basic design characteristics, and airflow controls common to Return diffuser types used in the Wastewater Treatment Plant:

WASTEWATER VENTILATION RETURN DIFFUSERS		
TAG	DIFFUSER STYLE	CONTROL
D	Perforated Ceiling Diffuser	Volume Control Damper
E	Perforated Ceiling Diffuser	Volume Control Damper

Exhaust diffusers (identified as F) control air volume, direction and velocity of unwanted air from a particular location within the plant. Majority of the time, the air is exhausted outside of the plant.

The table below lists the architectural identification tags, basic design characteristics, and airflow controls common to Exhaust diffuser types used in the Wastewater Treatment Plant:

WASTEWATER VENTILATION EXHAUST DIFFUSERS		
TAG	DIFFUSER STYLE	CONTROL
F	Perforated Ceiling Diffuser	Volume Control Damper

(Additional information regarding diffuser styles and sizes can be found in Appendix Section 4.2.3.2.5 and Drawing [M6](#), Appendix Section 4.1.2 of this manual.)

2.4.2.5 Air Cleaning Devices

The interior of the Wastewater Treatment Plant is maintained at a slight positive pressure, to limit infiltration of cold air. As a result, virtually all air entering the facility passes through the Air Handling Units (AHU). Because of this, the primary air cleaning devices in the station are the filter boxes that are an integral part of the AHUs. The filters used in the AHUs are typically 25 to 30 percent dust spot efficient, 2" nominal thickness, modular, replaceable, pleated media units.

Filter gauges are mounted on the outside of filter housings. The clean filter pressure drop is 0.22 inch water gauge at 400 feet per minute face velocity. Filters should be replaced when this pressure drop reaches 0.9 inch water gauge.

2.4.2.6 Dampers

Supply and exhaust dampers D-1 through D-7 are shown in the schedule table on the drawing sheet M7 (Found in Appendix Section 4.1.2 of this manual). These motorized dampers are controlled by the Direct Digital Control (DDC) system.

As an example: The exhaust/supply dampers are located on outside-air ducts connected to the Air Handling Units (AHU). The DDC modulates the outside-air damper to control the amount of outside air entering or leaving the Air Handling Units. In the event that air temperatures inside the AHU drop below a specific set point, the DDC closes the outside-air damper to block off the flow of frigid outside air.

Motorized dampers controlled by the DDC system establish room temperature. Control dampers are located in the outside air opening, return air opening, and exhaust air opening. When the radiator fans are de-energized, the outside air damper is normally closed, and the return air damper is normally open. When radiator fans start, dampers modulate to maintain a 7° F plenum temperature and 0.07 inch water gauge pressure. An alarm is generated if this temperature is not maintained.

Sequence of Operation for Outdoor Air Intake for the Blower Room using Coil HC-3.

An Interlock motor operated intake damper with blower motor is used to open the damper when the blower starts, and closes the damper by spring action when the blower fan stops. This prevents the blower from starting until the damper is open and the end-switch on the damper is made.

Using a duct mounted temperature sensor, adjust the control valve on HC-3 to maintain discharge Temperature. Initial Set point is 60° F (adjustable).

(Additional information regarding dampers can be found in Appendix Section [4.2.3.2.7](#) of this manual.)

2.4.3 Plumbing Systems

2.4.3.1 Plumbing Equipment

2.4.3.1.1 Sanitary Waste Lift Station / Sump Pump

The sanity waste lift station, located in Building 199, consists of a storage tank, duplex sewage ejector pumps, a control panel, and a pedestal-mounted float switch that automatically initiates pumping when the waste reaches a predetermined level. Mercury level switches are used to control on, off, alarm, and override levels.

The duplex sewage ejector pumps (SP-1 and SP-1A) are configured to operate in a lead-lag fashion. The pedestal-mounted float switch includes a mechanical alternator that exchanges the lead/lag status of the two pumps after each pumping sequence. The mechanical alternator switch also incorporates a “peak condition” mode, which operates both pumps simultaneously if the influx is too great for one pump to handle or the lead pump has failed. In the event that both pumps are insufficient to handle the incoming waste volume, the float switch is equipped with a high water alarm.

Raw sewage from the lift station is pumped into a 10” influent piping system. The pumped sewage line is provided with isolation valves and an emergency discharge pipe to route the pumped sewage to drain to the outfall in the event the treatment plant is not operational.

The sanitary waste lift station tanks incorporate auxiliary drainage fittings used for total drainage of the tanks for cleaning and inspection. Transport the waste to the disposal site.

The waste pumps are design-rated to pump 100 gallons-per-minute (gpm) @ 35-FT TDH.

(Additional information regarding waste lift station can be found in Appendix Section [4.2.3.3.1.1](#) of this manual.)

2.4.3.1.2 Backflow Preventers

Backflow preventers are used to protect potable water supplies from reverse-flow contamination, in accordance with national plumbing codes and water authority requirements.

The backflow preventer consists of an intermediate relief valve located in a low pressure zone between two in-line, independent, spring-loaded check valves. In the event that pressure on the supply side of the backflow preventer drops to equal or less than the pressure on the discharge side, the check valves close and the fluid contained in the low-pressure zone between them is discharged through the water outlet, to atmospheric pressure, via the central relief valve.

Each backflow preventer typically has a bronze body and incorporates two full-port, ball-type isolation valves, and four ball-type test cocks.

Access to internal parts is through a single, top-mounted cover secured with stainless steel bolts. The removable, modular check valves feature captured springs for safe maintenance, replaceable, silicone seat discs and replaceable check seats.

2.4.3.1.3 Water Heater

Water heaters (WH-1 and WH-2) are an induction type water heater. WH-1 is used to heat the domestic water supply and WH-2 is used to heat the water supplied to the Belt Filter Press. Water from the boiler is used to heat a double plated heat exchanger coil inside the water heater. The only electrical connections made to the water heater is for the internal mounted thermostat used to open and close the inlet valve used to control the water from the boiler.

DANGER:

Explosion hazard: Do not install to a high pressure steam boiler (greater than 15 psig). An explosion could occur.

Explosion hazard. The pressure of the heat transfer medium must be limited to a maximum of 30 psig by an approved safety or relief valve on your boiler. The tank pressure must be limited to 150 psig maximum by the installation of a temperature and pressure relief valve (included).

Scalding hazard: If the water temperature is over 120° f, household members can suffer serious or fatal scalding and painful and permanent injury. The consumer products safety commission recommends an initial setting of 120° f, but notes a slower response time of infants, aged, disabled and other persons increases the hazard to them and may require lower settings. always check the water temperature before use, including washing, bathing or showering. Temperature limiting valves are available from your plumbing supplier.

Scalding hazard: if the thermostat is not working properly or if this product is not installed in accordance with the manual, water temperature can reach excessive levels that may cause serious scalding, even if the temperature setting is correct.

After installation and any servicing of the unit, verify that the thermostat is working and firmly inserted in the thermostat well by following the thermostat testing instructions in the manual after installation and any servicing of the unit.

Scalding hazard: A check valve must be installed in the boiler return line to prevent gravity flow through the heat exchanger. This can cause over heating and result in serious scalding.

If not installed by the boiler manufacturer, install a low water cut-off or pressure reducing valves must be installed on your boiler so that leaking from any plumbing fixture will not result in a dry boiler; if the boiler continues to fire, an explosion hazard exists.

This unit must be installed as a separate heating zone. Do not connect this unit to an existing heating zone or feed boiler water directly through the coil as dangerous over-heating will result.

DANGER:

Do not drain this appliance before shutting off the supply valve and opening the relief valve or another downstream fixture, as it will damage this unit. A vacuum breaker should be installed to avoid damaging the liner.

Avoid risk of ingesting a toxic fluid. the heat transfer medium should be water. If glycol must be used, it should only be used with double-walled heat exchangers.

This tank, like most tanks under pressure, will over time corrode or fail and/or may burst and/or leak or flood (and in rare cases explode) which can cause serious or fatal personal injury and property damage. to minimize risk, a licensed professional must install and periodically inspect and service the unit. a drip pan, connected to an adequate drain must be installed if leaking or flooding can cause property damage.

As in all plumbing products and water storage vessels, bacteria can grow in your hot water “maker”, especially during times of non-use. Consult your local plumbing official regarding any steps you may wish to take to safely disinfect your home's plumbing system.

Follow all of the instructions and recommendations contained in this manual, and the following additional specific warnings. Failure to do so is unsafe and can cause serious scalding, explosion, serious or fatal personal injury and property damage.

(Additional information regarding water heaters can be found in Appendix Section [4.2.3.3.1.3](#) of this manual.)

2.4.3.1.4 Valves

The thermostatic mixing valve maintains and limits mixed hot water to the emergency eyewash and shower. The valve maintains and limits mixed hot water to a desired, selectable temperature range of 60° F to 120° F pre-set by the adjustable locking adjustment cap. The valve provides accurate temperature control (+/- 3° F) with low pressure drop.

2.4.3.2 Plumbing Fixtures

Plumbing fixtures selected are designed to use the minimum amount of water required. These include waterless urinals, low-flow water closets, and lavatories and showers with flow restrictors.

2.4.3.2.1 Water Closets

The water closets are white vitreous china, low consumption with an elongated bowl. Their direct-fed, siphon-jet action uses 1.6 gallons of water per flush. They are equipped with tank type pressure assist. Recommended working pressure range is 20 - 80 pounds-per-square-inch (psi) at the valve when flushing.

2.4.3.2.2 Lavatories

The lavatory used in the Toilet Room on the second floor consist of a seamless, vitreous china bowl with rear overflow. The lavatory is 14 1/4" wide, 10 3/4" front to back and 6" deep. The lavatory is wall hung.

2.4.3.2.3 Sinks

Two different types of sinks are used in the Wastewater Treatment Plant. The table below lists the sink location, function as identified by the architect, primary construction material, and general style of each sink type:

WASTEWATER SINK CHARACTERISTICS			
LOCATION	FUNCTION	MATERIAL	STYLE
Laboratory	Service Sink	Epoxy Resin	Drop-in, Cabinet
Janitor Closet	Mop Wash	Viterous China	Wall Hung

(Additional information about each particular sink type can be found in Appendix Section [4.2.3.3.2.3](#) of this manual.)

2.4.3.2.4 Emergency Eyewash / Shower

The stainless steel pedestal mounted emergency eyewash station consists of a 10 "stainless steel head with twin stainless steel anti-surge eyewash heads with dust covers which release with water pressure.

The stainless steel pull rod operates a stay open shower valve that is equipped with a stainless steel stem. Activation for the eyewash is by a stainless steel push flag and a stainless steel foot treadle assembly.

(Additional information for the emergency eyewash and shower can be found in Appendix Section [4.2.3.3.2.4](#) of this manual.)

2.4.4 Fuel Oil System

Fuel piping is installed above-grade which makes it available for continual visual inspection for any leaks or discharges. All piping is welded or flanged, with the exception threaded connections are allowed inside mechanical rooms. Fuel pressure is monitored by the DDC System; a sudden loss in pressure causes an alarm indicating a possible leak in the fuel piping system. Fuel is delivered to the point-of-use by piping and valves designated as Fuel Oil Supply (FOS).

The fuel oil system consist of the following major components:

- Fuel tank
- Filters
- Deaerator
- Piping and valves

Each of these major components are detailed below.

2.4.4.1 Fuel Tanks

A 2000-gallon horizontal fuel storage tank, located next to the Wastewater transformer, supplies heating oil to the boiler inside the Wastewater plant. The tank is a welded steel, double wall, horizontal cylinder, 60” in diameter by 144” long.

The tank has a fill port, clock level gauge, normal vents, emergency vents, outlet connections, and a sentinel leak detector. The level gauge measures the liquid level in the tank. Readout is on a standard 12 hour clock face. The small hand represents feet and the large hand inches. The emergency vent prevents the tank from becoming over-pressurized and possibly rupturing if exposed to fire.

Maintenance and filling of the tank is accomplished using the ladder and walkway mounted to the tank’s side.

The DDC System monitors the fuel level in the tank and controls the fuel solenoid valves to fill the tank as required.

(Additional information about the fuel tank can be found in Appendix Section [4.2.3.4.1](#) of this manual.)

2.4.4.2 Fuel Oil Filters

The fuel oil filter provides filtration of the fuel oil before it reaches the boiler. The mesh element inside the filter has a working pressure of 12 psi. (Pounds per Square Inch) and a firing rate of 24 GPH (Gallons per Hour).

2.4.4.3 Fuel Oil Deaerators

The deaerator mounts close to the boiler's burner, between the oil tank and the burner. The purpose of the deaerator is to remove air from the oil before it reaches the burner, thus eliminating the need for a return line back to the tank.

2.4.4.4 Fuel Oil Valves

Piping and valves are used to deliver fuel oil from the storage tank located outside of the plant to the boiler located in the boiler room. Fuel is delivered to the point-of-use by piping and valves designated as Fuel Oil Supply (FOS). Two of these valves are of great interest because of their safety function.

An isolation valve was included in the FOS to cut the supply of fuel oil off if needed. Also included in the FOS just after it enters the plant is a heat sensitive fuse linked shut-off valve. The fuse link is designed to sense heat from both floors and melt at 165° F, shutting off the fuel oil supply.

2.4.5 Control Systems

2.4.5.1 Direct Digital Control Systems

2.4.5.1.1 Control Valves

Four types of control valves are typically used in the DDC system:

Two-Way, Two-Position (Close-Off) Valves have only two operating positions; they either stop all flow or allow full flow. Typically, a 24-Volt, Alternating Current (24 VAC) signal, generated by the DDC system, activates the valve.

When the 24 VAC signal is not present, the valve returns to its "normal" position. That is, a "Normally Closed" (NC) valve opens when 24 VAC is applied and closes when the signal is removed; a "Normally Open" (NO) valve closes when 24VAC is applied and reopens when the signal is removed.

Three-Way, Two-Position (Diverter) Valves also have only two operating positions. However, they are designed to channel liquid flow down a "normal" path or divert flow to an alternate course.

Typically, a 24-Volt, Alternating Current (24 VAC) signal, generated by the DDC system, activates the valve, causing it to divert the flow down the alternate line. When the 24 VAC signal is not present, the valve returns to its "normal" position.

Two-Way Modulating Valves are designed to provide adjustable flow-rate, from no flow to full flow or any point in between. Typically, a 4 to 20 milliAmpere (mA) signal, generated by the DDC system, is sent to the valve actuator, which drives the valve to the desired position.

Three-Way Modulating Valves can be used as either Diverters or Mixers:

- **Three-Way Modulating Diverters** adjust the proportion of flow (from no flow to full flow) in the “normal” fluid line, while diverting the excess (if any) into the alternate line.
- **Three-Way Modulating Mixers** operate exactly the opposite of Three-Way Modulating Diverters. That is, they have two inlets and a single outlet. The Mixer valves proportion the flow ratio from the two inlets to achieve a desired “mix” at the outlet.

The actuator on many of these valves can be equipped with a spring return or an optional “Fail-in-last-place” module. If the 4-20 mA signal is lost, the “Fail-in-last-place” module will maintain the valve in the last commanded position until the signal is restored.

The TCV-1 Belimo B349B is a 2 inch, 3-way Ball Valve, Cv=46. This ball valve serves the AHU-1/HC-1 Belimo AF24-Srus Actuators. Modulating (24vac/ 2-10vdc signal) Hot Water control valve. Modulate to maintain Supply Air Temperature.

The TCV-2 Belimo B222B is a 1 inch, 2-way Ball Valve, Cv=7.4. This ball valve serves the AHU-2/HC-2 Belimo NF24-Srus Actuator. Modulating (24vac/ 2-10vdc signal) Hot Water control valve. Modulate to maintain Supply Air Temperature.

The TCV-3 Belimo B317B is a ¾ inch, 3-way Ball Valve, Cv=4.7. This ball valve serves the HC-3 Belimo NF24-Srus Actuator. Modulating (24vac/ 2-10vdc signal) Hot Water control valve. Modulate to maintain Supply Air Temperature.

The TCV-4 Honeywell V5011A-1767 is a 2 inch, 2-way Globe Valve. The TCV-4 Honeywell V5011A serves HX-3 Cogen Heat Recovery Side. Actuator Honeywell M7284Q-1017 Linkage Q5001D-1018. Modulating (120vac 4-20mA signal) Hot Water control valve. Modulate to maintain Building Heating Glycol Loop Supply Temperature.

(Further information on control valves can be found in the Appendix Section [4.2.3.5.5.1](#) of this manual.)

2.4.5.1.2 Damper Operators

Two types of damper operators are used in the Wastewater:

Modulating (variable position) damper operators are typically used on outside-air, return-air and relief-air dampers.

Two-position (full-open/full-closed) operators are typically used on exhaust dampers.

All damper operators have position indicators, local manual override at the damper, and spring return for fail-safe operation during conditions such as fire, power failure, or temperature protection. Damper function is covered in the ventilation section where the particular damper is used.

The DM-1 Belimo AF120-S is a 133in.lb., 120vac, 2-position spring return with auxiliary contacts damper control actuator.

The DM-1 Belimo Actuator operates dampers D-1 and D-2 for fans F-1 and F-2. Damper D-1 is used for outside air and damper D-2 is used as the exhaust air damper.

The DM-2 Belimo NF120-S is a 60in. lb., 120vac, 2-position spring return with auxiliary contacts damper control actuator.

The DM-2 Belimo Actuator operates dampers D-5 and D-4 for fans F-3 and F-4. Damper D-5 is used for outside air and damper D-4 is used as the exhaust air damper. The DM-2 Belimo Actuator also operates damper D-3 used to control fresh air for the blower room.

(Further information on damper operators can be found in the Appendix Section [4.2.3.5.5.2](#) of this manual.)

2.4.5.1.3 Input/Output Sensors

Differential Pressure Switches typically sense fan operation in Air Handling Units, Ceiling Fans and Exhaust Fans in the Wastewater Plant. These switches compare air pressure on the intake and exhaust sides of the fan to determine if it is operating. The pressure switches are adjustable from 0.07 to 1.0" of water column.

Damper position sensors typically use potentiometers mounted on the operator or crank arm to sense damper position. Relief-air dampers, as well as the outside-air and return-air dampers in the Air Handling Units, all have damper-position sensors that output a 2-Volt to 10-Volt linear signal for position feedback.

Temperature sensors are generally resistance temperature devices (RTD). They vary in resistance according to the exposed temperature. Some temperature probes are long averaging type.

Some are bend able to traverse ductwork. Each sensor is paired with a transmitter that converts the resistance (ohm) reading into a 4 to 20 milliampere (mA) signal for transmission to the DDC system (see Transmitters section). Temperature sensors are used in the ventilation system for measuring room temperature (thermostats), and for measuring outside, discharge, mixed, and return air temperatures in the air-handling system. Averaging-type sensors are used as needed where air temperatures vary over a ductwork cross section.

WARNING:

The low temperature detection thermostat is designed for use only as an operating control. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against, or warn of control failure.

NOTE:

The reset lever just be depressed manually and released to resume normal fan system operation.

Temperature sensors are also used to measure the following:

- Water temperatures in the domestic water heating system
- Glycol temperature in the Waste Heat (WHS/WHR) Loop, the Perimeter Heating (GHS/GHR) Loop, and the Process Cooling System

Carbon-dioxide (CO₂) sensors are mounted in the return-air ducts of the Air Handling Units (AHU). The DDC uses these sensors to monitor the CO₂ concentration in the ventilation air.

If an AHU's return-air CO₂ concentration exceeds 800 parts-per-million (800 PPM), the DDC increases fresh-air intake at that AHU. The increased fresh-air intake continues until the CO₂ concentration in return air is diluted below the 800 PPM threshold.

Air volume sensors in Variable Air Volume (VAV) boxes measure the amount of air flowing through the ductwork. The DDC uses this information to determine the proper damper setting for each VAV box.

Tank level sensors are typically used to determine when liquid in a tank reaches its maximum (as in Fuel Storage Tank) or minimum (as in Glycol Make-up Systems) limits.

Valve Position Sensors report the current setting of valves monitored by the DDC. Both Digital and Analog position sensors are used.

- **Digital valve position sensors** are used to report the “open” or “closed” position of close-off valves. With a digital sensor, the presence of a return signal typically indicates one valve position, and the absence of a return signal indicates the other position.
- **Analog valve position sensors** are used with modulating control valves and typically generate a 4-mA to 20-mA return signal that corresponds to the valve’s current setting within its operating range. (For example: If 4-mA represents the full-closed position, and 20-mA represents full open, 12-mA would indicate that the valve was open approximately half-way.)

The CS-x Veris H-608 Current Switch is a single pole, single throw (SPST), normally open (NO), 1-250 amp switch. The CS-x Veris H-608 Current Switch is used to monitor current status for the fans, pumps, unit heaters, and the boiler burners.

The IR1-x IDEC RH2B-UL24VAC/SH2B-05 Control Relay with Base is a double pole, double throw (DPDT), 24vac 10amp relay. The IR1-x IDEC RH2B-UL24VAC/SH2B-05 Control Relay is used as a Start/Stop relay for the pumps, fans, and the boiler.

The IR2-x Functional Devices RIBU1S Interface Relay is a single pole, double throw (SPDT), 10-30vac/dc, 10amp relay with LED and a Hand/Off/Auto (HOA) switch. The IR2-x Functional Devices RIBU1S Interface Relay acts as a Start/Stop relay for the unit heaters, exhaust fans, and the blowers.

The LTC Siemens 134-1504 Low Temperature Cutout Switch is a double pole, double throw (DPDT) switch with a manual reset. The LTC Siemens 134-1504 Low Temperature Cutout Switch is used as a low temperature (Freeze Protection) safety sensor for AHU-1/ HC-1 and AHU-2/HC-2.

The PE Grainger P10BC7 Pressure Electric Switch is a single pole, double throw (SPDT).

The R1-x IDEC RH2B-UL120VAC/SH2B-05 Control Relay with Base is a double pole, double throw (DPDT), 120vac, 10amp relay. The R1-x IDEC RH2B-UL120VAC/SH2B-05 Control Relay monitors status input of various line voltage stand alone systems.

S1-x Alerton TS-1050-BT Temperature Sensor Wall Mount (Space) 10K type 2 with Set point Adj.

S2-x Alerton TS-2008-BT Temperature Sensor 8' Duct Averaging 10K type 2.

S3-x Alerton TS-3200-BT Temperature Sensor Outside Air 10K type 2.

S5-x Alerton TS-2115-BT Temperature Sensor 6" Immersion 10K type 2 Stainless Steel

(Further information on sensors can be found in the Appendix Section [4.2.3.5.5.3](#) of this manual.)

2.4.5.1.4 Transmitters

Differential pressure transmitters are used to compare interior building air pressure to outdoor (ambient) pressure, and to monitor the pressure difference across air filters in the air handling units. Each transmitter sends out a 4 to 20 ma signal proportional to the pressure difference between its two sensor tube connections.

Temperature transmitters convert low-level Resistance Temperature Device (RTD) outputs to standard current (4 to 20 mA) signals for transmission.

PT1 Kele P100BTE-05 Pressure transmitter 4-20mA signal, 0-30 PSI.

(Further information on transmitters can be found in the Appendix Section [4.2.3.5.5.4](#) of this manual.)

2.4.5.2 Process Instrumentation and Control Systems

The compact operator terminal provides operator access to view controller and DDC system information, view and change system set points, and observe system temperatures. System temperatures are monitored by a thermistor temperature sensing element.

The process equipment, terminal units, air handling units, and central process systems at the Wastewater Treatment Plant are controlled by a fully programmable visual logic controller. The controller is programmed using standard protocol on the MS/TP LAN operating up to 76.8 Kbps. The on-board LED indicates communication status.

(Further information on process instrumentation and control systems can be found in the Appendix Section [4.2.3.5.6](#) of this manual.)

2.5 ELECTRICAL SYSTEMS

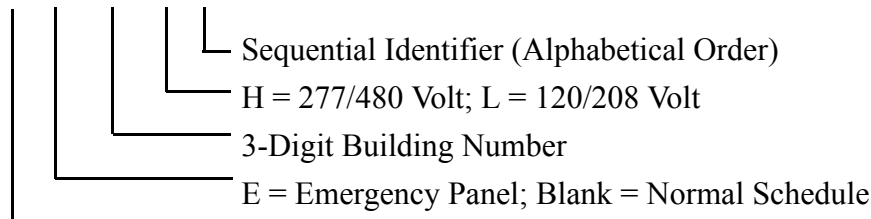
2.5.1 Interior Distribution System

2.5.1.1 Panelboards

Panelboards function as the smallest unit of the Power Distribution System. Power feeds are connected to the panelboard via a main circuit breaker or main lugs and are then distributed to smaller load segments via properly sized branch circuit breakers installed within the panelboard. All panelboards are equipped with bolt-on type branch circuit breakers.

Throughout the plant, each panelboard is identified with a unique designation number that conforms to the following pattern:

10-E 199 H A



Panelboards with the letter “E” preceding the building number in their designation are supplied from both normal (New Power Plant) and emergency (Emergency Power Plant) electrical power sources.

Panelboards containing the letters “UPS” in their designations are fed through an Uninterruptible Power Supply unit that provides conditioned and back-up power to the loads served.

The following table identifies panelboards by designation, voltage, model number, and phase/current rating:

WASTEWATER PANELBOARDS			
DESIGNATION	VOLTAGE	MODEL	PHASES(P)/WIRES(W)/ SPACES(S)
DP-1	277/480	NF	3P/4W
DP-2	277/480	NF	3P/4W
LPA	120/208	NF	3P/4W

WASTEWATER PANELBOARDS			
DESIGNATION	VOLTAGE	MODEL	PHASES(P)/WIRES(W)/ SPACES(S)
LPB	120/208	NF	3P/4W
IPA	120/208	NF	3P/4W
MPA	120/208	NF	3P/4W

Panelboards that supply fixed equipment are typically Square D type NF, 277/480 Volt, 3-phase, 4-wire, panelboards with either 30 or 42-spaces.

Panelboards that supply lighting circuits and wall outlets are typically Square D type NQOD, 120/208 Volt, 3-phase, 4-wire, 30 or 42-space panelboards.

(For information about a specific panelboard, see the Panel Schedules on Drawing Sheet [E9](#) in Appendix Section 4.1.2 of this manual.)

2.5.1.2 Motor Control Centers

A Motor Control Center (MCC) is functionally similar to a panelboard in that it provides a central location for the distribution of power to individual loads. The significant difference is that a MCC typically feeds larger loads and can incorporate load control components. The MCC generally serves motor loads but is not limited solely to motor loads.

The wastewater Treatment Plant has one Motor Control Panel designated MCC-P1 located in Electrical Room (RM-104). The Motor Control Panel is a Square D Model 6, 480-Volt, 3-phase, 4-wire device, 600-Ampere main bus.

The 600 Amp. 3 phrase, 4W, 480V main bus provides control power to the various process motors and power distribution panels throughout the Wastewater Treatment Plant.

DANGER:

Replace all devices, doors, and covers before turning on power to this equipment.

Never operate switches with the door open.

Failure to follow these instructions will result in death or serious injury.

Individual motor controllers (Full voltage Non-Reversing, Soft Starts, and Variable Frequency Drives) are located in compartmented units (known as “buckets”) within the MCC. Control-initiating devices, such as push-buttons or selector switches, are typically flush-mounted in the bucket access doors.

Control of motors 3 horsepower (HP) and smaller is provided using Full Voltage Non-Reversing (FVNR) motor starters with a coil operating voltage of 120 -Volts, 60 Hertz. Motor controller coils are energized via a momentary or maintained signal from the Direct Digital Control System (DDC), external contact closure, or the HAND-OFF-AUTO (HOA) selector switch to the control circuit. The control circuit then applies AC power to the starter coil, pulling in the armature of the contact block and applying full voltage to the motor. In the event of a motor overload condition or loss of a voltage phase, thermal magnetic overloads integral to the controller will shut down the operation of the controlled motor. Once the motor overload or phase loss condition has been resolved and cleared, the motor controller may be reset and normal operation may resume.

Control of motors 5 HP and larger that are intended to operate at constant speed or torque is provided using automatic soft start controllers with coil operating voltage of 120V/60 Hertz.

Soft start motor controllers are energized in the same manner as magnetic motor controllers. Soft start motor controllers provide starting employing field adjustable voltage ramp and current limit settings. Soft start controllers also provide freewheel or adjustable voltage ramp motor stopping. Solid-state thermal overload units provide protection in the event of a motor overload condition and may be manually reset.

Variable Frequency Drive (VFD) units provide control of motors whose associated equipment requires speed variation in order to maintain operational system parameters. Motor speed control is solid-state, microprocessor-based, and is accomplished by varying the applied voltage frequency using diode bridge rectification and pulse width modulation.

The VFD unit contains protection and annunciation features including, but not limited to:

- Current limit on all phases to automatically prevent over-current device trip due to momentary overload condition.
- Instantaneous over-current, under voltage, and over-voltage protective device trip.
- Ground fault protection.
- Voltage/current, power status, and motor temperature indication.
- Acceleration/deceleration rate setting.

Programmable logic via the DDC System, in conjunction with input/output sensors, transmitting devices, and interconnection control wiring, provides a 4-20 mA and/or 0-10 VDC input signal to initiate, modulate, and maintain the required speed for the associated equipment.

The following should be adhered to while programming the solid-state overload relay:

WARNING:

UNEXPECTED OUTPUT ACTUATION

Use hard-wired safety interlocks where personnel and/or equipment hazards exist. Failure to follow this instruction can result in serious injury, or equipment damage.

EQUIPMENT DAMAGE HAZARD

Install the battery in the battery adaptor before connecting the cable to the SSOLR. Failure to follow this instruction can result in equipment damage.

DANGER:

HAZARDOUS VOLTAGE

The ground fault current threshold (GF) functions as a Class II ground fault detector.

GF indicates motor degradation for maintenance purposes only.

GF does not provide ground fault protection for personnel.

Electric shock will result in death or serious injury.

CAUTION:

LOSS OF MOTOR PROTECTION

Removing power from the SSOLR resets the thermal memory, resulting in a longer trip time.

DO NOT remove power to reset a trip condition.

Failure to follow this instruction can result in serious injury, or equipment damage.

(Refer to Motor Control Center shop drawing, sheet [E3](#), in Appendix Section 4.1.2 of this manual, for equipment schedules, compartment configuration, and applicable controller types. For a more detailed explanation of motor control center operation, see Appendix Section [4.2.4.1.2](#) of this manual.)

2.5.1.3 Enclosed Disconnect Switches

Disconnect switches (also known as safety switches) provide a means for isolating electrical power from the connected loads. Disconnect switches are installed in accordance with the National Fire Protection Agency (NFPA) Article 70, (also known as the National Electrical Code, NEC). All disconnect switches manufactured by Square D are properly sized for the connected load. Disconnect switches may be fused or non-fused. As a general rule, non-fused disconnect switches are used whenever possible to reduce fuse inventory requirements. Disconnect switches may be “locked” in the *open* position to facilitate proper lockout/tagout procedures when servicing and/or troubleshooting equipment.

2.5.1.4 Enclosed Motor Controllers and Contactors

Motor controllers and contactors provide a means of starting and stopping motorized, and ancillary, electrical equipment loads manually and/or automatically. These electrical loads may be controlled locally or remotely.

Local control consists of push-buttons or selector switches. Push-buttons (i.e. Start-Stops, Jogs, etc.) require manual initiation of the control sequence. Remote control is typically provided by the DDC system through the use of Hand-Off-Auto selector switches. However, manual/local control may also be provided when the selector switch is placed in the “*Hand*” position.

Remote/automatic control is initiated and controlled by the DDC system programmable logic control sequences, or by direct operator input at the DDC Central Workstations. This is accomplished through the control circuitry interconnected with the “*Auto*” position of the Hand-Off-Auto selector switch.

(For additional motor controller and contactor information, refer to Appendix Section [4.2.4.1.4](#).)

2.5.1.5 Variable Frequency Drives

Variable Frequency Drive (VFD) units provide control of motors whose associated equipment requires speed variation in order to maintain operational system parameters. Motor speed control is solid-state, microprocessor-based. Typical applications of VFD speed control is; control of air delivery for air handling systems and control of fluid delivery for hydronic pumping systems.

The DDC System, in conjunction with input/output sensors, transmitting devices, and interconnection control wiring, provides the input signal to initiate and maintain the required speed for the associated equipment.

(For additional variable frequency drive information, refer to Appendix, Section [4.2.4.1.5](#).)

2.5.1.6 Transformers (Interior / Exterior)

Dry-type transformers were selected because oil-filled transformers may freeze requiring increased maintenance, and raise environmental concerns over potential oil spills. Dry-type transformers are lighter than oil-filled making them less costly to transport and easier to handle.

WARNING:

When dual-voltage, or delta-wye, connections cause transformer windings to be connected in parallel, tap changers or tap connections links must be positioned as shown on the transformer nameplate. Tap adjustments are not usually possible when the transformer windings are connected in parallel. Before re-energizing the transformer after changing the dual-voltage or delta-wye connections, check the tap settings with the transformer nameplate.

Operate all load break equipment with caution, make sure you are aware of circuit conditions. You must understand the purpose and function of all equipment's accessories. Wear the protective clothing or equipment required for the conditions.

Failure to follow these instructions can result in serious personal injury or death and property damage.

NOTE:

Dry-type transformers should be tested before the unit is placed in service. The purpose of testing is to ensure the condition of the transformer is satisfactory for operation, and to provide test data for future comparison.

Interior

There are four dry-type transformers (T-1 through T-4) used in the MCC tied directly to the panel's main bus. All four transformers are physically located in the Electrical Room (RM 104). All four transformers are of the step-down type, lowering the voltage from 480V on the primary side to 208V on the secondary side.

- The T-1 transformer has a 30 KVA, 480 - 120/208 Volt, 3 phrase, 4W rating. T1 provides power to the lighting panel (LPA) through a 50 Amp. circuit breaker.
- The T-2 transformer has a 30 KVA, 480 - 120/208 Volt, 3 phrase, 4W rating. T2 provides power to the lighting panel (LPB) through a 50 Amp. circuit breaker.

- The T-3 transformer has a 30 KVA, 480 - 120/208 Volt, 3 phrase, 4W rating. T3 provides power to the mechanical panel (MPA) through a 50 Amp. circuit breaker.
- The T-4 transformer has a 15 KVA, 480 - 120/208 Volt, 3 phrase, 4W rating. T4 provides power to instrument panel (IPA) through a 25 Amp. circuit breaker.

Exterior

Power to the Wastewater Treatment Plant comes from the secondary windings of a 300 KVA, pad mounted, transformer. The transformer is a 3 phrase, 60 Hertz, Class GA-H, 150° C rise, with a rated primary volts of 4160 delta (30 KV BIL) and secondary volts of 480y/277 (10 BV BIL).

The transformer has dry type coils with nitrogen seal. The primary coils are fused to reduce the risk of damage from voltage surges or lightning strikes. Protective coverings protect the transformer from the elements.

(For additional transformer information, refer to Appendix, Section [4.2.4.1.6](#).)

2.5.2 Lighting

2.5.2.1 Site Lighting

Weatherproof, incandescent light fixtures are typically mounted above the platforms of exterior decks and stairways, above the entrance doors, in vestibule areas adjacent to exterior doors, and along walkways.

The fixtures are typically vapor-tight, with glass globes and cast guards. They are equipped with either 100 or 150 Watt bulbs to provide maximum visibility.

Fixtures used to illuminate exterior doors are mounted approximately 12" above the door, while other exterior lighting is typically 10 - 15 feet above grade.

(Additional specifications for all site lighting can be found in Appendix Section [4.2.4.2.1](#) of this manual.)

2.5.2.2 Interior Luminaries

Interior lights consist of both fluorescent and incandescent fixtures. Typical mountings include ceiling, grating, and wall. Incandescent fixtures provide lighting in unheated areas. The fixtures are vapor-tight, with glass globes, cast guards, and 100 Watt lamps.

Fluorescent fixtures provide the primary lighting source. Fluorescent fixtures use bulbs ranging from 32 - 54 Watts. Fixtures are typically 4' long, contain 2 type fluorescent lamps, and use a 277V magnetic ballast.

The fluorescent fixtures are controlled by the use of either lighting switches and/or occupancy sensors. Recessed and surface mount incandescent and compact fluorescent fixtures are used where architectural aesthetics are conducive.

Wall mounted light fixture are located either 10 or 12 feet from the floor depending on their function.

(Additional specifications for all interior lighting can be found in Appendix Section [4.2.4.2.2](#) of this manual.)

2.5.2.3 Emergency Lighting Units

Emergency lighting within the interior spaces of the plant is provided through the use of wall mounted halogen 7.2 Watt lighting fixtures, which are equipped with emergency back-up ballasts that provide fluorescent egress lighting (as required by NFPA 101) in the event of a power failure. Each unit provides up to 90 minutes of illumination for the rated wattage upon loss of AC power. The fixtures containing back-up ballasts are equipped with a push button that facilitates periodic testing of the emergency lighting lamps. Pressing the push-button illuminates the back-up fluorescent lamps to verify functionality.

2.5.2.4 Exit Lighting/Signs

Exit lighting signs/fixtures are battery-powered, rechargeable, Light Emitting Diode (LED) devices. Each wall mounted unit contains 3.8-watt LEDs.

A sealed, maintenance-free, nickel cadmium battery, contained in the fixture, delivers emergency DC power to facilitate illumination in the event of a power outage. As required by the Life Safety Code, NFPA 101, the batteries are sufficient to provide illumination for a minimum of 120 minutes.

Conveniently located test switch and status indicator provide visual and manual means of monitoring system operation.

The self diagnostic emergency signs comply with NFPA Lite Safety Code and automatically test the battery once a month for five minutes and once every six months for 30 minutes.

2.5.3 Heat Trace

2.5.3.1 Vent-Thru-Roof / Water Piping

The heat trace (tape) installed in the Wastewater delivers up to 9-watts per foot. The tape is a self-regulating type, that delivers more wattage as the material it is attached to cools and less as it warms.

Heat tape is installed on the domestic water supply and return lines, forced main discharge (sewage) piping, and exhaust stack vents. Optional thermostatic controls may be used in conjunction with the self-regulating heat trace. Water lines are double heat traced while drain lines are single heat traced.

An ambient-sensing thermostat with a fixed 40° F set-point uses a probe to monitor surface temperature of the pipe and activates or deactivates current through the heat trace tape.

2.5.3.2 Below Slab

The heat trace (tape) installed delivers up to 9-watts per foot. The tape is a self-regulating type, that delivers more wattage as the material it is attached to cools and less as it warms. Heat tape is installed on the domestic water supply and return lines, forced main discharge (sewage) piping, and exhaust stack vents. Optional thermostatic controls may be used in conjunction with the self-regulating heat trace. Water lines below the slab are double heat traced while drain lines are single heat traced.

An ambient-sensing thermostat with a fixed 40° F set-point uses a probe to monitor surface temperature of the pipe and activates or deactivates current through the heat trace tape.

2.5.4 Signal Systems

2.5.4.1 Telephone

Copper wiring provides telephone connectivity. Telephones in the Wastewater Treatment Plant are connected to the PBX located in Building 182, “Telco”, via wiring panels located in the Communication Closet, RM 206, on the second floor. The PBX allows telephone voice connectivity to other Station telephones and off-Station telephones.

Telephone outlets are typically provided in the Boiler Room, Electrical Room, the two loading areas, one in each corner of the main process room (206), and the Communication Closet. Additional telephone outlets are distributed as part of the multimedia outlets throughout the plant as required.

(For additional information on telephone outlet locations, please see Drawings [E-901](#) and [E-902](#) in Appendix Section 4.1.2.1 of this manual.)

2.5.4.2 Public Address System

The WWTP has no dedicated public address system.

2.5.4.3 Local Area Network (LAN)

Within the Wastewater, the Local Area Network uses Category 5e copper wire to provide a throughput rate of up to 100 megabytes (100,000,000 bytes per second) per computer workstation. LAN signals are routed to a communications wiring closet, (RM 206), located on the second floor. A network switch in Room 206 provides network services distribution within the WWTP, and access to the McMurdo Station LAN.

Connections to the McMurdo LAN is via optical fiber at 1 Gbit/second. LAN signals travel from the WWTP to a layer-3 switch-router in the Network Operations Center (NOC), Building 165. The equipment in the NOC provide connectivity to file servers, E-mail, and the Internet.

The LAN is dependent on power in the building to power the hub and PC. If the hub fails, it will cause the LAN to become inoperative and connectivity to the Station LAN will be lost. Failure of either the PC or the copper connection to the hub will cause that PC to lose its connection to the LAN.

2.5.4.4 Fire Detection and Alarm Systems

2.5.4.4.1 Fire Detection and Alarm Control Panel

The fire alarm control panel (FACP) is a microprocessor-addressable type system that provides early detection of smoke and/or heat produced by fire. The FACP system is configured to interconnect with the planned addressable system.

The complete FACP system includes a master Fire Alarm and Control Panel, located in the Communications Closet (RM-206).

The existing system includes heat detectors, smoke detectors, manual pull stations, projected beam detector transmitters, projected beam detector receivers, duct detectors, and horn/strobe alarm stations. All pull stations, detectors, and sensors currently report to the Fire Alarm and Control Panel.

When one, or more, of the zone initiating devices latches the panel into an alarm condition, the FACP begins an alarm condition sequence which pulses the respective individual zones RED alarm LED, pulses the common RED alarm LED activate the notification appliances, and transmit the appropriate zone(s) to the central receiving unit.

The FACP also monitors its own operational status for: system troubles, improper board insertion, control switches or cables abnormal, notifies of open or short circuits conditions in the signaling devices, ground fault conditions, loss of primary power, and battery circuit trouble.

The FACP automatically switches to a 24V DC back-up battery in the event of a power outage. The FACP initiates trouble signal two minutes after a power outage.

(A complete and detailed operation explanation of the FACP can be found in Appendix Section 4.2.4.4.4.1 of this manual. For additional information on the fire detection control system, see Drawing Sheets FS-101 - FS-103 in Appendix Section 4.1.2 of this manual.)

2.5.4.4.2 Initiating Devices

Initiating devices, such as detectors and pull stations, are located throughout the Wastewater Treatment Plant. Heat detectors are of the Fenwal 27021 rate compensated type.

Two types of *heat detectors* are used in the Wastewater Treatment Plant. Fixed-temperature and rate-of-rise type heat detectors. Both types of detectors initiate an alarm if the surrounding air reaches the detector's set temperature point (normally 140° F).

The *Fixed-temperature/rate-of-rise detector* also initiates an alarm prior to reaching its set temperature point if it detects a rapid rise in the surrounding air temperature.

Photoelectric type smoke detectors are used in areas not subject to frequent occupancy, or where combustion might not be immediately noticed, such as in sub-floor areas and plenums. The photoelectric smoke detectors use a photo chamber sensor to detect smoke particles in the air. They also use a thermistor sensor to sense temperature changes. A microprocessor in the detector uses inputs from both sensors to identify actual fire conditions while ignoring non-threatening phenomena such as cigarette smoke.

Pull stations provide a manual means of initiating a fire alarm. The pull stations are located throughout the plant.

Thermal Fire Detectors are of the rate compensation/fixed temperature type. When subjected to a very slow heat rise the tubular shell and the interior struts lengthen at approximately the same rate. At the detectors set temperature 135° F or 200° F, the interior struts are fully extended, thereby closing the contact points and initiating an alarm.

Gas Detector System is a diffusion-based, point-type, hydrocarbon gas, infrared detection system. The system is comprised of a detector and a junction box.

The hydrocarbon gas detector provides continuous monitoring of combustible hydrocarbon gas concentrations in the range of 0 to 100% lower explosive limit (LEL). During normal operation, the detector has a current output from 4 to 20 milliamperes that is proportional to gas concentrations from 0 to 100% LEL. A current output other than 4 to 20 milliamperes indicates either negative gas level, a fault or over-range condition, or that the unit is in the calibrate mode.

The detector has four operating modes: Warm-up, Normal, Fault, and Calibration.

NOTE:

It is not recommended to physically connect or touch the calibration lead wire to DC common in the field to begin calibration. This practice is often less than precise, and may result in a spark or other undesirable result. For optimum ease of installation and calibration, always use a PointWatch Junction Box (furnished with magnetic reed switch, indicating LEDs, and terminal strip).

If the device is being used with a gas other than methane, it must be calibrated with 50% LEL of the gas selected with the gas selection switch.

To check calibration, inhibit output loads as necessary, then apply 50% LEL calibration gas to the detector using the equipment provided in the calibration kit. Ensure that the correct calibration gas is used. Check the current output for the appropriate response (12 milliamperes).

Ensure the detector has been operating for at least two hours before calibrating.

Do not open the explosion-proof enclosure when power is applied to the system unless the appropriate permits have been procured.

Drift will be indicated by a constant zero offset in one direction either above or below 4 Milliamperes. The presence of background gas would be indicated by a small but constantly changing output.

The calibration ports must be capped to prevent dirt and water from entering the direct path into the optics. Failure to protect the optics can result in a fouled optics fault. If a permanent gas delivery system is used, the delivery tube must be plugged when not in use.

The calibration gas used must be the same as the gas selected on the Gas Selection Switch. The factory setting is for methane, so use methane to calibrate if the Gas Selection Switch is set in position "0." If the Gas Selection Switch is set in any other position, ensure that the correct gas is used to calibrate. Only 50% LFL calibration gas can be used to calibrate the detector.

NOTE:

If the detector is being used in a stand alone configuration, the use of an inhibited current loop is recommended. Live current loop calibration was designed primarily for use with the Infinity Transmitter or the Eagle 2000 system. Accomplishing live current loop calibration manually is possible but not recommended. Instructions for live current loop calibration are provided after the "Calibration Procedure - Inhibited Current Output During Calibration" procedure.

The calibration sequence is initiated by momentarily connecting the calibration lead to the negative lead (common) of the power supply using the Cal Magnet or an external switch. If the Det-Tronics J-box with magnetic Cal Switch is being used, this is accomplished by holding the Cal Magnet near the side of the J-box for one second. The location of the Cal Switch. An alternate way of accomplishing this is to install a pushbutton switch between the yellow lead and the power supply common (-). Use of the Cal Magnet to activate the Cal Switch in the J-box will be referred to throughout the following procedures. If an alternate method of initiating calibration is used, substitute that method in all places in which the Cal Magnet/Cal Switch activation are referenced.

The calibration sequence can be exited at any time during the span calibration by holding the Cal Magnet near the Cal Switch in the J-box for one second.

At all times other than when calibration is being performed, all calibration ports must be capped. This prevents dirt and water from entering the direct path into the optics. Failure to protect the optics can result in a fouled optics fault. If a permanent gas delivery system is used, the delivery tube must be plugged when not in use.

Inhibit alarm outputs before performing this calibration procedure. Alarm levels will be exceeded using the live current output calibration procedure.

All calibration notes listed at the beginning of the "Calibration Procedures" section also apply to this procedure. Review those notes prior to proceeding.

Combustible Gas Controller is used to monitor the output from electrochemical sensors. It provides a continuous reading of the sensor input and operates in a variety of ranges depending on the detection range of the electrochemical sensor. The controller provides a 4 to 20 milliampere output status signal to other monitoring equipment.

In addition to the Normal mode, the controller can operate in other modes that are selected by pressing the appropriate push-button) located on the controller front panel. These modes include system reset, displaying and programming alarm set-points, calibration of the 4 to 20 mA. output, and sensor replacement.

CAUTION:

Operating ranges are not field selectable and must be specified when ordering. Operating ranges for the controller and sensor must match to ensure proper operation.

NOTE:

If an alarm or fault condition exists, the controller will return to alarm or fault status when the reset button is released.
The remote reset performs a reset function only. It cannot be used for entering other controller operating modes.

Air Duct Detectors are used in heating, ventilating and air conditioning duct systems to signal the presence of hazardous quantities of products of combustion or smoke being carried through the duct system.

The detector employs a cross-sectional sampling principle of operation. A continuous cross-sectional sampling of air moving through the duct is taken by the inlet sampling tubes. This averages the effects of laminar flow, stratification or skin effect phenomena occurring in the duct that could prevent combustion product or smoke from reaching a spot type detector.

(Additional operating information for all these initiating devices is available in Appendix Section 4.2.4.4.4.2 of this manual.)

2.5.4.4.3 Signaling Appliances

Signaling devices, such as audible/visual alarms, provide the ability to transmit warnings of existing emergency conditions to personnel. These devices are typically a combination of audio horns and light strobes. These devices are placed throughout appropriate areas to alert personnel of possible dangerous conditions.

(Additional operating information for the signaling appliances is available in Appendix Section 4.2.4.4.4.3 of this manual.)

2.5.4.4.4 Miscellaneous Electrical Devices

The automatic voice/pager dialer system is used to notify the McMurdo fire station and alert local personnel of a fire condition. The dialer system takes its input from the fire alarm panel. Each of the dialer's four channels can be activated by a normally open dry contact, a normally closed dry contact, or a positive 5 - 28 VDC voltage. Notification is accomplished through telephones and voice paging devices.

When activated, the dialer instantly begins calling the pre-programmed telephone numbers in sequence. During each successful calling attempt, the dialer delivers each recorded outgoing message (OGM) one to three times in a row, in accordance with the pre-selected number of dialing attempts.

CAUTION:

If the message is sent to a phone attached to an answering machine, once the answering machine picks up the dialer considers this a successful attempt. Make sure to designate the maximum number of message repeats to ensure that a complete message will be recorded on the answering machine.

In unsuccessful attempts, the dialer will move on to the next phone/pager number after receiving eight busy or eight rings without an answer.

Other miscellaneous electrical devices used in the fire system include fuses, receptacles, connector bodies, plugs, flanged inlets, utility boxes, and conduit fittings.

(Additional information on the dialer and these other devices is available in Appendix Section [4.2.4.5](#) of this manual.)

2.6 WASTE WATER TREATMENT PROCESS SYSTEMS

The wastewater process equipment points that appear in the DDC are for monitoring and manual control only. There is no automation of the treatment process.

2.6.1 Preliminary and Secondary Treatment

2.6.1.1 Plant Bypass (Eccentric) Valves

Ten inch eccentric plug valves are used to bypass treatment processing and re-route the raw sewage to the current outfall. These valves are manually operated and should **only** be opened because of an emergency situation, or if treatment of the raw sewage is not possible because of plant closure.

WARNING:

This valve is a pressure vessel. Pressure must be completely released before disassembly. The bonnet will blow off if the bonnet bolts are removed with pressure in the valve.

2.6.1.2 Macerators

Raw sewage enters the Wastewater Treatment Plant where it passes through one of two (1 duty, 1 standby) in-line macerators (Process Equipment: 101 -Macerator No. 1, and 102-Macerator No.2) which grind materials within the sewage and discharge the ground material into the wastewater stream.

Conditions to Stop Equipment:

“**STOP**” pushbutton

“**FAIL**” condition

Conditions for Alarm:

“**FAIL**” condition - minor alarm

Local Control Station - Components:

“**LOCAL/REMOTE**” two position switch

“**START**” pushbutton.

“**LOCK-OUT-STOP**” pushbutton.

“**RUN**” indicating light.

“**FAIL**” indicating light.

Local Control Station -Modes of Control:

Local Control of the equipment at the Local Control Station uses the motor starter control circuit. The **“LOCAL/REMOTE”** switch must be in the **“LOCAL”** position. Start equipment by pushing the **“START”** pushbutton. Stop equipment by pushing the **“LOCK-OUT-STOP”** pushbutton. A **“RUN”** indicating light illuminates when the equipment is running. A **“FAIL”** indicating light illuminates when the equipment has failed.

Remote Control of the equipment from the PICS uses the motor starter control circuit. The **“LOCAL/REMOTE”** switch must be in the **“REMOTE”** position.

Remote control of the equipment using the PICS Operator Interface is identical to “LOCAL” control.

Typical Operation:

Place all equipment in the **“REMOTE”** mode of operation.

The operator shall run either of the macerators continuously. The operator should verify the valving is correct prior to the macerator being started.

(Additional operational information on the macerators is available in Appendix Section [4.2.5.1.2](#) of this manual.)

2.6.1.3 Influent Flow System

2.6.1.3.1 Trapezoidal Flume

The Trapezoidal Flume allows for measuring of the influent waste sewage just after the macerators. The flume itself has no operating components.

2.6.1.3.2 Flow Metering

The flow indicating transmitter displays instantaneous and daily totalized flow. The transmitter sends the flow signal input data to the PICS. Based on this flow signal input, the operator interface displays instantaneous and totalized daily flow as well as conditions for alarm.

WARNING:

This product can only function properly and safely if it is correctly transported, stored, installed, set-up, operated, and maintained.

CAUTION:

If the relay status can affect plant operation or personnel safety, it is advisable to override the relay functions or disconnect the relay wiring during calibration or simulation.

Keep power disconnected at main breaker when MultiRanger cover is opened.

The operator can input adjustable set-points for the conditions for alarm using the PICS Operator Interface.

NOTE:

Always use product in accordance with specifications.

The parameters shown in the auxiliary reading field are indexed as follows:

- global
- by transducer
- by level point

To activate PROGRAM from RUN mode, press PROGRAM

The display briefly reads ---- while the measurement reading is verified. Reading level and other data is displayed and programmed relays are operated.

Placing a programmed unit that is in normal operation into PROGRAM mode deenergizes all control relay outputs. Be sure to bypass the MultiRanger while programming it.

Power up display

Single Point Model:

- Preset to display distance from the face of the transducer to the material
- Transducer selection is preset for the XPS-10.
- Empty distance is preset to 5m.

Dual Point Model:

- Starts in an OFF state and does not take level measurements.
- To set up measurement, the quick start parameters must be configured.

The flow meter will not sacrifice other pumping strategies to ensure that the ratio is held true.

NOTE:

If Parameter Value alteration is not permitted, access the Lock parameter (P000) and enter the security code.

Transducers are always indexed when the dual point option is enabled.

An indexed transducer is commonly referred to as a Point (short for Measurement Point.). Point Number refers to indexed transducers.

To set all indexed values for a parameter to the same value, use index 0.

MR 200 only: Transducer parameters are indexed only if Operation (P001) is set to Difference (value=4) or Average (value=5) on a single point MultiRanger.

Set all pump control relay ON and OFF set points to the same value.

If the level is within 5% of Span (P007) of the OFF setpoint, then the next pump is not started.

Conditions for Alarm:

“NO FLOW” condition - major alarm.

“LOW FLOW” condition - minor alarm.

“HIGH FLOW” condition -minor alarm.

“HIGH-HIGH FLOW” condition - major alarm.

2.6.1.3.3 Ultrasonic Level Meter

The ultrasonic level meter displays instantaneous and daily totalized flow. The transmitter sends the flow signal input data to the PICS. Based on this flow signal input, the operator interface displays instantaneous and totalized daily flow as well as conditions for alarm.

WARNING:

This product can only function properly and safely if it is correctly transported, stored, installed, set-up, operated, and maintained.

This product is designated as a Pressure Accessory per Directive 97/23/EC and is not intended for use as a safety device.

Failure to observe these necessary precautions can result in death, serious injury, and/or considerable material damage.

NOTE:

Always use this product in accordance with specifications.

Kynar® polyvinylidene fluoride is resistant to attack from most chemicals under the described operating conditions. However, for exposure to specific environments, check with chemical compatibility charts before installing the XPS/XCT Transducers in your application.

When using a stilling well, make sure there is no build-up, welds, couplings, or other debris on the inside of the well wall. This can affect reliability of level measurement.

The operator can input adjustable set-points for the conditions for alarm using the PICS Operator Interface.

Conditions for Alarm:

“NO FLOW” condition - major alarm.

“LOW FLOW” condition - minor alarm.

“HIGH FLOW” condition -minor alarm.

“HIGH-HIGH FLOW” condition - major alarm.

2.6.1.4 Raw Sewage Bypass and Secondary Treatment Bypass

2.6.1.4.1 Raw Sewage Bypass (Eccentric) Valve

The influent system is equipped with bypass pipeline and isolation eccentric plug valves located just before the macerators for complete system bypass. The valves are manually operated by the operators.

A “RAW SEWAGE BYPASS FLOW” condition alarm is generated by a limit switch mounted on the valve indicating the valve is not closed.

In an emergency operation situation, operate the valve as under normal conditions, taking care to bring the plug to the position required by the particular emergency condition.

2.6.1.4.2 Secondary Treatment Bypass (Eccentric) Valve

The influent piping to the Secondary Treatment System is equipped with bypass pipeline and isolation eccentric plug valves located just after the macerators. The valves are manually operated by the operators.

A “RAW SEWAGE BYPASS AND SECONDARY TREATMENT BYPASS FLOW” condition alarm is generated by a limit switch mounted on the valve indicating the valve is not closed.

In an emergency operation situation, operate the valve as under normal conditions, taking care to bring the plug to the position required by the particular emergency condition.

2.6.1.5 Anoxic Basin Mixing

2.6.1.5.1 Anoxic Basins

The purpose of the three anoxic chambers (one for each aeration basin) is to separate the solid materials from the liquids and to denitrify the wastewater. A solid baffle separates the anoxic chamber from the aeration chamber with an opening located at the bottom of the baffle. A continuous duty mixer is used to push waste material downward further into the process allowing it to enter the aeration chamber through the baffle opening. Wastewater is introduced into the anoxic chamber from the flow control outlet trough, from the return activated sludge from the clarifiers, and from a recycle pump located in the aeration chamber.

2.6.1.5.2 Anoxic Basin Mixers

The anoxic basin mixers (one for each anoxic chamber) are located in the anoxic chambers. Each mixer is of the continuous duty type. The mixers are mounted at a 20° angle near the center of the anoxic chamber. The mixers push the wastewater down into the chamber by rotating a propeller mounted at the end of a 1^{1/4}" shaft.

IMPORTANT:

DO NOT operate shaft scaling devices at temperatures or pressures higher than those specified in the manual or on the nameplates.

DO NOT operate the mixer for service other than its intended use.

DO NOT operate the mixer until you have checked the following items:

- **Make sure the mixer is properly grounded.**
- **Ensure all protective guards and covers are installed.**
- **Ensure all detachable components are securely coupled to the mixer.**
- **Thoroughly REVIEW and ADHERE TO the mixer operating instructions supplied by the manufacturer.**
- **Ensure the mixer output shaft rotates freely by hand.**
- **Ensure all personnel and equipment are clear of rotating parts.**
- **Ensure all exterior connections (electrical, hydraulic, pneumatic, etc.) have been completed in accordance with all applicable codes and regulations.**

Local Control of the mixers at the Local Control Station uses the motor starter control circuit. The **“LOCAL/REMOTE”** switch must be in the **“LOCAL”** position. Start equipment by pushing the **“START”** Pushbutton. Stop the equipment by pushing the **“LOCK-OUT-STOP”** Pushbutton. A **“RUN”** indicating light illuminates when the equipment is running. A **“FAIL”** indicating light illuminates when the equipment has failed.

Remote Control of the mixers from the PICS uses the motor starter control circuit. The **“LOCAL/REMOTE”** switch must be in the **“REMOTE”** position.

Monitoring control of the mixers using the PICS Operator Interface is identical to **“LOCAL”** control.

Conditions to Stop Equipment:

1. **“STOP”** pushbutton.
2. **“FAIL”** condition.

Conditions for Alarm:

1. “FAIL” condition - minor alarm

Local Control Station - Components.

1. “**LOCAL/REMOTE**” two position switch.
2. “**START**” pushbutton.
3. “**LOCK-OUT-STOP**” pushbutton.
4. “**RUN**” indicating light.
5. “**FAIL**” indicating light.

Typical Operation:

1. Equipment in the “**REMOTE**” mode of operation.
2. The operator shall run the mixer for each basin continuously for each basin in service.

2.6.1.5.3 Influent Splitter Box

The influent splitter box is manually operated by the operator. The splitter box allows the operator to divert influent waste into any active single basin at low influent periods, or to one than one basin at high influent periods. The splitter box is feed from one 10” raw influent piping. The raw influent exits the box through 4 exit pipes selected by the use of V-notched flow control weir plates manually positioned by the operator. Three of the four exit pipes feeds three current basins and the fourth one is slatted for future expansion.

2.6.1.6 Mixed Liquor Recycle Pumping

2.6.1.6.1 Mixed Liquor Recycle Pumps

The Mixed liquor pumps are responsible for transferring the mixed liquor from the aeration basins to the anoxic zones. The pumps are equipped with an “**HAND/OFF/AUTO**” switch, operating lights, and alarms at the UCP and the MCR.

The Mixed liquor pumps can be operated manually by placing the “**HAND/OFF/AUTO**” selector switch in the “**HAND**” position on the LCP.

The Mixed liquor pumps are controlled through the Direct Digital Control (DDC) system when the **“HAND/OFF/AUTO”** selector switch in the **“AUTO”** position. The speed of the pumps can be controlled using either the automatic or manual modes of operation.

When the automatic speed control is selected, the DDC system modulates the speed signal to the variable frequency drive (VFD) which maintains the mixed liquor gallons-per-minute (GPM) set-point as set through the DDC workstation.

When the manual speed control is selected, the DDC system maintains the selected signal to the VFD.

Conditions to Stop Equipment:

1. **“STOP”** pushbutton.
2. **“FAIL”** condition.

Conditions for Alarm:

1. **“FAIL”** condition - minor alarm

Local Control Station - Components.

1. **“LOCAL/REMOTE”** two position switch.
2. **“START”** pushbutton.
3. **“LOCK-OUT-STOP”** pushbutton.
4. **“SPEED CONTROL”** potentiometer.
5. **“RUN”** indicating light.
6. **“FAIL”** indicating light.

Local Control Station - Modes of Control:

Local control of the recycle pumps at the Local Control Station using the motor starter control circuit. The **“LOCAL/REMOTE”** switch must be in the **“LOCAL”** position. The pumps are started by pushing the **“START”** pushbutton and are stopped by pushing the **“LOCK-OUT-STOP”** pushbutton. A **“RUN”** indicating light illuminates when the equipment is running. A **“FAIL”** indicating light illuminates when the equipment has failed. The speed of the pump is controlled by a **“SPEED CONTROL”** potentiometer.

The operator shall adjust the speed to meet the required mixed liquor recycle flow rate as determined by the operator based on field sample and laboratory tests. The operator shall monitor the mixed liquor recycle flow rate by a local flow indicating transmitter display of instantaneous and totalized daily flow.

Remote control of the recycle pumps from the PICS using the motor starter control circuit. The **“LOCAL/REMOTE”** switch must be in the **“REMOTE”** position. Monitoring/control of the equipment using the PICS Operator Interface. Starting and stopping of the pumps is per the operator's discretion. The operator shall be able to input an adjustable value of mixed liquor recycle flow rate in gallons-per-minute (GPM). The pump will speed up or speed down to meet the input mixed liquor recycle flow rate as measured by the flow indicating transmitter. The PICS will automatically adjust the speed of the pump to meet the desired mixed liquor recycle flow rate.

WARNING:

To avoid serious or fatal personal injury or major property damage, all operators and service personnel should read and follow all safety instructions in the manufacturer's manual and on the pump.

Typical Operation:

1. Place the equipment in the **“REMOTE”** mode of operation.
2. The operator shall evaluate daily if a change in the value of mixed liquor flow rate is required.
3. A local flow indicating transmitter displays instantaneous and totalized daily flow for each process train. The transmitter outputs a signal to the PICS.
4. Based on this flow signal input, the Operator Interface displays instantaneous and daily totalized flow for each process train.

2.6.1.6.2 Magnetic FlowMeter

The magnetic flowmeter displays volume information of the mixed liquor being pumped from the aeration basins to the anoxic zones. The flow meters provide a local readout as well as a readout back to the main control room.

The keypad is used to set the flowmeter by use of function keys. The display is alphanumeric and indicates flow values (including totalizer values), flowmeter settings and error messages.

The cleaning unit cleans the electrodes electro-chemically by applying a voltage to the electrodes for approximately 60 seconds. While cleaning, the signal converter stores and holds the last measured flow reading on the display and also the signal outputs. Cleaning should only take place with liquid in the pipe. AC-cleaning is used to remove fatty deposits on the electrodes. DC-cleaning is used to eliminate electrically conductive deposits in the measuring pipe influencing the measuring accuracy. During DC-cleaning, electrolysis takes place where the flow of electrons removes the particle deposits from the electrode area. Cleaning is initiated by selecting either the *AC*-cleaning or *DC*-cleaning mode at the switch located on the base of the cleaning unit.

(For additional information regarding the flowmeter, see Appendix Section 4.2.5.1.6.2 of this manual.).

2.6.1.7 Return Activated Sludge (RAS) and Waste Activated Sludge (WAS) Pumping

2.6.1.7.1 Final Clarifiers

Three clarifiers are used to settle activated sludge from the mixed liquor suspended solids (MLSS). MLSS enters the clarifier by a 12"x12" cutout in the aeration baffle located between the aeration basins and the clarifiers. Scum, being lighter than the treated liquid, floats to the surface leaving the MLSS to settle towards the bottom. The flow is then directed outward causing the effluent to flow towards the overflow and into the effluent trough. From here effluent is conveyed to the UV disinfection system. The weirs are provided with a scum baffle to avoid overflow of scum and floatables.

Air from the blowers is blown through two regulating valves into a 4" sludge airlift assembly mounted in each clarifier. The amount of air through the regulating valves is manually controlled by the operator. The sludge airlift assembly creates a vacuum which sucks the sludge up from the bottom of the clarifier. The settled activated sludge is then conveyed to the RAS/WAS air lift pumps.

2.6.1.7.2 (RAS/WAS) Airlift Pumps

The RAS/WAS pumping operation shall be a manual operation with no monitoring or control through the PICS.

Typical Operation:

1. The operator shall manually adjust the air regulating valve to control the flow rate of the airlift pump.
2. The operator shall adjust the Air Lift regulating valves based on inspecting the flow as visually monitored through the use of a V-notch weir and vertical scale.
3. The flow direction for the RAS/WAS shall be set by manual adjustment of a diverter gate or individual valves for the RAS and WAS.
4. The operator shall adjust the Air Lift regulating valves for RAS to return 50 to 150 percent of the maximum average daily flow. The operator shall verify the maximum average daily flow locally at the influent flow meter or through the PICS

Operator Interface:

1. The operator shall then determine the amount of RAS to return and adjust the equipment accordingly. The operator shall evaluate this on a daily basis.
2. The operator shall adjust the valve for WAS to waste the desired amount of activated sludge. The operator shall determine how often and how much activated sludge is to be wasted. The operator shall evaluate this on a daily basis.

2.6.1.8 Scum Removal System

The scum and floatables are then removed by a scum skimmer. The Scum pumping operation shall be a manual operation with no monitoring or control through the PICS.

Typical Operation:

1. The operator shall manually adjust the air regulating valve to control the flow rate of the airlift pump.
2. The operator shall open or close the valve for to regulate scum sent to the aeration tanks.

3. The operator shall open or close the valve for scum to regulate scum sent to the digesters.
4. The operator shall evaluate daily if a change in the location of where the scum is drained to.

2.6.2 Tertiary Treatment

2.6.2.1 Ultraviolet Light (UV) Disinfection

2.6.2.1.1 UV Light Banks

Secondary effluent from the clarifiers flows by gravity to the ultraviolet (UV) light disinfection system. A dual UV channel system provides continuous disinfection. Flow enters the UV system and is directed into the channels containing the UV lamps. The disinfected flow is then routed through a Parshall Flume measuring device. A ultrasonic flow meter transducer provides a local readout as well as a readout at the MCR. The disinfected liquid then flows to the outfall.

Contact closure for remote annunciation at the MCR is used to indicate lamp rack failure due to ground fault interruption and is designated as an alarm condition in the Tertiary Treatment area.

Each bank of UV lamps is equipped with an ultraviolet intensity sensor. The sensor transmits a signal to an intensity meter located in the UCP. The meter provides a percent UV output reading indicating the amount of UV light available at a representative location within the bank of lamps. For remote monitoring purposes the UV intensity meter provides a 4-20 mA output, for indication at the MCR.

The UV intensity meter has only one fully adjustable alarm set point. Contact closure occurs at the preset level for remote alarm annunciation at the MCR, designated by an alarm condition in the Tertiary Treatment area.

A solid state digital elapsed time counter is used for each bank of lamps or each section of lamps within a bank. The counter is located in the UCP.

Each module is equipped with an electronic lamp monitoring system. This system indicates the geometric location of each individual lamp and the operating status of each lamp by means of a neon light. Upon lamp failure, the corresponding neon light brightly illuminates and a contact closes signaling a remote alarm annunciation at the MCR. This alarm annunciation is designated as an alarm condition in the Tertiary Treatment Area.

WARNING:

Exposure to a burning UV lamp can damage eyes and skin.

Each lamp in the UV Module is a powerful source of ultraviolet light. UV light can cause serious damage to unprotected skin and eyes, but is safe when the proper precautions are taken.

Typical Operation:

The operator shall put in service either or both of the UV Light Banks by manually opening and closing the respective valves to bring the equipment on line.

All components on the local control panel shall be transmitted to the PICS and displayed on the Operator Interface.

Control Panel - Components:

1. ***“PERCENT UV OUTPUT”*** meter.
2. ***“LAMP FAILURE”*** Yellow indicator.
3. ***“LAMP RACK FAILURE”*** Red indicator.
4. ***“UV TRANSMITTANCE PERCENTAGE”*** meter

Conditions for Alarm:

1. ***“LAMP RACK FAILURE”*** condition - major alarm
2. ***“LAMP FAILURE”*** condition - minor alarm.

(For additional information regarding the UV light banks, see Appendix Section [4.2.5.2.1.1](#) of this manual.)

2.6.2.1.2 UV Washer

The UV washer simply consist of a metal cleaning rack designed to hold the UV Lamp assembly during manual cleaning.

2.6.2.2 Effluent Flow System

2.6.2.2.1 Trapezodial Flume

The Trapezodial Flume allows for measuring of the influent waste sewage just after the macerators. The flume itself has no operating components.

2.6.2.2.2 Flow Metering

The flow indicating transmitter displays instantaneous and daily totalized flow. The transmitter sends the flow signal input data to the PICS. Based on this flow signal input, the operator interface displays instantaneous and totalized daily flow as well as conditions for alarm.

The operator can input adjustable set-points for the conditions for alarm using the PICS Operator Interface.

WARNING:

This product can only function properly and safely if it is correctly transported, stored, installed, set-up, operated, and maintained.

CAUTION:

If the relay status can affect plant operation or personnel safety, it is advisable to override the relay functions or disconnect the relay wiring during calibration or simulation.

Keep power disconnected at main breaker when MultiRanger cover is opened.

NOTE:

To activate PROGRAM from RUN mode, press PROGRAM

The display briefly reads ---- while the measurement reading is verified. Reading level and other data is displayed and programmed relays are operated.

Placing a programmed unit that is in normal operation into PROGRAM mode deenergizes all control relay outputs. Be sure to bypass the MultiRanger while programming it.

Power up display

Single Point Model:

- **Preset to display distance from the face of the transducer to the material**
- **Transducer selection is preset for the XPS-10.**
- **Empty distance is preset to 5m.**

Dual Point Model:

- **Starts in an OFF state and does not take level measurements.**
- **To set up measurement, the quick start parameters must be configured.**

NOTE:

The flow meter will not sacrifice other pumping strategies to ensure that the ratio is held true.

If Parameter Value alteration is not permitted, access the Lock parameter (P000) and enter the security code.

MR 200 only: Transducer parameters are indexed only if Operation (P001) is set to Difference (value=4) or Average (value=5) on a single point MultiRanger.

Transducers are always indexed when the dual point option is enabled.

An indexed transducer is commonly referred to as a Point (short for Measurement Point.). Point Number refers to indexed transducers.

To set all indexed values for a parameter to the same value, use index 0.

Set all pump control relay ON and OFF set-points to the same value.

If the level is within 5% of Span (P007) of the OFF setpoint, then the next pump is not started.

Always use product in accordance with specifications.

The parameters shown in the auxiliary reading field are indexed as follows:

- global
- by transducer
- by level point

Conditions for Alarm:

“NO FLOW” condition - major alarm.

“LOW FLOW” condition - minor alarm.

“HIGH FLOW” condition -minor alarm.

“HIGH-HIGH FLOW” condition - major alarm.

2.6.2.2.3 Ultrasonic Level Metering

The ultrasonic level meter displays instantaneous and daily totalized flow. The transmitter sends the flow signal input data to the PICS. Based on this flow signal input, the operator interface displays instantaneous and totalized daily flow as well as conditions for alarm.

WARNING:

This product can only function properly and safely if it is correctly transported, stored, installed, set-up, operated, and maintained.

This product is designated as a Pressure Accessory per Directive 97/23/EC and is not intended for use as a safety device.

Failure to observe these necessary precautions can result in death, serious injury, and/or considerable material damage.

NOTE:

Always use this product in accordance with specifications.

Kynar® polyvinylidene fluoride is resistant to attack from most chemicals under the described operating conditions. However, for exposure to specific environments, check with chemical compatibility charts before installing the XPS/XCT Transducers in your application.

When using a stilling well, make sure there is no build-up, welds, couplings, or other debris on the inside of the well wall. This can affect reliability of level measurement.

The operator can input adjustable set-points for the conditions for alarm using the PICS Operator Interface.

Conditions for Alarm:

“NO FLOW” condition - major alarm.

“LOW FLOW” condition - minor alarm.

“HIGH FLOW” condition - minor alarm.

“HIGH-HIGH FLOW” condition - major alarm.

2.6.3 Digestion

2.6.3.1 Blower System

2.6.3.1.1 Blowers

Field Mounted Instrumentation Equipment: Thermal Mass Flowmeter for the 300-Air System Header, Pressure Indicating Transmitter for the Air System Header.

Local Control Station - Modes of Control:

Local control of the blowers at the Local Control Station uses the motor starter control circuit. The **“LOCAL/REMOTE”** switch shall be in the **“LOCAL”** position. The blowers are started by pushing the **“START”** pushbutton. The blowers are stopped by pushing the **“LOCK-OUT-STOP”** pushbutton. A **“RUN”** indicating light illuminates when the equipment is running. A **“FAIL”** indicating light illuminates when the equipment has failed.

Remote control of the blowers is from the PICS using the motor starter control circuit. The **“LOCAL/REMOTE”** switch shall be in the **“REMOTE”** position. Monitoring control of the blowers uses the PICS Operator Interface identical to “LOCAL” control.

WARNING:

Blower casing and associated piping or accessories may become hot enough to cause major skin burns on contact.

Internal and external rotating parts of the blower and driving equipment can produce serious physical injuries. Do not reach into any opening the blower while it is operating, or while subject to accidental starting. Cover external moving parts with adequate guards.

Disconnect power before doing any work, and avoid bypassing or rendering inoperative any safety or protective devices.

If blower is operated with piping disconnected, place a strong coarse screen over the inlet and avoid standing in the discharge air stream.

Stay clear of open inlet piping (suction area) of pressure blowers, and the open discharge blast from vacuum blowers.

Stay clear of the blast from pressure relief valves and the suction area of vacuum relief valves.

Avoid extended exposure in close proximity to machinery which exceeds safe noise levels.

Use proper care and good procedures in handling, lifting, installing, operating and maintaining the equipment.

Casing pressure must not exceed 25 PSI (172 kPa) gauge. Do not pressurize vented cavities from an external source, nor restrict the vents.

Do not use air blowers on explosive or hazardous gases.

Other potential hazards to safety may also be associated with operation of this equipment. All personnel working in or passing through the area should be warned by signs and trained to exercise adequate general safety precautions.

Typical Operation:

1. Place the blowers in the ***“REMOTE”*** mode of operation.
2. The operator then inputs the operator adjustable values of pressure for “low air pressure” and “high pressure” conditions for alarm through the PICS Operator interface.
3. Manually adjust the inlet guide vanes of the blowers locally at the equipment to keep the air pressure in the Air System Header out of an alarm condition. The operator starts or stops blowers as required to maintain the correct air pressure in the Air System Header to keep it out of an alarm condition.

Changes to the Air Inlet Valves for the Aeration Tanks and the Digesters will affect the pressure in the Air System Header, thereby requiring to start or stop blowers to maintain pressure in the Air System Header.

Conditions to Stop Blowers:

1. ***“STOP”*** pushbutton.
2. “FAIL” condition.

Conditions for Alarm:

1. “FAIL” condition - minor alarm.
2. “LOW AIR PRESSURE” condition - minor alarm
3. “HIGH AIR PRESSURE” - minor alarm.
4. Local Control Station - Components:
5. ***“LOCAL/REMOTE”*** two position switch.
6. ***“START”*** pushbutton.
7. ***“LOCK-OUT-STOP”*** pushbutton.
8. ***“RUN”*** indicating light.
9. ***“FAIL”*** indicating light.

2.6.3.1.2 Thermal Mass Flowmeter

NOTE:

The flow transmitter contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the flow transmitter.

The flowmeter has been configured and calibrated to customer specifications. Each instrument contains distinct operating limits and units of measurement. This section provides basic operation steps, a more detailed explanation of operation along with additional commands can be found in Chapter 3 of the *ST98 Installation, Operation and Troubleshooting Guide*.

Start Up:

Verify the wiring before applying power. Verify the correct power connections have been made to the flow transmitter. If the instrument does not have a display, plug in an FC88 Hand Held Communication unit or other compatible communication device into P1 of the customer connection board.

1. Apply power.
2. When operating power is applied to the instrument the following messages will be displayed:
FCI ST98",
Initialization!",
Heater On!"
3. Wait 5 minutes for the instrument to warm-up and stabilize.
4. The instrument automatically enters the flow metering mode. The instrument's display (if present), and /or the FC88 display will show the normal operation.

NOTE:

If the FC88 does not display the monitored results properly, press [P] to re-configure the FC88 to the operation of the ST98.

The flow meter displays an output signal that is representative of the calculated current process media flow.

If the display does not appear, or is out-of-range for the expected values, turn the power off and proceed to Chapter 5 -Troubleshooting of the *ST98 Installation, Operation and Troubleshooting Guide*.

Using an FC88 Communicator

An FC88 is a hand held communicator that is plugged into the flow meter which controls the various functions of the ST98. Plug in the FC88 to P1 of the customer connection board.

This hand held communicator is convenient, compact, and obtains its operating power from the flow transmitter. It provides a keypad for operator input and a display for system output.

Menu Control and Organization

Most entries require at least two key strokes; a letter and the [ENTER] key, or one or more numbers and the

[ENTER] key. All user entries begin at the Input Mode?< prompt except when the instrument is in the Main

Function Mode (just press the letter and [ENTER] to make an entry).

A user entry is indicated by brackets [] being placed around the entry. Y/N refers to Yes (Y), save or change parameter or No (N) do not save or change parameter unless otherwise specified.

Backspaces are made using the backspace [BKSP] key.

Some entries are case sensitive between numbers and letters. Be sure the SHIFT key is pressed to indicate the correct case. A square after the prompt caret indicates the FC88 is in lower case. A slightly raised rectangle in the same spot indicates the FC88 is in the upper case.

5. It is recommended that the FC88 be plugged into the instrument before power is applied. If the FC88 is plugged in while the instrument power is on and the FC88 does not respond, press [ENTER], if there is no response press [P], if there is still no response Press [N].

NOTE:

Some entries require a pass code (942) to continue programming the instrument. The instrument will prompt the user when this is necessary. Do not change any parameters that require this code unless there is an absolute understanding of the instrument's operation. Incorrect changes can cause an inaccurate or a non-operational instrument. The figures in the "Delta "R" Table would need to be re-input.

The user can not exit some routines unless all entries are completed or the power is recycled.

(For more detailed information regarding operation of the thermal mass flowmeter, see Appendix Section 4.2.5.3.1.2 of this manual. The operator is reminded to adhere to all the “Notes” throughout the operation procedure in the manufacturer’s manual)

2.6.3.2 Aeration and Digestion Air Supply System

2.6.3.2.1 Aeration Basins

Blowers supply oxygen to the wastewater in the aerobic zone of the aeration tank through submerged diffusers. The amount of air delivered to the aeration basins by the blowers is controlled automatically.

2.6.3.2.2 Aerobic Digesters

The Supernatant pumping operation shall be a manual operation with no monitoring or control through the PICS.

Digester Airlift Pumps - Typical Operation:

1. The operator shall periodically shut off the air supply to the digesters and allow the contents to settle. After a sufficient amount of time, supernatant from the digesters shall be removed by airlift pumps.
2. The operator shall open or close the valve to send supernatant to the Anoxic Basins.
3. The operator shall manually adjust the air regulating valve to control the flow rate of the airlift pump. The airlift pumps shall be operated by manually opening and closing the valves to allow the airlift pumps to operate.
4. The pumping of supernatant shall be done prior to sending digested sludge to the Belt Filter Press.

2.6.3.2.3 Aeration Basin Air Inlet Valves

Local Control Station - Components:

Aeration Basin Air Inlet Valve Control Station

WARNING:

Moving parts from accidental operation of a powered actuator can cause personal injury or equipment damage.

1. **“LOCAL/REMOTE”** two position switch.
2. **“OPEN”** pushbutton.
3. **“CLOSE”** pushbutton.
4. **“STOP”** pushbutton.
5. **“FULL OPENED”** indicating light.
6. **“FULL CLOSED”** indicating light.
7. **“POSITION”** indicator.

Local Control Station - Modes of Control:

Local control of the equipment at the Local Control Station using the valve operator control circuit:

1. The **“LOCAL/REMOTE”** switch shall be in the **“LOCAL”** position.
2. Open the Air Inlet Valve by pushing the **“OPEN”** pushbutton. Close the Air Inlet Valve by pushing the **“CLOSE”** pushbutton.
3. Stop the Air Inlet Valve in a desired position by pushing the **“STOP”** pushbutton.
4. A **“FULL OPENED”** indicating light illuminates when the Air Inlet Valve has reached its full open position. A **“FULL CLOSED”** indicating light illuminates when the Air Inlet Valve has reached its full closed position.
5. The Air Inlet Valve percent open is displayed by the **“POSITION”** indicator.
6. The operator shall open or close the Air Inlet Valve to deliver the desired amount of air to the respective process train.
7. The operator shall monitor the flow rates as displayed by the thermal mass flowmeter indicating transmitter.
8. The operator shall monitor the air flow rate and determine if an adjustment is needed on any of the Air Inlet Valves.

9. The operator shall consider the dissolved oxygen reading for each aeration tank and manually adjust the Air Inlet Valves per the operator's discretion.

Remote control of the equipment from the PICS using the valve operator control circuit:

1. The ***“LOCAL/REMOTE”*** switch shall be in the ***“REMOTE”*** position.
2. Monitoring and control of the equipment using the PICS Operator Interface shall be identical to ***“LOCAL”*** control.

Conditions for Alarm:

1. “LOW 0.0.” -minor alarm.

“HIGH D.O.” - minor alarm.

2.6.3.2.4 Aerobic Digester Air Inlet Valves

Local Control Station - Components:

Digester Air Inlet Valve Control Station:

WARNING:

Moving parts from accidental operation of a powered actuator can cause personal injury or equipment damage.

1. ***“LOCAL/REMOTE”*** two position switch.
2. ***“OPEN”*** pushbutton.
3. ***“CLOSE”*** pushbutton.
4. ***“STOP”*** pushbutton.
5. ***“FULL OPENED”*** indicating light.
6. ***“FULL CLOSED”*** indicating light.
7. ***“POSITION”*** indicator.

Local Control Station - Modes of Control:

Local control of the equipment at the Local Control Station using the valve operator control circuit:

1. The **“LOCAL/REMOTE”** switch shall be in the **“LOCAL”** position.
2. Open the Air Inlet Valve by pushing the **“OPEN”** pushbutton. Close the Air Inlet Valve by pushing the **“CLOSE”** pushbutton.
3. Stop the Air Inlet Valve in a desired position by pushing the **“STOP”** pushbutton.
4. A **“FULL OPENED”** indicating light illuminates when the Air Inlet Valve has reached its full open position. A **“FULL CLOSED”** indicating light illuminates when the Air Inlet Valve has reached its full closed position.
5. The Air Inlet Valve percent open is displayed by the **“POSITION”** indicator.
6. The operator shall open or close the Air Inlet Valve to deliver the desired amount of air to the respective process train.
7. The operator shall monitor the flow rates as displayed by the thermal mass flowmeter indicating transmitter.
8. The operator shall monitor the air flow rate and determine if an adjustment is needed on any of the Air Inlet Valves.
9. The operator shall consider the dissolved oxygen reading for each aeration tank and manually adjust the Air Inlet Valves per the operator's discretion.

Remote control of the equipment from the PICS using the valve operator control circuit:

1. The “**LOCAL/REMOTE**” switch shall be in the “**REMOTE**” position.
2. Monitoring and control of the equipment using the PICS Operator Interface shall be identical to “**LOCAL**” control.

Conditions for Alarm:

1. “LOW 0.0.” -minor alarm.
2. “HIGH D.O.” - minor alarm.

2.6.3.2.5 Actuators

The actuators used to open and close the butterfly valves used as the Air Inlet Valves for both the aeration and aerobic digestion systems are operated and controlled by the DDC and the local control panels for the aeration and aerobic digestion basins.

CAUTION:

To prevent ignition of hazardous atmospheres, do not remove actuator cover while circuits are live.

(Reference sections [2.4.5.1.1](#) and [2.4.5.1.2](#) of this manual for operating details.)

2.6.3.2.6 Dissolved Oxygen Analyzers

Dissolved oxygen (D.O.) probes are mounted in the aeration basins. The D.O. probes send a 4-20 mA signal to a Programmable Logic Controller (PLC). The PLC has an operator input set point for the desired D.O. value to maintain in the aeration basins. The PLC then outputs a signal which automatically controls the blowers to maintain the desired D.O. level in the aeration basins.

2.6.4 Biosolids Handling

2.6.4.1 Digested Sludge

2.6.4.1.1 Pumps

CAUTION:

The manufacturer's documentation must be made available for at least 10 years.

Always comply with instructions mounted directly on the machine.

Failure to comply with all safety instructions may lead to hazards to life and limb as well as dangers for the environment and the machine. Non-observance of safety instructions can invalidate the right of claim to damages.

Always comply with the safety instructions listed in the manufacturer's documentation, the existing national accident prevention regulations and any company-internal work, operating and safety rules.

Before switching on the pump, fill the suction-sided pump casing with fluid so that the first rotations will lubricate the conveying elements immediately. A small quantity of fluid is sufficient for lubrication; the subsequent operation of the pump is self-priming, even if an air column up to the liquid level remains.

To prevent damage to the pump, the unhindered flow of liquid must be guaranteed between the points of entry to and exit from the pipeline. For this reason, open all relevant valves etc. prior to activation of the Pump.

Digested Sludge Pump -Components:

1. **"HAND/OFF/AUTO"** selector switch.
2. **"RUN"** indicating light.

Digested Sludge Pump - Modes of Control:

1. "HAND" mode:

The **"HAND/OFF/AUTO"** switch shall be in the **"HAND"** position. Start equipment by turning the switch to the **"HAND"** position. Stop equipment by turning the switch to the **"OFF"** position. Starting and stopping control of equipment per the operator's discretion. This mode bypasses all interlocks except safety devices. The operator shall verify that the Belt Filter Press is in operation and ready to receive sludge, or divert the pump discharge to an acceptable location prior to starting the pump in the hand mode.

2. "OFF" mode:

Equipment is not operating.

3. "AUTO" mode:

The equipment shall start automatically operation if the Belt Filter Press has started. The equipment shall stop if the Belt Filter Press is called to stop.

Conditions to Stop Equipment:

Digested Sludge Pumps

1. **"STOP"** pushbutton.

2. "FAIL" condition.

Sludge Feed Pumps

1. **"STOP"** pushbutton.

2. "FAIL" condition.

Conditions for Alarm:

Digested Sludge Pumps

1. "FAIL" - minor alarm

Sludge Feed Pumps

1. "FAIL" - minor alarm.

2.6.4.2 Polymer Mixer Chamber

2.6.4.2.1 Mixer

The polymer mixer uses a 5-stage process to achieve polymer-water blending. A normally occurring pressure drop across the system's variable water control orifice produces a high velocity water jet (50+ West.) which impinges on the concentrated polymer as it enters the high turbulence zone of the mixing chamber. This energy releases the emulsifier (oil), instantaneously exposing the polymer to and dispersing the polymer in the dilution water. A useless coiled-up like spring of polymer transforms into an extended, undamaged, string of exposed polymer charge sites.

As the polymer molecules extend, they become "tangled". The high turbulence zone serves to "untangle" the polymer, producing a homogenous blend.

Exit ports split the solution flow, allowing the re-circulation of polymer solution in the high turbulence zone. Re-circulation re-exposes polymer solution to additional, non-damaging, high mixing energy, creating a higher level of polymer activation and a more thorough dilution.

The re-circulation of polymer solution into the high turbulence zone promotes blending of the concentrated (neat) polymer - Concentrated (neat) polymer is injected into blended polymer solution - a blending environment superior to merely injecting polymer into dilution water.

Polymer solution leaves the high turbulence zone and travels through a series of concentric chambers where the mixing energy diminishes evenly into laminar flow.

CAUTION:

SEVERE INJURY HAZARD

Keep all fingers and loose clothing away from rotating pump and motor shafts and mixer blades.

Equipment may start or stop automatically at any time.

Polymer Mixer Local Control Station - Components:

1. ***“START”*** pushbutton.
2. ***“STOP”*** pushbutton.

Polymer Mixer Local Control Station - Modes of Control:

1. Starting and stopping of equipment per the operator's discretion.

Conditions to Stop Equipment:

1. ***“STOP”*** pushbutton.

2.6.4.2.2 Polymer Pump

Polymer Pump Local Control Station - Components:

CAUTION:

Read the manufacturer's steps for start-up, adjusting, and priming of the pump before completing the task.

Read and adhere to all cautions and notes listed throughout the start-up, adjusting, and priming procedures listed in the manufacturer's manual.

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working on or near your metering pump. Additional precautions should be taken depending on the solution being pumped. Refer to MSDS precautions from your solution supplier.

Determine if the materials of construction included in the liquid handling portion of your pump are adequate for the solution (chemical) to be pumped. Pumps are tested by NSF for use on muriatic acid and sodium hypochlorite. Always refer to the solution supplier and the Chemical Resistance Chart for compatibility of your specific metering pump. Contact your local pump distributor for further information.

Inlet and outlet tubing or pipe sizes must not be reduced. Make certain that all tubing is **SECURELY ATTACHED** to fittings prior to start-up. **ALWAYS** use manufacturer supplied tubing with your pump, as the tubing is specifically designed for use with the pump fittings. It is recommended that all tubing be shielded to prevent possible injury in case of rupture or accidental damage. If tubing is exposed to sunlight, black UV resistant tubing should be installed. Check tubing frequently for cracks and replace as necessary.

1. **"HAND OFF AUTO"** selector switch.
2. **"START"** pushbutton.
3. **"STOP"** pushbutton.
4. **"RUNNING"** indicating light.

Polymer Pump Local Control Station - Modes of Control:

5. **"HAND"** mode:
Starting and stopping control of equipment per the operator's discretion. This mode bypasses all interlocks except safety devices.
6. **"OFF"** mode:
Equipment is not operating.

7. “AUTO” mode:

Starting control of equipment per the operator's discretion. The equipment automatically stops if the belt filter press stops.

Conditions to Stop Equipment:

1. ‘**STOP**’ pushbutton.
2. In auto mode, belt filter press “STOP” condition.

2.6.4.2.3 Polymer Flowmeter

This device is designed to monitor the Polymer output flow from the Polymer pump. It may be set to deliver a pulse signal output for each successful pump stroke registered. If the flow stops or lessens, the pulse outputs will cease. With the FM-200-9 connected to the flow monitor input, the presence or lack of pulses can be detected.

NOTE:

After the initial pump and setup is complete, any adjustment of the stroke length of the pump (output per stroke) will require a readjustment of the flow monitor.

Press the “**Mode**” key until the flow monitoring screen displays. Use the “Up” and “Down” keys to select either flow monitoring enabled “1” or disabled “0”. When flow monitoring is enabled, a flow screen displays showing the flow amount on the LCD screen. Again, pressing the “Mode” key displays the number of missing pulses to be detected. This may be set to any value from 1 to 255. The factory default is 8. A setting of 1 is the most sensitive, a setting of 255 the least sensitive.

For example, if the setting is 5, and five (5) strokes of the pump occur without any pulse being received from the FM-200-9, the LCD screen will display an E2 error code. The pump will stop, and the alarm outputs will be activated (i.e. FLOW INT). Pressing the “**START/STOP**” (Start/Stop) key clears the error.

The word “Flow” blinks every time the A9, B9, or C9 receives a signal from the Digi-Pulse™. This serves as an aid in setting up the Digi-Pulse™ itself.

2.6.4.3 Belt Filter Press

The Belt Filter Press control system is equipped with a Local Control Panel (LCP) and a Programmable Logic Control (PLC) Panel that will contain the necessary operator controls and equipment for controlling the dewatering process. Manual control will be at the LCP, with automatic control located at the PLC panel.

All automatic logic and timing functions will be performed using an Allen Bradley SLC 5/04 programmable logic controller (PLC) with DH+ network communication capabilities. Control devices located on the door will be Square D type SK operators.

The first portion of this section contains information the operator should read and become familiar with before operating the belt filter press. The second portion covers the routine operation of the Klampress KP05 and should be used as a model for a plant's customized procedures. The final portion of this section lists troubleshooting procedures and recommended solutions, and minor adjustments.

Process Start-Up:

Knowing how to safely operate the mechanics of the belt press is important. However, knowledge of how the Klampress KP05 dewaterers and how to achieve the optimum performance from the press is what generates long term savings.

Process Variables:

1. Sludge Feed: The amount of dry solids dewatered per hour, or throughput, desired and the feed solids concentration determine the flow rate required for this process. The belt press width is then sized to handle that particular flow.
2. Polymer: Sludge dewatering on a belt filter press is made possible to a great extent through the addition of a poly-electrolyte or polymer to the sludge. The primary duty of the polymer is to cause the sludge solids to flocculate. To do this, the polymer must neutralize the sludge charge, cause a rapid desorption of the sludge particles which unbinds surface water and cause the sludge particles to form chains or flocs along the polymer. To accomplish the optimum dewatering, it is important to select the proper polymer type and concentration. The most common types of polymers used in the dewatering market today are the following:
 - 9 Dry Polymers (95-100% active)
 - 9 Emulsion/Dispersion Polymers (20-67% active)
 - 9 Mannich Polymers (3-7% active)

Regardless of the type of polymer selected, the plant personnel should verify that the polymer system specified can handle the type of polymer selected for the application. The recommended final polymer solution concentration to condition the slurry is the following:

- Dry Polymers (0.1-0.5% by wt.)
- Emulsion Dispersion Polymers (0.2-0.7% by vol.)
- Mannich Polymers (1-5% by vol.)

NOTE:

If the polymer solution is prepared at concentrations that are considerably higher than the solution concentrations recommended, the polymer dewatering costs will increase because the polymer cannot be dispersed efficiently into the slurry. Polymer overdosing will deteriorate the sludge dewatering process as well.

Polymer Charge: A polymer should be chosen which neutralizes the sludge charge, and works within the pH range of the treatment plant's process. The three basic types of polymer (relating to charge) are:

1. Cationic: A positively charged polymer used with negatively charged sludges. This is the most common polymer.
2. Non-ionic: A neutrally charged polymer used with neutrally charged sludges.
3. Anionic: A negatively charged polymer used with positively charged sludges.

Polymer Dose: Polymer should be injected into the sludge at the minimum level required for dewatering. All non reacted polymer is wasted to filtrate and therefore not cost or process effective. A process diagnostic chart is attached to help the plant operators determine if too little or too much polymer is being used.

Mixing Eneer: This is the energy required to instantaneously mix the polymer with the suspended solids of the slurry. The optimum mixing energy is usually determined on site by the Ashbrook Corp. Service Department Representative by adjusting the throat opening inside the variable orifice mixer. Too little or too much mixing energy creates flocs of different size causing a reduction of the void spaces between flocculated particles available for filtering free water. The diagram at the end of this section illustrates the detrimental effects of these conditions.

Retention Time: This is the time required for the polymer react with the biosolids/residuals suspended in the slurry to complete the flocculation process. Most dewatering applications require 15-20 seconds to complete the flocculation process. With too little time, the flocs will be small and with too much time the result is large, clumpy flocs. Both of these lead to reduced dewatering. For ideal dewatering, small strong flocs are desired.

The pipeline design should include three spool locations that can accommodate the variable orifice mixer in order to change the retention time, if necessary, to improve the dewatering process.

Klampspress KP05 Adjustments:

Belt Speed: There are two basic considerations with belt speed. The slower the belt speed, the greater the effects of the pressure section which translates into increase cake dryness. This works because as the belt slows, the cake trapped between the belts is allowed to thicken which increase the shear-action produced by the pressure rollers. Conversely, the faster the belt speed, the greater the process throughput (assuming sludge feed rate is increased). The belt speed should be slowly adjusted until the optimal balance between process throughput and cake dryness is achieved.

Belt Tension: The belt tension should be set at 350 psig initially by adjusting the pressure valve on the hydraulic power unit. Since the sludges vary from plant to plant, the optimal pressure should be determined once the belt press is operating. An increase in the belt tension will increase the shear action in the pressure rollers resulting in a dryer cake. However, it could cause the negative effect of belt blinding or through the belts which will result in an unacceptable amount of solids lost to filtrate. Ideally the pressure should be just below the point where the belt is blinded.

Belt Time: The opening size and weave of the belt determine the dewatering characteristics of that belt. The initial belt supplied by Ashbrook Corp. with your machine as been selected based on our experience with processes similar to your own.

Upstream Variables: There are other items upstream of the belt press than can affect the performance of the press. The information here is to illustrate some of the variables that may affect the overall dewaterability of the plant slurry:

Slurry Pump Selection: For sludge dewatering applications, the use of positive displacement pumps is recommended. The preferred pumps for these applications include Progressive Cavity, Rotary Lobe, and Gear pumps. These pumps allow even flow of the slurry along the pipeline to allow good dispersion of the polymer with the suspended solids of the slurry and a constant pressure drop across the variable orifice mixer.

Slurry Characteristics: It is extremely important that the characteristics of the slurry being dewatered remain relative constant in order to maintain good process control of the belt filter press. For example, if the feed solids concentration increases by 30% (i.e. from 2% to 2.6%), one of the following variables has to be adjusted in order to keep the press running satisfactorily:

- **P Polymer Dosage** > Belt Speed
- **P Slurry Flow Rate** (to maintain constant solids loading)

When dewatering waste activated biosolids, it is critical to control the population of filamentous bacteria in the aeration basin(s) to prevent poor belt filter press performance. Blooms of filamentous bacteria increase the polymer dose, reduce the solids loading, and the cake solids during the dewatering process because water is stored inside the cells of the bacteria.

Washwater Characteristics: The washwater used to clean the belts needs to have the following quality to prevent poor performance of the belt filter press:

P The total suspended solids (TSS) concentration should be **S** 509 The washwater pressure should be 85 psig.

Occasionally if the TSS concentration reaches 200 mgll, the unit can operate marginally if the nozzles in the spray tubes are cleaned frequently with the wire brushes (these are actuated by opening and closing the manual valve). If the washwater pressure drops considerably, the solids that are embedded in the belts during the filtration process cannot be dislodged, causing belt blinding after a certain period of time.

Process Calculations:

To evaluate the Klampress KP05 performance, it is important to understand the basic calculations involved. The governing process variables of the dewatering process are the following:

- Solids Loading (lb. skr processed, dry basis).
- Cake Solids (%TS,% total solids in the cake).
- Polymer Dose (lbs of dry or neat polymer of dry solids dewatered).
- Capture (% of dry solids of the feed retained in the cake during the dewatering process).
- Cake Solids: This is determined by conducting a total solids test.

Loadinn Rate: The amount of solids loacling dewatered in the press is determined by the following equation:

$$SL = SPR \times BDS \times STSC \times 0.6 \text{ I}$$

where, SL = solids loading (lbs/hr.)

SFR = slurry flow rate (gpm)

BDS =bulk density of the fluid (usually 8.34 lbs/gal for most municipal slurries)

STSC = slurry total solids concentration (%TS)

In order to determine the solids loading, the slurry flow rate (usually measured by a magnetic flow meter or a calibration tank) and the total solids concentration or the slurry must be known.

Polymer Concentration:

Liquid Polymer: 1 percent Concentration = (Gallons Polymer/Gallons Water) x 100 I

Example: Determine percent polymer concentration using 2.5 gallons polymer and 1000 gallons of water $2.5/1000 = 0.0025$ Multiply by 100 to convert to percentage $0.0025 \times 100 = .25\%$.

Dry Polymer:

I percent Concentration = [Gallons Polymer/(Gallons Water x 8.34)] x 100 I

Example: Determine polymer concentration using 10 pounds dry polymer and 1000 gallons water. Convert gallons to pounds - 1 gallon = 8.34 pounds $1000 \times 8.34 = 8340$ pounds $10/8340 = 0.0019$ To convert to percent, multiply be 100 $0.0019 \times 100 = .19$ or .12% (rounded)

Polymer Usage

The polymer dose required for the dewatering process is determined by the following equation: $PD = (PSFR \times PSC \times PSBD \times 2000) \div (SFR \times BDS \times STSC)$

The expected performance of the press. The optimum speed is usually determined by the Ashbrook Corp. Service Representative during the Performance Test of the press.

Adjust side sludge restrainers until most solids are retained inside the restrainers. Water seeping under the seals is common and will not hurt the dewatering process.

Process Adjustments:

Because the dewatering process is dependent on numerous variables, it is important to understand how changes in the process will affect the end result. All of the process variables have an optimum point depending on the other variables. Because of this, Ashbrook Corp. recommends adjusting the process slowly by changing one variable at a time and logging the results. A suggested order for adjusting the process is:

1. Adjust sludge feed rate to achieve the throughput desired.
2. Adjust polymer flow for proper flocculation.
3. Adjust belt speed.
4. Fine tune the performance by adjusting the belt tension, mixer, chicanes, etc.

House Keeping and Clean Up:

Refer to the detailed information in the Daily Operation Section of this manual for the house keeping and clean up required prior to shutting down the machine.

Operation

These procedures cover the routine operation of the Klarnpress KP05 and should be used as a model for a plant's customized procedures. The routine practice of inspecting the belt press during the operation phase will help keep it running with minimal down time. The inspection instructions are divided into mechanical and process checklists for the aid of the operators and mechanics.

Pre-operation:

This covers the steps which should be followed prior to starting any of the belt press functions. These steps help ensure the safety of the operators as well as the equipment.

Pre-Start Inspection:

1. Verify no foreign objects are on the belt or in an area that will interfere with the belt press operation.
2. Ensure chicanes are positioned on belt.
3. Verify that the belt is ready for tensioning.
4. Ensure all feed pumps are ready for operation and all valves are open.

5. Verify panel and machine have not been locked-out due to a prior alarm or maintenance condition.
6. Inspect hydraulic power unit and verify the oil level is adequate for operation.

Mechanical Inspection:

1. Ensure feed assembly is evenly loading the belt.
2. Ensure chicanes are turning sludge mass and inspect them for wear. Replace chicanes as required.
3. Ensure edge restrainer seals are contacting the belt and seals are not worn. Replace or adjust seals as required.
4. Ensure doctor blades are functioning correctly. Inspect blades for wear and replace as required.
5. Inspect gravity drainage grid for wear. Replace wiper bars before belt contacts metal support grid.
6. Ensure belt wash system is completely cleaning belt. Look for streaking or striping on the belt. If present, rotate the wash water hand wheel fully counter clockwise and then fully clockwise to clean the spray nozzles.
7. Inspect dewatering belts for wear. Repair holes per maintenance instructions. Repair or replace broken belt seam wires.
8. Ensure there are no leaks from any of the systems.
9. Inspect roller coatings for wear.
10. Ensure all electrical controls are functional.

Process Inspection:

1. Adjust sludge feed rate for process throughput requirements.
2. Adjust polymer feed rate until flocculation is correct.
3. Adjust belt speed for above conditions.
4. Ensure mixing energy is in the correct range.

Belt Filter Press Control Panel - Components:

- “CONTROL POWER ON/OFF”*** selector switch.
- “CONTROL POWER ON”*** indicating light.
- “PRESS READY”*** indicating light.
- “PRESS RUNNING”*** indicating light.
- “WASHWATER PUMP START”*** pushbutton.
- “WASHWATER PUMP STOP”*** pushbutton.
- “WASHWATER PUMP RUNNING”*** indicating light.
- “LOW WASHWATER PRESSURE”*** indicating light
- “HYDRAULIC PUMP START”*** pushbutton.
- “HYDRAULIC PUMP STOP”*** pushbutton.
- “HYDRAULIC PUMP RUNNING”*** pushbutton.
- “LOW HYDRAULIC PRESSURE”*** indicating light.
- “BELT DRIVE START”*** pushbutton.
- “BELT DRIVE STOP”*** pushbutton.
- “BELT DRIVE RUNNING”*** indicating light.
- “BELT DRIVE SPEED CONTROL”*** potentiometer.
- “BELT DRIVE SPEED”*** indicator.
- “BELT MISALIGNED”*** indicating light.
- “BELT BROKEN”*** indicating light.
- “EMERGENCY STOP”*** pushbutton.
- “POLYMER PUMP”*** misc. controls.
- “POLYMER FLOW”*** indicator/totalizer

Belt Filter Press - Modes of Control

The Belt Filter Press can be operated in either a manual mode or an automatic mode. Typical operation nebbish modes would involve:

WARNING:

Use extreme caution when working around the moving belt. Never reach into the machine while it is running. Avoid loose clothing that might become caught in the belt.

1. The operator shall start the polymer mixer and stop the polymer mixer once adequate mixing has taken place.
2. The operator shall start the belt filter press.
3. Once the belt filter press is ready, the operator shall start one of the digested sludge pumps. A flow indicating transmitter shall display instantaneous and totalized daily flow of digested sludge. The transmitter shall output a signal to the PICS. Based on this flow signal input the Operator Interface shall display instantaneous and daily totalized flow of digested sludge.
4. The operator shall start the polymer pump. The operator shall adjust the valve to vary the polymer flow. A flow indicating transmitter shall display instantaneous and totalized daily flow of polymer. The transmitter shall output a signal to the PICS. Based on this flow signal input the Operator Interface shall display instantaneous and daily totalized flow of polymer.
5. The operator shall stop the equipment in the reverse order and clean the belt filter press.
6. All I/O points shall be monitored through the PICS Operator Interface.

Manual Mode Of Operation:

On the Local Control Panel (LCP):

1. Apply power to the press by placing the **“CONTROL POWER OFF/ON”** selector switch in the **“ON”** position.
2. To operate the press, the operator shall start the washwater pump by placing the **“WASHWATER PUMP HAND/OFF/AUTO”** selector switch in the **“HAND”** position.

3. Start the hydraulic pump by placing the ***“HYDRAULIC PUMP HAND/OFF/AUTO”*** selector switch in the ***“HAND”*** position.

CAUTION:

The operator must not proceed until the belts are allowed to be fully tensioned. No interlock is provided to prevent the operator from starting the belt drive before the belts are tight.

Failure to follow this caution can cause major equipment damage.

4. The operator shall place the ***“BELT DRIVE HAND/OFF/AUTO”*** selector switch in the ***“HAND”*** position.
5. Now place the ***“BELT CONVEYOR HAND/OFF/AUTO”*** selector switch in the ***“HAND”*** position.

CAUTION:

Allow time for the belt to pre-wet before starting the sludge pump.

Failure to follow this caution can cause major equipment damage.

6. The operator shall place the ***“SLUDGE PUMP HAND/OFF/AUTO”*** selector switch in the ***“HAND”*** position.
7. The operator shall place the ***“POLYMER PUMP HAND/OFF/AUTO”*** selector switch in the ***“HAND”*** position.
8. The system shall be stopped by placing the respective ***“HAND/OFF/AUTO”*** selectors in the ***“OFF”*** position in the reverse order stated above.
9. The ***“EMERGENCY STOP”*** pushbutton, when pushed, de-energizes all equipment in the system including digested sludge pumps and the polymer pump. This pushbutton should only be used in an emergency situation.

Automatic Mode Of Operation:

On the Local Control Panel (LCP):

1. Place all the equipment ***“HAND/OFF/AUTO”*** selector switches in the ***“AUTO”*** position.

On the Programmable Logic Controller Panel (PLC):

1. Place the ***“AUTO MODE SELECT OFF/ON”*** selector switch in the ***“ON”*** position.
2. Press the ***“AUTO START”*** pushbutton.
3. Before proceeding, confirm:
 - The washwater pump starter (WP) energizes.
 - The ***“PRE-WASH CYCLE ON”*** light begins to flash.
 - The ***“WASHWATER PUMP RUNNING”*** lights illuminate on both the LCP and PLC panels.
 - The hydraulic pump starter (HP) energizes.
 - The ***“HYDRAULIC PUMP RUNNING”*** lights illuminate on both the LCP and PLC panels.
 - The hydraulic belt tensioning timer starts timing.
 - The timer times out and the belt drive relay (BDR) energizes.
 - The ***“BELT DRIVE RUNNING”*** lights illuminate on both the LCP and PLC panels.
 - The ***“PRE-WASH CYCLE ON”*** light illuminates steady.
 - The pre-wet timer starts timing.
 - The belt conveyor relay (BCR) energizes.
 - The ***“BELT CONVEYOR RUNNING”*** lights illuminate on both the LCP and PLC panels.
 - The pre-wet timer times out.
 - The ***“PRESS READY”*** light illuminates.
 - The ***“PRE-WASH CYCLE ON”*** light de-energizes and a press ready relay (PRR) energizes.
 - Check continuity between terminals 140 and 141.
 - The sludge pump relay (SPR) energizes.

- The “**SLUDGE PUMP RUNNING**” lights illuminate on both the LCP and PLC panels.
- The polymer pump relay (PPR) energizes.
- The “**POLYMER PUMP RUNNING**” lights illuminate on both the LVCP and PLC panels.

Shutdown Fault Alarm:

There is only the emergency stop fault provided, which causes a complete shutdown of the belt filter press and ancillary equipment.

1. “LOW WASHWATER PRESSURE” - minor alarm.
2. “LOW HYDRAULIC PRESSURE” - minor alarm
3. “BELT MISALIGNED” - minor alarm.
4. “BELT BROKEN” - minor alarm
5. “EMERGENCY STOP” - major alarm

Conditions to Stop Equipment:

1. “LOW WASHWATER PRESSURE” condition.
2. “LOW HYDRAULIC PRESSURE” condition.
3. “BELT MISALIGNED” condition.
4. “BELT BROKEN” condition.
5. “EMERGENCY STOP” condition.
6. “**STOP**” pushbutton.

Process Trouble Shooting

There are several circumstances that can cause poor dewatering performance in a belt filter press:

1. Low Cake Solids
2. Low Capture
3. Low Solids Loading

Low Cake Solids: When this instance occurs, the following corrective measures are recommended:

- **Adjust Belt Speed**
Measure the current belt speed and the cake thickness. If the belt speed is greater than 3 m/min. and the cake thickness is less than 3/8", reduce the belt speed in 10% increments allowing enough time before cake samples are taken to determine if the reduced belt speeds improve the cake solids concentration.
- **Adjust The Polymer Dose**
Sometimes, the slurry solids concentration can increase creating a starved polymer condition. This can be resolved by increasing the polymer solution flow rate to the variable orifice mixer. Take samples to determine if changes in poplar-dose settings improve cake solids concentration.
- **Adjust The Mixing Energy**
Mixing Energy. If the slurry characteristics vary, it may require an increase or a decrease in mixing energy by adjusting the throat of the variable orifice mixer (see diagram at the end of this section). Take samples to determine if changes in mixer settings improve cake solids concentration.
- **Adjust Hydraulic Pressure**
Increase the hydraulic pressure in 50 psig increments (do not exceed hydraulic pressures of 500 psi& to prevent irreversible belt damage).

CAUTION:

Caution has to be taken when this procedure is executed to prevent blinding the belts with solids.

Failure to follow this caution can cause personal injury or major property damage.

Low Capture: when this instance occurs, the following corrective measures are recommended:

- **Adjust Belt Speed**
Measure the current belt speed. If the belt speed is greater than 3 m/min., reduce the belt speed in 10% increments allowing enough time before filtrate samples are taken to determine if the reduced belt speeds improve the capture.
- **Adjust Polymer Dose**
Sometimes, the slurry solids concentration can increase creating a starved polymer condition, allowing extra solids to pass through the belts. This can be resolved by increasing the polymer solution flow rate to the variable orifice mixer. Take samples to determine if changes in polymer dose settings improve cake solids concentration.
- **Adjust Doctor Blades**
Check the doctor blades to be sure they are touching the face of the belts. If there is a small gap, extra solids will remain on the belts which will enter the wash boxes, and show up in the filtrate. If the blades are worn out, contact the Ashbrook Retrofit and Spares Parts Department to order new ones.
- **Inspect slurry restrainer seals in the gravity zone and the wedge zone**
- **Restrainer Seals**
Verify that the slurry restrainer seals in the gravity zone do not allow the slurry to pass underneath them. Otherwise, the slurry will fall on the filtrate pan in the gravity zone causing an increase of the suspended solids concentration in the filtrate. In addition, the restraining seals in the wedge zone should not allow any thickened slurry to exit from the edges of the wedge; if they are loose, adjust the external wall of the wedge zone until the seals prevent thickened slurry from migrating to the filtrate stream.

Low Solids Loading:

When this instance occurs, the following corrective measures are recommended:

1. Verify the slurry solids concentration. If the slurry solids concentration is decreased, the solids loading to the press will be decrease by the same amount. Adjust the slurry flow rate to make up for the reduced solids concentration.
2. Inspect the slurry pipeline upstream of the belt filter press is free of obstructions and debris.

NOTE:

If these procedures do not correct the problem, contact the Ashbrook Corporation Service Department.

Process Diagnostic Chart

1. Insufficient Polymer:
 - Sludge squeezing from the belts
 - Large weak flocs
 - Poor gravity dewatering
 - Gravity section overflows
 - Poor capture rates
 - Wet cake
2. Insufficient Mixing:
 - Large clumpy flocs
 - Filtrate in sludge inlet is cloudy
 - High filtrate solids
 - Low cake dryness
 - Cake sticks to belts
3. Excessive Polymer:
 - Foaming at sludge inlet
 - Sludge feels “slimy “
 - Filtrate is foamy and slimy

- Puddling in the gravity section
- High polymer bills
- Cake sticks on belts at discharge

4. Excessive Mixing:

- Sheared flocs
- Poor gravity drainage
- High filtrate solids
- Sludge squeezes from belts

Normal Shut Down & Clean Up

The key to minimal down time and reduced maintenance costs is housekeeping. If the belt press is inspected and maintained daily, it can be counted on for years of service. The following guidelines should be used for daily machine shut down and cleaning:

NOTE:

Do NOT steam clean the belts. Steam cleaning will damage the belts. Use a maximum of 1500 psi water at a maximum of 140° F.

- Shut down the sludge and polymer feed systems.
- Allow the belt wash station to run for 45 minutes without any sludge or polymer feeding onto the belt press. During this time period:
- Lift the chicanes off the belt.
- Wash down the Klampress KP05 from top to bottom using a garden hose.
- Rotate the scraper blades away from the belt and hose down the scraper assembly.
- Wash out the drain pans.

When the machine is completely washed down and free film sludge, replace the chicanes and scrapers in their operating position.

Clean the wash water spray tube by rotating the wash water hand wheel completely in the counter clockwise direction and then completely in the clockwise direction.

- Shut down the belt wash water system.
- Shut down the drive unit.

- Shut down the hydraulic power unit.

Emergency Shut Down:

The machine can be stopped without going through the normal shut down sequence due to a mechanical failure or other emergency. While the machine will not be damaged due to this type of shutdown, the life of components could be shortened by not cleaning the belt press. If the machine is shut down because of an emergency, the following steps should be taken:

Identify the problem and estimate the down time. If the machine will be down for more than one shift then wash the machine down to prevent sludge from drying on the belt.

- If possible, relax the belt tension.
- Correct the emergency condition.
- Start hydraulic power unit and reduce hydraulic pressure to 15 psi by adjusting the pressure control valve on the hydraulic power unit.
- Start wash water and allow belt to pre-wet.
- Start belt drive. If belt is not clean, allow the machine to run for 45 minutes to complete a belt wash down cycle.
- Increase belt tension to normal limits (25 psi).
- Start sludge and polymer feed systems and begin thickening.
- Correct the emergency condition.
- Start the hydraulic power unit and reduce the pressure to 15 psi.
- Start the belt wash system and allow the belt to pre-wet.
- Start the belt drive.
- Increase hydraulic pressure to normal limits (25 psi).
- Start sludge and polymer feed systems.
- Continue dewatering process as normal.

2.6.4.4 Filtrate Drain

The slurry enters the gravity drainage zone from the belt press inlet, and here the solids and the water begin to physically separate. The solid-water mixture sits on the porous belt allowing the free water to drain through it. The water from the gravity drainage section is collected in drain pans and routed back to the anoxic basins by 4" drain pipes. A series of manual plug valves allows the operator to route the drainage to the active basin(s).

2.6.4.5 Biosolids Loading Station

Dewatered biosolids will enter the containers until they are full. Manual inspection of the container is required to determine when the container must be replaced. When full, the container will be removed using a forklift, or other means, and transported to the waste storage area to await transport to the United States.

It is anticipated that the containers will freeze at the storage site and that they will be refrigerated on the transport vessel during retrograde to the US. to minimize any gas production.

2.6.4.6 Adjusting Shower Angle

The adjustable angle shower provides variable spray angle and brush position. This manual includes the information necessary to service the 1-1/2" and 2" showers.

WARNING:

Disconnect the water source to the shower before disassembly. High pressure water can cause personal injury.

The following procedure will ensure that the shower is safe to disassemble:

1. Turn off and lock out the pump that supplies the shower.
2. Turn off and lock out the oscillator (if present).
3. Open the shower valve to discharge any water that may be present in the shower.

2.6.4.7 Setting Spray Angle

The spray angle can be changed by loosening four 1 1/4" screws, permitting pipe rotation. The lock ring is marked in degrees to aid in determining the shower angle. The hose connection on the valve body should be oriented vertically downward to drain the valve.

When the proper angle is reached, tighten the four screws to lock the valve assembly in the new position. See the drawing below for the tightening pattern.

CAUTION:

Do not apply a torsion force in excess of 78 in-lbs to the four screws. Excessive force will break the screws.

Check the location of the brush to ensure that it is not blocking the spray nozzles. If the nozzles are blocked adjust the brush position using the procedure outlined below.

2.6.4.8 Setting Brush Location

Close the valve completely. Check the brush location to make sure that the brush does not interfere with nozzle discharge.

WARNING:

Disconnect the water source to the shower before disassembly. High pressure water can cause personal injury.

If the brush blocks the nozzles, loosen the four screws and pull the valve body away from the pipe providing access to the valve gaskets.

Remove a gasket by tearing it in half and pulling it out of the gap, or add a gasket. Each gasket will rotate the brush about 45 degrees.

Re-assemble the valve by aligning the pipe pointer with the desired angle mark on the lock ring and tightening the four screws. Tighten the screws as shown on bolt sequence above.

CAUTION:

Do not apply a torsion force in excess of 78 in-lbs to the four screws. Excessive force will break the screws.

2.6.4.9 Flat Spray Nozzle Cleaning

Cleaning of the flat spray nozzles is achieved by turning the handwheel one full turn in a counter clockwise direction.

This action opens the drain valve and the bristles in the brush dislodge any contaminants from the nozzles. The wash water flushes the contaminants out to the sump through the drain valve.

Turning the hand wheel in a clockwise direction closes the discharge valve and returns the press to normal operation.

2.6.5 Waste Station Unloading / Transfer

2.6.5.1 Waste Station Pumps

Conditions to Stop Equipment:

1. **“STOP”** pushbutton.
2. **“FAIL”** condition.
3. **“LOSS OF FLOW”** condition

Conditions for Alarm:

1. **“FAIL”** condition - minor alarm.
2. **“LOSS OF FLOW”** condition - minor alarm

Local Control Station -Components:

1. **“LOCAL/REMOTE”** two position switch.
2. **“START”** pushbutton.
3. **“LOCK-OUT-STOP”** pushbutton.
4. **“RUN”** indicating light.
5. **“FAIL”** indicating light.

Remote Control Station - Components:

1. **“START”** pushbutton.
2. **“STOP”** pushbutton.
3. **“RUN”** indicating light.
4. **“FAIL”** indicating light.

Local Control Station - Modes of Control:

Local control of the Wastewater Station Pumps at the Local Control Station using the motor starter control circuit. The **“LOCAL/REMOTE”** switch shall be in the **“LOCAL”** position. Start equipment by pushing the **“START”** pushbutton. Stop equipment by pushing the **“LOCK-OUT-STOP”** pushbutton. A **“RUN”** indicating light illuminates when the equipment is running. A **“FAIL”** indicating light illuminates when the equipment has failed.

Remote control of the Wastewater Station Pumps from the control station at the Waste Station using the motor starter control circuit. The ***“LOCAL/REMOTE”*** switch shall be in the ***“REMOTE”*** position.

WARNING:

This pump is designed to handle mild industrial corrosives, residues, and slurries containing large entrained solids. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.

After filling the pump casing, reinstall and tighten the fill plug. Do not attempt to operate the pump unless all connecting piping is securely installed. Otherwise, liquid in the pump forced out under pressure could cause injury to personnel.

Allow an over-heated pump to cool before servicing. Do not remove plates, covers, gauges, or fittings from an overheated pump. Liquid within the pump can reach boiling temperatures, and vapor pressure within the pump can cause parts being disengaged to be ejected with great force. After the pump cools, drain the liquid from the pump by removing the casing drain plug. Use caution when removing the plug to prevent injury to personnel from hot liquid.

Do not operate the pump against a closed discharge throttling valve for long periods of time. If operated against a closed discharge throttling valve, pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode.

CAUTION:

Pump speed and operating conditions must be within the performance range.

Never operate this pump unless there is liquid in the pump casing. The pump will not prime when dry. extended operation of a dry pump will destroy the seal assembly.

If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

Typical Operation:

The Waste Station Pumps can be used for unloading raw airfield waste from tank trucks at the East Loading Area, or for dewatering the process tanks.

For Waste Station Unloading: Set the Local Control Station for either Pump No. 1 or Pump No. 2 in the **“REMOTE”** position. Manually adjust the valves for appropriate operation. At the Remote Control Station, 'START' and 'STOP' pump as necessary for unloading the airfield tank truck in a manner that prevents overloading the plant, preferably during a low flow period.

For process tank dewatering: During seasonal shutdown of the process tanks, the Waste Station Pumps can be used for emptying the tanks. Set the Local Control Stations for either Pump No. 1 or Pump No. 2 (or both pumps in parallel) in the **“LOCAL”** position. Manually adjust valves for dewatering the selected tank. “START” and “STOP pump(s) as necessary.

2.6.6 Lift Station (Building 200)

2.6.6.1 Lift Station Pumps

Intellipump is a self-diagnostic system that recognizes inoperable float switches and pumps then compensates for them through a pre-programmed sequence of operations. This built-in troubleshooting system flashes a fault code message on a light emitting diode indicator. Microprocessor technology and printed circuit construction reduces product assembly time and facilitates smart control features. The result is hitech control at low cost.

Intellipump detects individual pump failures. Pump operation is verified using a check valve limit switch or auxiliary starter contact. On the start of a pumping cycle, a built in delay operates while pumping operation is established.

After the initial delay, if the feedback switch is not closed, the controller shall light an alarm LED to indicate failure of the specific pump. Failure of a pump will cause the second pump to operate automatically.

Panel Operation

For normal panel operation, the Overload connection must be set to ON or must be bypassed with a wire jumper. The Pump Thermal connections must also be connected or bypassed with a wire jumper. The HOA switches (front panel or board mounted) must be set to the Auto position for the float logic to function.

Normal Float Operation

If the Off and Lead floats are made, a single pump will be called for. If this condition is repeated, the controller will cycle one pump at a time, alternating between the two pumps.

If the Off, Lead, Lag, and High floats are made, both pumps will be called for, and the high level alarm light will flash, and the buzzer will sound. To silence the buzzer, press the silence switch, which is located on the front of the panel or the controller.

Float Logic Operation

If one or more floats are left out of the normal float sequence, the Intellipump will compensate for the inoperable float, and produce an alarm code indicating which float is not operating. The code is indicated by an LED on the control board. The number of flashes followed by a pause will be your code. This code is repeated until the inoperable float or floats are shown to be good by returning to a normal float operation sequence.

The alarm codes are noted on the controller board front label, and are as follows:

1 = Float # 1

2 = Float # 2 '

3 = Float # 3

4 = Float # 1 & 2

5 = Float # 1 & 3

6 = Float # 2 & 3

7=Float # 1 & 2 & 3

If only the High Level float is made, both pumps will be called for, and the high level alarm light will flash, and the buzzer will sound. Both pumps will enter a timer sequence, which prohibits short cycling of the pump motors. If all floats are shown to be good, the controller will return back to normal operation.

Pump Fail Operation

The Intellipump can be configured to signal a Pump Fail condition. A Fail condition can occur if the overload, pump thermal, or auxiliary connection opens. If a pump is called for, but a Pump Fail condition occurs, the controller will automatically call for the other pump.

The Pump Fail Alarm is a time delayed operation, this is done to allow the controller to verify pump operation using a check valve limit switch or auxiliary starter contact. A Pump Fail condition is indicated by an LED on the controller, an optional front panel light, and also activates a set of Normally Open contacts.

Seal Fail Operation

The seal fail connections on the Intellipump monitors the resistance of the pump motor Seal Fail probe. If the resistance of the probe drops below a preset point, a Seal Fail condition occurs. This is indicated by an LED on the control board, an optional light on the front of the enclosure. A Seal Fail condition will also activate a set of Normally Open contacts that can be used in conjunction with additional control equipment.

Priming Pump

Use the following steps to prime the pump:

1. Remove priming cap on suction inlet box and fill case with water. Have air vent valves open when filling case. Replace priming cap, be sure gasket is in place.
2. Turn the H-0-A switch to the inlet position to start motor. Allow sufficient time for priming. Pump requires a longer priming time is 3 to 5 minutes. After pumps are primed and operating, turn selector switch for both pumps to auto position and check automatic operation. Allow level in sump to rise until one pump starts.
3. For float operation, adjust stops on rod so that pump comes on when level rises about 20 inches. With 3900 controls the turn on level switch should be about 20 inches above turn off level switch. Allow pump to cycle causing alternation of pumps on each successive cycle.
4. Turn off power and allow sump level to rise to override position. Turn power on and both pumps should start and operate together until level drops to the stop position. The override position is the same with either the float or 3900 controls, that is, both pumps operate together once started until level drops to turn off point.



3 MAINTENANCE

3.1 GENERAL BUILDING MAINTENANCE

The Waste Water Treatment Plant is comprised of one building with an associated lift station housed in a separate building:

- Building 199 is commonly referred to as Waste Water Treatment Plant.
- Building 200 is identified as Lift Station.

The information contained in these Maintenance sub-sections provides a basic outline of the general building systems, sub-systems, associated equipment, and their respective inspection, servicing and maintenance requirements.

Each Building is comprised of three major building systems: architectural/structural, mechanical, and electrical. To ensure that critical and elementary components of these systems consistently operate at their maximum performance levels, preventative, predictive, and corrective maintenance practices are required.

Preventative maintenance (PM) shall be performed per the applicable referenced PM procedures at the recommended intervals. Corrective maintenance shall be performed in accordance with the latest editions of the *National Fire Protection Association (NFPA)*, *National Electrical Code (NEC)*, *Uniform Plumbing Code (UPC)*, *Uniform Mechanical Code (UMC)*, and the *International Building Code (IBC)*.

SAFETY CONSIDERATIONS:

Before performing any maintenance procedures, personnel should review and adhere to all safety instructions taking the necessary steps to ensure personal injuries do not occur.

All personnel involved in handling, installing, testing, and performing maintenance on any of the systems or equipment covered by this section should be thoroughly familiar with the information in this section, and any reference material in the Appendices, before working on any system or equipment.

Personnel should be trained and qualified in the operation and maintenance of the equipment being serviced, and have knowledge of the degree of severity of potential injury if the notes, cautions, warnings, and dangers are not followed.

(FPN:) Referenced preventative maintenance frequencies shall be as follows:

Daily (every day), Weekly (every week), Monthly (every month), Quarterly (every three months), Semi-Annual (every six months), Annual (every year).

Along with equipment maintenance procedures detailed in the subsequent sections of this manual, Ashbrook recommends the following process maintenance steps for Ashbrook products used in the process systems:

Daily Maintenance

- Make a visual inspection of the plant to ensure that all mechanical equipment is operating.
- Check to see that there is equal air distribution along the entire length of tank.
- Verify the sludge return pumps are returning sludge to the aeration chamber.
- Verify the air lift skimmer is working.
- Check the spray pump and spray system for proper operation.
- Check and break up the scum in the settling tank to insure proper return through the skimmer.

Weekly Maintenance

- Thirty minute settling test (Activated Sludge Volume Test) - Collect one sample from the aeration tank and one from the effluent of the settling tank.
- Clean the grease and floating solids from walls and water surface of aeration and settling tanks.
- Verify all equipment is operating properly and if any fuses are blown or circuit breakers are open.
- Clean the growths and accumulated solids from weirs and pipe inlets.
- Verify the diffusers and aerators are all working properly and are not plugged.
- Verify the airlift sludge return pumps or skimmers are not clogged or about to clog.
- Run a dissolved oxygen test.
- Check the oil level in the blowers.
- Verify the time setting on the time clocks is correct.
- Scrape the walls and hoppers of the settling tank.

Monthly Maintenance

- Check and clean the trash trap if necessary.
- Lubricate blower bearings. NLGI #2 premium grade petroleum based grease suitable for high temperature (300° F) is the recommended lubricate to be used on all motor and blower bearings.
- Check all V-belts for proper tension and wear. Replace if necessary.
- Check all air filters and clean if necessary.

3.2 ARCHITECTURAL / STRUCTURAL SYSTEMS

3.2.1 Building Systems

3.2.1.1 Removable Guardrails

The removable guardrail system is constructed from 1 1/2" outside diameter (OD) schedule 40 painted steel pipe. During performance of the annual building inspection (PM #3405FM), inspect all guardrails for damage, structural integrity and surface blemishes. Repair as necessary.

(For additional information regarding the guardrails, see Appendix Section [4.2.1.1.1](#) of this manual.).

3.2.1.2 Trench Drains

During performance of the annual building inspection (PM #3405FM), inspect the trench drains for damage, obstructions, and leaks. Repair as necessary.

(For additional information on the trench drains, see Appendix Section [4.2.1.1.2](#) of this manual.).

3.2.1.3 Grating Walkways

The grating walkways are provided in the service area for servicing the plant equipment. The fiberglass grating is corrosion resistant, resilient, non-magnetic and maintenance free. During performance of the annual building inspection (PM #3405FM), inspect all walkways for damage, obstructions, and structural integrity. Repair as necessary. No maintenance assigned at this time.

(For additional information regarding walkways, see Appendix Section [4.2.1.1.3](#) of this manual.).

3.2.1.4 Floor Access Hatches

During performance of the annual building inspection (PM #3405FM), inspect all floor hatches for damage, structural integrity and adequate perimeter seal. Repair as necessary.

(For additional information regarding access hatches, see Appendix Section [4.2.1.1.4](#) of this manual.).

3.2.1.5 Roof Hatches

During performance of the annual building inspection (PM #3405FM), inspect all floor hatches for damage, structural integrity and adequate perimeter seal. Repair as necessary.

(For additional information regarding roof hatches, see Appendix Section [4.2.1.1.5](#) of this manual.).

3.2.2 Windows and Doors

3.2.2.1 Windows / Process Observation Area Viewing Glass

During performance of the annual building inspection (PM #3405FM), inspect all windows for damage, structural integrity and adequate perimeter seal.

3.2.2.2 Doors

During performance of the annual building inspection (PM #3405FM), inspect all doors for structural integrity, damage and proper operation. Additional periodic inspections of doors in heavy traffic areas shall be performed. Repair as necessary.

Exterior doors of the Waste Water Treatment Plant and the Lift Station are critical for maintaining the envelope of each building and protecting its contents from the environmental elements.

Inspect each door to insure integrity of all hardware, lubrication and smooth operation of moving parts, sealant condition in seams and joints, and door-gasket sealing.

Lubrication: In normal service it is recommended that a few drops of light oil be used on all moving parts. Specialized cold environment lubricants may be used as applicable.

Wax the inner edge of the door to allow for smooth contact between door and gasket.

Sealant: During the life of the door it is possible for the factory sealant (silicone) in the seams and joints to come loose, either from abuse and/or normal use. It is critical that all seams and joints are kept vapor tight at all times. Inspections of seams and joints for loose or missing sealant should be performed. Replace sealant in problem areas.

NOTE:

Failure to maintain the sealant in problem areas will affect the vapor seal integrity and cause deterioration of the door.

All operators should be inspected for smooth operation. Latches and strikes should be adjusted as required to maintain the proper pressure on perimeter gaskets. All fasteners should be checked and re-tightened as required.

(For additional information regarding doors, see Appendix Section [4.2.1.2.2](#) of this manual.).

3.2.2.3 Overhead Coiling Doors

While performing the annual building inspection (PM #3405FM) and PM #6212FQ, inspect the coiling doors (Equip. # DO01138 and DO01139) for structural integrity, damage and proper operation. Insure that all inner cylinders rotate smoothly and the rollers are free of obstructions and debris. Repair as necessary.

(For additional information regarding the coiling doors, see Appendix Section [4.2.1.2.3](#) of this manual.).

3.2.2.4 Finish Hardware

During performance of the annual building inspection (PM #3405FM), inspect all door hardware for proper operation. This includes all passageway doors within the Wastewater Treatment Plant. Mechanical door closers should operate smoothly, keep the door under orderly control at all times, and provide sufficient leverage to close against the latch.

Knobs/levers and latch bolts should operate smoothly without undue force. Latch bolts on passage/non-keyed entry devices shall operate from either side of doors at all times. Latch bolts on keyed entry devices shall be retracted by key outside of door or by knob/lever inside door.

Pay special attention to emergency panic bar exit devices during periodic inspections. Check the devices for smoothness of operation. Any binding or dragging may indicate worn parts or the need for lubrication.

Check the devices for full extension of the latch bolt and full retraction during operation. Short extension may indicate binding, and insufficient retraction indicates worn parts or vertical rods out of adjustment.

The latch bolt should retract fully when dogged. Check the deadlocking function by depressing the latch bolt when engaged with the strike. If the latch bolt fully retracts, strike or vertical rod adjustment may be necessary.

Periodic lubrication is required to inhibit excessive wear of working parts. For normal to heavy traffic areas, good commercial grease is sufficient for proper operation. For devices exposed to adverse conditions and/or abnormally high exposure to dust and dirt, a graphite or silicone-based lubricant can be used at more frequent intervals.

Inspect all hardware for missing or loose fasteners and replace and/or re-tighten as necessary.

(For door hardware details see Appendix Section [4.2.1.2.4](#) of this manual.)

3.2.3 Interior Finishes

3.2.3.1 Sheet Vinyl Flooring

Routine and proper cleaning of the sheet vinyl flooring is essential. Depending on area usage, a typical routine may involve periodic sweeping, vacuuming or damp mopping with water and an approved, alkaline, floor cleaner, complemented by scrub cleaning as required.

(For additional information regarding the vinyl flooring, see Appendix Section [4.2.1.3.1](#) of this manual.).

3.2.3.2 Acoustical Ceilings

The suspended ceiling tile can be cleaned of dust and loose dirt by brushing or vacuum cleaning. The manufacturer recommends the use of vacuum cleaner attachments such as those designed for cleaning upholstery or walls. Cleaning should be accomplished in one direction only, to avoid rubbing dust into the surface. An art gum eraser may be used to remove pencil marks, smudges, or clinging dirt. A good grade of wall cleaner, mild detergent or germicidal cleaner may also be used.

(For additional information regarding the ceilings, see Appendix Section [4.2.1.3.2](#) of this manual.).

3.2.4 Interior Specialties / Fixtures

3.2.4.1 Miscellaneous Specialties

3.2.4.1.1 Graphic Display Board

During performance of the annual building inspection (PM #3405FM), inspect the display board for damage and repair as necessary.

(For additional information regarding the display board, see Appendix Section [4.2.1.4.1.1](#) of this manual.).

3.2.4.1.2 Fire Extinguishers

Annual maintenance of type A:B:C or multi-purpose extinguishers is performed by the Operations Fire Department in accordance with National Fire Protection Agency (NFPA) *Publication 10*.

(For additional information regarding fire extinguishers, see Appendix Section [4.2.1.4.1.2](#) of this manual.).

3.3 CONVEYING SYSTEMS

3.3.1 Monorail Hoist Systems

The monorail hoist systems (Equip. #HO00042 and HO00043) located in rooms 210 and 212 should be periodically inspected to determine the condition of hoist components. Besides performing quarterly PM #3415FQ, the manufacturer recommends monthly, semi-annual, and annual inspections. Inspection criteria is listed in the *Operation, Service & Parts Manual* found in Appendix Section [4.2.2.1](#).

Lubrication intervals should coincide with the maintenance inspections.

WARNING:

Before performing any internal work on the hoist, be certain power is shut off. Lock main service switch in the open position.

To avoid serious personal injury from a dropped load caused by possible chain breakage, when replacing link load chain, use only factory specifications for material, hardness, strength and link dimensions. Chain not conforming to the manufacturer's hoist specifications may be dangerous as it will not fit in the load sprocket and chain guide correctly, causing serious internal damage to hoist, and it will wear prematurely, deform and eventually break.

Keep fingers clear of chain sprocket when replacing link load chain.

When replacing roller type load chain, use only factory approved chain conforming to factory specifications for material, hardness, tensile strength, size and construction. The manufacturer's hoist roller chain is specially designed for hoisting service and is the only type roller chain that can safely be used with the manufacturer's electric hoists. Chain not conforming to the manufacturer's roller chain specifications may be dangerous as it will not withstand heavy impact loads and does not have adequate tensile strength.

Do not change circuit wiring, severe damage and malfunction of hoist may result.

Do not lift more than rated load except for test purposes.

CAUTION:

Do not assume that load chain is safe because it measures below replacement points given herein. Other factors, such as those mentioned in visual checks above, may render chain unsafe or ready for replacement long before elongation replacement is necessary.

Two “C” links must be used on one-quarter, one-half, and one ton capacity hoists in order to correctly position end link on tail end of chain to fit tail end anchor at side of hoist frame; only one “C” link is required on 2 thorough 5 ton capacity hoists.

To avoid serious internal damage to hoist, when installing link load chain do not attempt to hand feed chain into hoist, or use a piece of wire in place of the method described herein. To do so may result in serious internal damage to hoist, as link chain links must be properly seated in chain sprocket before chain is run into hoist. Install chain only as described in this manual.

Do not assume that load chain is safe because it measures below replacement points given herein. Other factors, such as those mentioned in visual checks, may render the chain unsafe or ready for replacement long before elongation replacement is necessary. Do not attempt to splice the chain to replace worn or damaged sections unless you have the required equipment to properly spin rivet heads. It is suggested that you have this done by an authorized manufacturer’s repair station that is equipped with the necessary specific tools.

Hooks, upper or lower, damaged from chemicals, deformation or cracks or having more than 15 percent in excess of normal throat opening or more than 10 degrees twist from the plane of the unbent hook, or opened, allowing the hook latch to bypass hook tip must be replaced. Any hook that is twisted or has excessive throat opening indicates abuse or overloading of the hoist. Other load bearing components of the hoist should be inspected for damage.

(For additional information on the hoist systems, see Appendix Section [4.2.2.1](#) of this manual.).

3.4 MECHANICAL SYSTEMS

3.4.1 Heat Generation and Distribution Systems

One important aspect of hot water heating systems that is often neglected is cleaning the system. It is sometimes drained for changes and adjustments but never actually cleaned.

How To Tell If A System Needs Cleaning

There are definite indications of an unclean system. Here is a check list. If any of these test positive, the system needs cleaning.

1. Obviously discolored, musky, dirty water.
2. Vented gases at high points in the radiation that will ignite and burn with an almost invisible bluish flame.
3. A pH or alkalinity test that gives a pH test reading below 7.

No matter how carefully a system is installed certain extraneous materials do find their way inadvertently into the system during construction. Pipe dope, thread cutting oils, soldering flux, rust preventatives or slushing compounds, core sand, welding slag, and dirt, sand, or clays from the job site are usually found. Fortunately the proportions of these are usually small and do not cause trouble. In some cases there are sufficient quantities to break down chemically during the operation of the system causing gas formation and acid system water.

Hot water systems, in most cases, naturally operate with a pH of 7 or better. The condition of the water can be quickly tested with Hydrion paper which is used in the same manner as Litmus paper except it gives specific readings. A color chart on the side of the small Hydrion dispenser gives the readings in pH. Hydrion paper is inexpensive and obtainable from any chemical supply house.

A system that tests acid (below 7 on the scale, sometimes as low as 4) will usually have the following symptoms:

- Gas formation (air troubles),
- Pump seal and gland problems,
- Air vent sticking and leaking,
- Frequent relief valve operating, or
- Piping leaks at joints.

Once in this condition the symptoms continue for years until corrected by cleaning. Many times, because of the gas formation, automatic air vents are added throughout the system to attempt a cure.

The promiscuous use of automatic air vents can defeat the function of the system because in a normal system the small quantities of air finding their way to the system and piping must be returned to the expansion tank to maintain the balance between the air cushion and the water volume.

If system deterioration is permitted and leaks develop and water losses increase, it is possible to cause serious damage to the boiler. Therefore, our main aim is to have a closed system that is clean, neutral, and water tight.

snow melting and radiant panels, because of the large quantities of pipe used, should be cleaned. Convertors and systems using anti-freeze solutions must be cleaned. If not, the anti-freeze solutions bring back the debris from the piping and deposit it on the convertor tubes. This destroys heat transfer ability shortly after placed in operation, cutting its capacity as much as 50% in a few weeks time.

We propose that all hot water systems be cleaned on completion, making even the finest job better and helping to eliminate the few bothersome jobs that sometimes occur.

How To Clean A Hot Water Heating System

Cleaning a hot water system (either steel or copper piping) is neither difficult nor expensive. The materials for cleaning are readily available. Trisodium phosphate, sodium carbonate, and sodium hydroxide (lye) are the most common materials for cleaning. Their preference is in the order named and should be used in the following proportions using a solution of only one (1) type in the system:

- Trisodium phosphate, one pound for each fifty gallons in the system;
- Sodium carbonate, one pound for each thirty gallons in the system; Sodium hydroxide (lye), one pound for each fifty gallons in the system.

Fill, vent, and circulate the system with this solution, allowing it to reach design or operating temperatures if possible. After circulating a few hours, the system should be drained completely and refilled with fresh water. Usually enough of the cleaner will adhere to the piping to give an alkaline solution satisfactory for operation. A pH reading between 7 and 8 is preferred, and a small amount of cleaner can be added if necessary.

A clean, neutral hot water system should never be drained except for an emergency or necessary servicing of equipment which may be after years of operation. Anti-freeze solutions in systems should be tested from year to year as recommended by the manufacturers of the anti-freeze used. It is our contention that a clean system is a better system. Once cleaned, it will never need cleaning again.

3.4.1.1 Fuel-Fired Boilers

The Fuel-fired Boiler B1 (Equip. #BH00088) is located in the boiler room (RM101) on the second floor should be inspected and maintenance completed in accordance with PM #6509FS, PM #3801FA, and PM #3802FW.

WARNING:

Do not attempt to operate or maintain the burner equipment without first familiarizing yourself with these instructions! Improper operation or maintenance of the equipment may result in injury to persons or loss of life and damage to equipment.

Do not operate this equipment unless guides, shields, or covers are in place for moving components, rotating equipment, mechanically automate devices, and electrically and pneumatically operated control components.

Do not enter a furnace or fired vessel until an adequate cool-off period has been observed and your company's vessel entry procedures have been completed. Enter heater or furnace only in the presence of someone who is capable of rendering aid.

This burner uses fuel which is flammable and potentially explosive. Familiarize yourself with the specific welding, hot work guidelines, torquing, draining, venting, purging, bleed-down procedures, leak checks, and line-entry instructions for the component worked on before starting work on the fuel system.

Dust generated from castable refractory may contain crystalline silica, which is carcinogenic. The ceramic fiber refractory contains fibers, which may be carcinogenic, and after firing ceramic fiber material cristabolite could be present, which is carcinogenic. use proper and approved respiratory protective equipment to avoid exposure.

Do not bypass flame management sequencing and safety interlocks!

If information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

Vibration in any high RPM rotating mechanism can be a safety hazard. Failure to follow this warning can result in serious personal injury and/or property damage.

During startup, the operator must be ever mindful of possible dangerous conditions such as fuel leaks, electrical or mechanical malfunctions, overheating of the boiler or heater being fired, etc., and the location of all manual fuel shut-off valves.

WARNING:

Always keep the main fuel valve shut “OFF” if the burner is shut down for an extended period of time.

When starting the burner, take special note of the requirement to make certain the combustion chamber and flues are clear of fuel and fuel vapor. The burner shall not be manipulated to by-pass “pre” and “post” purge requirements. Do not attempt to restart the burner when the combustion chamber is very hot.

In addition to the steps detailed in the Boiler PM inspections, the manufacturer recommends daily, weekly, and annual inspections and maintenance for the boiler and many of the interconnecting components associated with the boiler. This information can be found in the vendor manuals contained in Appendix Section [4.2.3.1.1](#) of this manual. When doing any servicing, maintenance, or adjustments, be sure to read and adhere to all manufacturer warnings, cautions, and notes. Because of the large number of manufacturer notes, they were not repeated in this manual.

WARNING:

Personnel using this manual, or any of the vendor manuals, are reminded to always follow and adhere to any notes, cautions, and warnings listed. Otherwise, a fire or explosion may result causing property damage, personal injury or death.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a phone in another facility. Follow the gas supplier’s instructions.**
- **Open all windows.**
- **Extinguish any open flame.**
- **EVACUATE people from the building.**
- **If you cannot reach your gas supplier, call the fire department.**

Improper servicing of this equipment may create a potential hazard to equipment and operators.

WARNING:

Before disconnecting or opening up a fuel line and before cleaning or replacing parts of any kind:

- **Turn OFF the main manual fuel shutoff valves including the pilot gas cock, if applicable. If a multiple fuel burner is used, shut OFF all fuels.**
- **Turn OFF all electrical disconnects to the burner and any other equipment or systems electrically interlocked with the burner.**

Do NOT use TEFLON® TAPE or compound with TEFLON® content as an oil or gas pipe sealant. TEFLON® can cause valves to fail creating a SAFETY HAZARD.

Rectorseal No. 2 pipe thread compound is used for factory assembly of oil and gas piping.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

When adjusting the gas pilot ignitor assembly:

- **Turn off power at the master switch and remove flame safeguard from the subbase. Turn the pilot gas cock OFF.**
- **Turn off all electrical disconnects to the burner and any other equipment or systems electrically interlocked with the burner. Turn off the manual pilot gas valve.**

Electrical shock hazard. Can cause serious injury or death. Replace the electrical access slot covers on the wiring subbase after performing voltage checks or anytime they are removed.

When servicing the relay modules:

- **Explosion hazard. Can cause serious injury or death. Do not allow fuel to accumulate in the combustion chamber for longer than a few seconds without igniting to prevent danger of forming an explosive mixture. Close all manual fuel shutoff valves if a flame is not burning at end of specified time.**
- **Electric shock hazard. Can cause serious injury or death. Use extreme care while testing the system. Line voltage is present on most terminal connections when power is on.**
- **Electric shock hazard. Can cause serious injury or death. Open the master switch before removing or installing any relay module or the keyboard display module connector.**
- **Adhere to all manufacturer's warnings when performing fault isolation procedures.**

WARNING:

When performing a static checkout on the relay modules:

- **Fire or explosion hazard. Can cause property damage, severe injury, or death. Close all manual fuel shutoff valves before starting the tests. use extreme care while testing the system. Line voltage is present on most terminal connections when power is on.**

Electric shock hazard. Can cause electrical shock, serious injury or death. Disconnect the power supply before removing, installing, or replacing the relay module. More than one (1) power supply connection can be involved.

Equipment damage hazard. Improper wiring can destroy the ultraviolet sensing tube. Carefully follow polarity sensitive instructions for the relay module. Reversing the lead wires, even momentarily, can destroy the ultraviolet sensing tube.

If replacing the plug-in purge timer:

- **Fire or explosion hazard. Can cause severe injury, death or property damage. Perform verification of safety requirements each time the control is installed to prevent possible hazardous burner operation.**
- **Electrical shock hazard. Can cause serious injury or death. Disconnect the power supply before installing the purge timer to prevent electrical shock or equipment damage. More than one (1) power supply disconnect can be involved.**

Failure to provide an adequate air supply will result in boiler damage and hazardous conditions in the building

The boiler room must be maintained at a positive or neutral pressure (relative to outdoors) at all times. exhaust fans or connections from the boiler room to zones of negative pressure (air ducts, negative pressure rooms, etc.) will cause negative pressure in the boiler room. such conditions will cause hazardous operation of the boiler and introduction of combustion products into the building air.

WARNING:

When servicing normally closed fuel oil solenoid valves:

- This valve is normally closed (N.C.) to permit flow when powered. Do not use in place of a normally open (N.O.) valve.

When servicing normally open fuel oil solenoid valves:

- This valve is normally open to flow when not powered. Do not use in place of a normally closed valve.

When servicing any fuel oil solenoid valve:

- Piping must comply with applicable local and national codes and ordinances.
- High temperatures reduce coil life. Select a location where the ambient temperature is below the maximum rating.
- To prevent electrical shock, personal injury, or damage to property, turn off the electrical supply before installing or servicing valve. Label all wires prior to disconnection when servicing valve. Wiring errors can cause improper and dangerous operation.
- Turn off fuel oil supply before installing or servicing valve, Isolate, depressurize, and purge all interconnected piping.
- Inspect the complete system after installing the valve. Check for leaks and ensure the power circuit is properly connected and grounded.
- Wiring must meet applicable electrical codes and ordinances. Be sure the power circuit is properly connected and grounded before operating the valve.
- This valve should be installed and serviced only by a trained and experienced service technician.
- Verify valve nameplate ratings satisfy the design requirements of the application before installing.
- It is not necessary to remove the valve from the pipeline for maintenance.

CAUTION:

When joining threaded pipe or nipples to valves or control devices, and the end of the pipe is threaded too deep, the pipe will extend too far into the valve distorting the valve body and seating surfaces.

Plug-In Purge Timer - This mercury switch contains Mercury Thallium Amalgam. Amalgam may be released upon breakage. Clean-up broken parts and residue immediately. Dispose of in accordance with local, state, and federal regulations. Inhaled vapors can cause headache, abdominal pain, difficulty breathing, inflammation of gums and mouth, tremors, kidney failure, and death. Skin contact with the Mercury Thallium Amalgam may cause irritation because of absorption.

Do not set fire visually on forced draft burners. Instruments are the only safe and reliable means to determine the proper adjustment.

Adjustable linkage mechanisms which are driven by an actuator (such as modutrol motor or motorized gas valve) must be adjusted while the actuator's arm is in the 0 degree travel position.

When adjusting the oil nozzle and ignition electrode assemblies:

- The final adjustments must not allow the fuel oil to impinge on the air diffuser or oil ignition electrodes.
- Manufacturing tolerances in both the nozzle and the oil drawer assembly may cause variations in the adjustment dimensions.
- It is recommended that after all adjustments have been made and the burner has been test fired that the oil drawer assembly be removed and examined for wetting or excessive carbon build-up. Evidence of these conditions requires re-adjustment.

Adjustment of characterized linkage:

There should be no more than 3/16" variation between adjacent screws.

When servicing the relay modules:

Equipment malfunction or damage hazard. Each relay module type is unique. Using existing wiring on a relay module change can cause equipment damage. Make wiring changes when a relay module is replaced with a different relay module to sequence the burner.

When performing a static checkout on the relay modules:

Electrical hazard. Can cause equipment damage or failure. Do not perform a dielectric test with the relay module installed. Internal surge protectors can break down, allowing the relay module to fail the dielectric test and destroy the internal lightning and high current protection.

Incorrect reassembly of the standard or explosion proof parts of the fuel oil solenoid valve will affect the magnetic circuit and valve functions, and may result in coil burnout.

CAUTION:

The boiler area should be kept free of combustible materials, gasoline and other flammable liquids.

The boiler and venting system must be kept free of obstructions of the air louvers and draft hood relief openings.

The following procedures must be conducted as outlined to assure safe operation of the boiler.

All cover plates, enclosures, and guards must be in place at all times, except during maintenance and servicing.

Failure to properly clean the system or to install mechanical sediment removal equipment can result in tube blockage and severe corrosion plus damage to pumps, controls, and air removal devices.

The manufacturer of the low water cut-off probe recommends the following maintenance schedule:

WARNING:

All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of plumbing, steam, and electrical equipment and/or systems in accordance with all applicable codes and ordinances.

To prevent flooding, do not use manual reset models with electric automatic water feeders.

Failure to follow this warning could cause property damage, personal injury or death.

Inspect the probe annually for scale build-up and clean if necessary. Make certain there is not scale or build-up on the probe or its white Teflon® insulator. Be careful not to damage the Teflon® insulator.

Replace the probe every 10 years. More frequent replacement of the probe is required if it is used in locales where significant water treatment is required, where more frequent cleaning is necessary, or in applications with high make-up water requirements.

Replace the low water cut-off every 15 years. More frequent replacement of the probe is required if it is used in locales where significant water treatment is required, where more frequent cleaning is necessary, or in applications with high make-up water requirements.

3.4.1.2 Terminal Heat Transfer Units

3.4.1.2.1 Unit heaters

The following table identifies the horizontal steam/hot water unit heaters (Equip. #HT00895 through HT00908) in the Waste Water Treatment Plant by equipment number and heat output.

WASTE WATER TREATMENT PLANT UNIT HEATERS	
EQUIPMENT DESIGNATOR(S)	HEAT OUTPUT (MBH*)
UH-1, UH-2	87,600 Btu (92,400 KJ)
UH-3, UH-4, UH-5, UH-6	60,500 Btu (63,800 KJ)
UH-7, UH-8	87,600 Btu (92,400 KJ)
UH-9, UH-10	87,600 Btu (92,400 KJ)
UH-11, UH-12	125,700 Btu (132,600 KJ)
UH-13, UH-14	125,700 Btu (132,600 KJ)
NOTE: Btu = British Thermal Units-per-hour.	

WARNING:

Always disconnect unit heater from power supply before attempting to service, clean, or disassemble any component from the unit. Failure to disconnect power before servicing can cause severe personal injury or death.

Open all disconnect switches and secure in that position before servicing unit. Failure to do so may result in personal injury or death from electrical shock.

Allow rotating fans to stop before servicing to avoid serious injury to fingers and hands.

CAUTION:

Do not use any tools (i.e. screwdrivers, pliers, etc.) across terminals to check for power. Use a voltmeter.

Because of the simple design of the steam and hot water unit heaters, they are nearly maintenance free. However, depending on the environment, simple maintenance practices should be adopted.

Besides performing annual maintenance per PM #3218FA, the manufacturer recommends the following periodic cleaning regimen:

- Wipe all excess lubricant from the motor, fan and casing. Clean the motor thoroughly. (A dirty motor may run hot and eventually cause internal damage.)
- Clean the coil:
Loosen the dirt with a brush on the fan side of the coil. Operate the motor allowing the fan to blow the loosened dirt through the unit.
Use high pressure air, or steam, on the side of the coil away from the fan.
- Clean the casing, fan blades, fan guard and diffuser using a damp cloth.
- Any rust spots on the casing should be cleaned and repainted.
- Tighten the fan guard, motor frame and fan bolts. Check the fan for clearance in the panel orifice and free rotation.

For fans equipped with sleeve bearing motors, the manufacturer recommends periodic lubrication with SAE 20W oil in ambient temperatures above 100° F, use SAE 30W to 50W when temperatures are 32° F to 100° F, and SAE 10W in lower ambient temperatures.

For cleaning and maintenance purposes, the fan and motor assembly may be removed easily from the unit heater.

(Additional data on the steam/hot water unit heaters can be found in Appendix [4.2.3.1.2.1.](#))

3.4.1.2.2 Electric Unit Heaters

Electric unit heaters (Equip. # HT00891 through HT00894 are located in rooms RM104 and RM206 of the Wastewater Treatment Plant, and HT00890 in Bldg. 200).

WARNING:

Failure to comply with the general safety information may result in extensive property damage, severe personal injury, or death.

Do not alter the unit heater in any way or damage to the unit and/or severe personal injury or death may occur!

Do not depend upon a thermostat or other switch as the sole means of disconnecting power when installing or servicing heater. Always disconnect power at main circuit breaker. Failure to do so could result in fatal electric shock.

Always disconnect unit heater from power supply before attempting to service, clean, or disassemble any component from the unit.

Allow rotating fans to stop before servicing to avoid serious injury to fingers and hands.

Line voltage is present on some of the terminals. Always disconnect the power from the heater before making any connections.

Because of the simple design of the electric unit heaters, they are nearly maintenance free. However, depending on the environment, simple maintenance practices should be adopted.

The manufacturer recommends the following periodic cleaning regimen:

- Wipe all excess lubricant from the motor, fan and casing. Clean the motor thoroughly. (A dirty motor may run hot and eventually cause internal damage.)
- Clean the coil.
- Loosen the dirt with a brush on the fan side of the coil. Operate the motor allowing the fan to blow the loosened dirt through the unit.
- Use high pressure air, or steam, on the side of the coil away from the fan.
- Clean the casing, fan blades, fan guard and diffuser using a damp cloth.
- Any rust spots on the casing should be cleaned and repainted.

- Tighten the fan guard, motor frame and fan bolts. Check the fan for clearance in the panel orifice and free rotation.

For fans equipped with sleeve bearing motors, the manufacturer recommends periodic lubrication with SAE 20W oil in ambient temperatures above 100° F, use SAE 30W to 50W when temperatures are 32° F to 100° F, and SAE 10W in lower ambient temperatures.

For cleaning and maintenance purposes, the fan and motor assembly may be removed easily from the unit heater.

(Additional data on the electric heaters can be found in Appendix [4.2.3.1.2.2.](#))

3.4.1.2.3 Baseboard Radiation Heaters

Radiation heaters (Equip. #HT00909 through HT00912) are located in rooms RM204, RM205, RM203, and VB208.

Hydronic system maintenance should include routine checks for piping leaks (usually indicated by frequent makeup water), and a yearly diagnosis of the system water pH to evaluate its corrosive potential.

Internal radiator maintenance depends entirely on the system water makeup and proper venting. Hydronic system additives are available to passivate and protect against freezing. These additives will not significantly reduce the output of the radiators.

External radiator maintenance consists of keeping the surfaces clean, and any paint nicks or deep scratches painted with touch-up to prevent any surface rust.

Radiators can be repainted after sanding with fine grit paper to dull the high gloss and by wiping with solvent or a tack rag. Use only oil based enamel paint (alkyd, acrylic, urethane, epoxy) - do not use latex or lacquer paint. Use urethane or epoxy enamel for radiators located in harsh environments, Spray the paint to achieve an even coating, and let dry completely before heating the radiator.

(Additional information on radiant heaters is available in Appendix Section [4.2.3.1.2.3](#) of this manual.)

3.4.1.3 Heating Coils / Duct Reheat Coils

The duct reheat coils (equipment tagged HC-1, HC-2, and HC-3) should be kept clean to maintain maximum performance. Accumulation of dust and dirt on the coils reduces their ability to transfer heat.

WARNING:

Follow directions provided with cleaners to avoid personal injury and/or coil damage.

The manufacturer recommends cleaning the coil fins with steam and detergent, hot water spray and detergent, or one of the commercially available chemical coil cleaners, then rinsing the coils thoroughly after cleaning. (See Appendix Section [4.2.3.1.3](#) of this manual for additional information on reheat coils.)

3.4.1.4 Heat Exchangers

Two types of heat exchangers are used at the Wastewater Treatment Plant, HX-1 (Equip. # EE00029) and HX-2 are air-to-air transfer and HX-3 is of a water-to-water, plate-and-frame construction. HX-3 (Equip. # EE00031) should be inspected periodically for internal build-up of scale or sediment. If found, scale or sediment should be removed either chemically or mechanically.

Besides inspecting the heat exchangers annually in accordance with PM #0112FA, the manufacturer recommends cleaning and/or backflushing the unit annually. Cleaning the unit may be accomplished by either backflushing, circulating cleaning agents in unit or by disassembly. If the water contains suspended foreign material, deposits can accumulate in the flow passages. Under these circumstances, backflushing may be adequate to clean unit. If this method is ineffective for the removal of hard scale, you may want to circulate buffered cleaning agents as recommended by the manufacturer of the agents in unit to remove scale or disassemble unit for manual cleaning.

Plates can be cleaned while hanging on frame or removed depending on how much work is required

NOTE:

Under no circumstances should hydrochloric acid be used with STAINLESS STEEL PLATES Water of more than 300 ppm, CI may not be used for the preparation of cleaning solutions It is very Important that carrying bars and support columns In aluminum are protected against chemicals Do not use brushes with carbon steel bristles or steel wool A fiber type brush is recommended but as a last resort use a brush of similar material to thermal plates Be careful not to scratch plates or damage gaskets if they are to be reused After brushing rinse each plate with water for better sealing wipe all gaskets dry.

The following solvents should not be used in contact with gaskets

- Ketones (e.g. Acetone, Methyl ethyl ketone, Methyl isobutyl ketone),
- Esters (e.g. Ethyl acetate, Butyl acetate),
- Halogenated hydrocarbons (e.g. Chloroethene, Carbon tetrachloride, Freons), and
- Aromatics (e.g. Benzene, Toluene).

WARNING:

Care must be exercised when handling certain fluids. Follow manufacturer's instructions. Use eye and skin protection. Wear a respirator when required.

CAUTION:

The gasket may have to be stretched prior to installation to fit the gasket groove. Avoid excess stretching as damage to gasket can result.

(Additional maintenance information on heat exchangers is available in Appendix Section [4.2.3.1.4](#) of this manual.)

3.4.1.5 Glycol Pumps

Glycol pumps (Equip. #PU00613 and PU00614) provide fluid flow for the hydronic system under control of the Direct Digital Control (DDC) system. The following list identifies glycol pumps by model number, pump designation, and pump size:

WASTE WATER TREATMENT PLANT GLYCOL PUMPS		
MODEL #	PUMP DESIGNATION	PUMP SIZE
SERIES 1510	P-1	2 ^{1/2} BB
SERIES 1510	P-2	2 ^{1/2} BB

WARNING:

ELECTRICAL SHOCK HAZARD - Electrical connections to be made by a qualified electrician in accordance with all applicable codes, ordinances and good practices.

ELECTRICAL OVERLOAD HAZARD - Three phase motors must have properly sized heaters to provide overload and under voltage protection. Single phase motors have built-in overload protectors.

EXTREME TEMPERATURE HAZARD - If the pump, motor, or piping are operating at extremely high or low temperature, guarding or insulation is required.

HOT WATER HAZARD - When disassembling a gasketed joint, always use a new gasket upon reassembly. Never re-use old gaskets.

UNEXPECTED START-UP HAZARD - Disconnect and lockout power before servicing.

Excessive Pressure Hazard - The maximum working pressure of the pump is listed on the nameplate—do not exceed this pressure.

Excessive System Pressure Hazard - Make certain internal pressure of the pump is relieved before servicing.

EXCESSIVE PRESSURE HAZARD - VOLUMETRIC EXPANSION - The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release high temperature fluids. This can be prevented by installing properly sized and located compression tanks and pressure relief valves.

Failure to follow these instructions could result in serious personal injury or death, or property damage.

WARNING:

Adhere to all manufacturer warnings and cautions while performing maintenance on these pumps and all its associated parts.

***EXCESSIVE PRESSURE HAZARD - VOLUMETRIC EXPANSION* - The heating of water and other fluids causes volumetric expansion. The associated forces may cause failure of system components and release high temperature fluids. This can be prevented by installing properly sized and located compression tanks and pressure relief valves.**

Disconnect and lock out power before servicing.

Do not operate without all guards in place.

Consult installation and service instruction sheet before operating or servicing.

Eyebolts or lifting lugs, if provided, are for lifting only the components to which they are attached.

Failure to follow these instructions could result in serious personal injury or death, or property damage.

CAUTION:

Allow pump temperature to reach acceptable levels before proceeding. Open the drain valve, do not proceed until liquid stops coming out of the drain valve. If liquid does not stop flowing from the drain valve, isolation valves are not sealing and should be repaired before proceeding. After liquid stops flowing from the drain valve, leave the drain valve open and continue. Remove the drain plug located on the bottom of the pump housing. Do not install plug or close drain valve until the assembly is completed.

Do not run pump dry or seal damage may occur.

Inspect pump seal regularly for leaks. Replace as required.

For lubrication requirements, consult service instructions.

Failure to follow these instructions could result in property damage and/or moderate personal injury.

Quarterly, inspect motor/pump alignment, flexible coupling, mounts and bearings, gauges, seals, pump and motor blocks, oil level, and motor operation. Clean the unit and tighten fittings.

Inspect the pump regularly for leaky seals or gaskets and loose or damaged components. Replace or repair as required. Lubrication should be in accordance with the motor manufacturer's instructions.

The manufacturer recommends the following maintenance on the suction diffuser portion:

WARNING:

High temperature and pressure hazard. Make sure that system temperature is below 100° F (38° C) and system pressure is reduced to and maintained at zero during servicing.

Corrosion, or leakage, are indications that the Suction Diffuser may be about to cause serious damage from leakage, rupture or parts entering the pump. The Suction Diffuser must be periodically inspected and if noted, the Suction Diffuser must be serviced or replaced.

Failure to follow these instructions could result in serious personal injury or death, or property damage.

CAUTION:

Potential pump damage. Inspect and replace damaged or corroded Suction Diffuser inlet vanes and orifice cylinder so that parts will not be forced into the system pump.

Failure to follow these instructions could result in property damage or moderate personal injury.

Periodic inspection of Inlet vanes and cleaning of the orifice cylinder is required to guard against damage to the pump. If damaged, they must be replaced.

1. Shut the pump off and isolate the Suction Diffuser and pump from the system.
2. Allow system temperature to cool to below 100° F (38° C).
3. Open a drain valve in the isolated Suction Diffuser piping and allow system pressure to drop to zero. If fluid continues to flow from the drain valve, repack or replace the isolation valves before proceeding.
4. Loosen the screws that secure the Suction Diffuser cover and break it loose from the body. Make certain all drainage stops before removing the screws and cover.
5. Grasp the inlet vane assembly with pliers and pull it out of the Suction Diffuser Body.
6. Remove start up strainer if still in place and inspect the orifice and inlet vane assembly for damage. Replace damaged components with new components as required.
7. Inspect the "O" ring seal and replace with new component as required.

8. Reassemble the Suction Diffuser and secure the cover with a criss-cross tightening pattern.
9. Open isolation valves slowly and inspect the gasket area for leaks.
10. Return system to normal operation.

(For additional maintenance information on Glycol Pumps and associated parts, See Appendix Section [4.2.3.1.5](#) in this manual.)

3.4.1.6 Hydronic Specialties

3.4.1.6.1 Expansion Tanks

The Hydronic Expansion Tank is designed to absorb the expansion forces and control the pressure in heating/cooling systems.

During performance of the annual building inspection (PM #3405FM), inspect the tanks for rust and leaks, paying particular attention to connections in accordance with PM #0504FS.

Expansion tanks are pre-charged to 2 P.S.I. below the design system operating pressure prior to being placed into operation. To ensure proper operation, the precharge should be checked periodically. If the expansion tank is not equipped with a precharge pressure gauge, an accurate pressure gauge should be used to check the pressure at the charging valve.

(For additional information on expansion tanks, see Appendix Section [4.2.3.1.6.1](#) of this manual.)

3.4.1.6.2 Air Separators

Air separators remove trapped air from the liquid in a hydronic system.

WARNING:

Leakage, corrosion or indications of damage are signs of an impending serious failure of the component. Periodically inspect all components for damage and note if the component must be serviced or replaced.

System fluid under pressure and/or at high temperature can be very hazardous. Before proceeding to service strainer, reduce system pressure to zero or isolate the Rolairtrol from the system. Allow the system to cool below 100° F.

Water at temperatures above 100° F can be very hazardous. Allow system water temperature to cool down below 100° F before blowing down.

Failure to follow these instructions could result in serious personal injury or death, or property damage.

Inspection and maintenance of the Air Separators, including periodic cleaning of the strainers is accomplished in accordance with the manufacturer's instructions listed in Appendix Section [4.2.3.1.6.2](#).

(For additional information on air separators, see Appendix Section [4.2.3.1.6.2](#) of this manual.)

3.4.1.6.3 Flow Controls

Hydronic flow controls (mixing valves) limit the volume of fluid that passes through a piping system to maintain a desired selectable temperature. Inspect control valves annually. Clean strainers periodically. Cartridges may need to be changed periodically. In most cases both the control range and the flow rate can be changed by replacing the cartridges.

(For additional information, refer to Appendix Section [4.2.3.1.6.3](#) of this manual.)

3.4.1.6.4 Balance Valves

Balance valves maintain the proportional volumes of fluid flowing through separate branches of a piping system. The balance valves are calibrated for use as a pre-settable balance valve, variable orifice flow meter, and positive shut-off service valve.

Valves are furnished with a calibrated nameplate and memory stop indicator that permits the valve to be preset to a fixed position, and then closed for service without disturbing the valve setting.

WARNING:

Check for proper sealing when using the balance valve as an isolation valve. If the seat is not sealing properly, liquid will continue to flow from drain valves. In this case the valve must be isolated from the system and repaired. Failure to follow this instruction can result in serious personal injury and/or property damage.

Corrosion or leakage are indications that the valve may be about to cause serious damage. The Circuit Setter must be replaced or serviced. Failure to follow this instruction can result in serious personal injury and/or property damage.

System fluid under pressure and/or temperature can be very hazardous. Isolate the valve from the piping system. Allow system temperature to cool below 100° F (37°C). Open a drain and vent all pressure from the valve. Failure to follow this warning can cause serious injury or death and/or property damage.

CAUTION:

Avoid excessive pressure drop. Do not throttle the valve to pressure drops above 25 ft. of H₂O (7.6m of water). Failure to follow this instruction may result in valve noise and valve damage which can result in additional property damage.

Rubber materials other than those supplied by the manufacturer may fail prematurely. This could result in personal injury and/or property damage when used as an isolation valve.

Gasket materials other than those supplied by the manufacturer may fail prematurely. This could result in personal injury and/or property damage.

The manufacturer recommends the valves should be checked periodically for proper position setting, signs of leakage, corrosion, or damage. Additionally the stem should be lubricated.

(For detailed maintenance information regarding balance valves, refer to Appendix Section [4.2.3.1.6.4](#) of this manual.)

3.4.1.6.5 Relief Valves

Relief valves are designed to protect fired and un-fired hot water pressure vessels (such as a boiler) against over-pressure conditions.

WARNING:

An undersized relief valve of inadequate relieving capacity can cause a boiler to explode. Before installing the safety relief valve, check the nameplate to make sure the pipe size, relief (opening) pressure, and BTUH rating are the same as required to protect the system against over pressure. BTUH rating and maximum operating pressure are stamped on the boiler nameplate.

Corrosion, scale buildup, leakage, or damage to safety relief valves are indications the safety relief valve may fail to provide over pressurization protection. Every 30 days the safety relief valve must be inspected and if any of the above conditions are noted it must be replaced.

Scale buildup from frequent discharging of safety relief valve can prevent safety relief valve from being able to discharge its rated capacity. The causes of frequent discharging such as a water logged compression tank must be immediately corrected.

Failure to follow these instructions could result in serious personal injury or death and property damage.

WARNING:

Attempts to change safety relief valve setting will prevent it from relieving at rated capacity and thus causing the system/component to explode. Do not attempt to adjust the pressure setting of the safety relief valve.

The uncontrolled discharge of hot water from the safety relief valve can be very hazardous and could scald anyone in the vicinity. Make sure that proper discharge piping is in place at all times.

Improper safety relief valve installation can prevent the valve from protecting the system against over pressure conditions. The following instructions must be followed if the safety relief valve is to provide the over pressure protection required.

Scale buildup from frequent discharging of the safety relief valve will prevent the safety relief valve from discharging its rated capacity should an over pressurization condition occur. Immediately shut down the boiler and replace the safety relief valve should this condition occur.

Failure to follow these instructions could result in serious personal injury or death and property damage.

CAUTION:

The use of Teflon® impregnated pipe compound and Teflon® tape on pipe threads provides lubricity which can lead to over tightening and breakage. Do not over tighten.

System additives may cause premature failure of the safety relief valve components. The compatibility of additives with the safety relief valve must be checked before they are used.

Failure to follow these instructions could result in property damage and/or moderate personal injury.

Check the operating condition of the safety relief valves every 30 days, or after any prolonged period of inactivity.

Check the relief valve by manually operating the lever on top of the relief valve to the full open position, releasing the lever and allowing the valve to snap closed, and inspecting the relief valve for leakage. When performing the manual test, inspect the safety relief valve for signs of corrosion, damage, or scale buildup.

(For more information on the pressure relief valves, refer to the Instruction Manual in Appendix Section [4.2.3.1.6.5](#) of this manual.)

3.4.1.6.6 Valves

The hydronic valves within the Waste Water Treatment Plant are part of the Glycol Loop Systems.

The valves should be inspected on a weekly basis for proper position setting, signs of leakage, corrosion, and damage.

WARNING:

Hot fluid leaking from the valve can cause burns. Avoid contact with leaking fluid while servicing the valve.

Hot system fluid can be hazardous. Isolate the valve from the system with shutoff valves or drain the system. Allow isolated system and the valve to cool to approximately 100° F. Reduce isolated system pressure to zero. Leave the drain open.

Check for proper sealing when using as an isolation valve. If seat is not sealing properly, liquid will continue to flow from drain valves. In this case the valve must be isolated from system pressure and inspected for seat or disc damage. Replace as necessary.

Failure to follow these instructions can result in serious personal injury or death and property damage.

CAUTION:

Improper tightening of bonnet can cause damage to the bonnet and gasket. If the bonnet is bolted, tighten bolts in a criss-cross pattern.

Improper valve stem orientation can cause damage to 3D valves or improper system operation. For proper installation, valve stem just point up above horizontal plane.

Failure to follow these instructions can result in property damage and/or moderate personal injury.

The manufacturer recommends the following maintenance on the suction diffuser portion:

WARNING:

High temperature and pressure hazard. Make sure that system temperature is below 100° F (38° C) and system pressure is reduced to and maintained at zero during servicing.

Corrosion, or leakage, are indications that the Suction Diffuser may be about to cause serious damage from leakage, rupture or parts entering the pump. The Suction Diffuser must be periodically inspected and if noted, the Suction Diffuser must be serviced or replaced.

Failure to follow these instructions could result in serious personal injury or death, or property damage.

CAUTION:

Potential pump damage. Inspect and replace damaged or corroded Suction Diffuser inlet vanes and orifice cylinder so that parts will not be forced into the system pump.

Failure to follow these instructions could result in property damage or moderate personal injury.

Periodic inspection of Inlet vanes and cleaning of the orifice cylinder is required to guard against damage to the pump. If damaged, they must be replace!.

1. Shut the pump off and isolate the Suction Diffuser and pump from the system.
2. Allow system temperature to cool to below 100° F (38° C).
3. Open a drain valve in the isolated Suction Diffuser piping and allow system pressure to drop to zero. If fluid continues to flow from the drain valve, repack or replace the isolation valves before proceeding.
4. Loosen the screws that secure the Suction Diffuser cover and break it loose from the body. Make certain all drainage stops before removing the screws and cover.
5. Grasp the inlet vane assembly with pliers and pull it out of the Suction Diffuser Body.
6. Remove start up strainer if still in place and inspect the orifice and inlet vane assembly for damage. Replace damaged components with new components as required.

7. Inspect the “0” ring seal and replace with new component as required.
8. Reassemble the Suction Diffuser and secure the cover with a criss-cross tightening pattern.
9. Open isolation valves slowly and inspect the gasket area for leaks.
10. Return system to normal operation.

(For detailed inspection and maintenance information regarding valves, refer to Appendix Section [4.2.3.1.6.6](#) of this manual.)

3.4.1.6.7 Glycol Make-up System

The Glycol Make-up System (GMS) automatically monitors, controls and maintains the required minimum pressure in the heating system.

Check the glycol solution level in the translucent solution container and replenish as necessary.

The GMS (Equip. #TN00031) was designed to operate without the need of servicing or adjustment. The pump is equipped with self-lubricating carbon bearings, and the motor is a life-time lubricated type for standby make-up applications. The pump has a seal type packing that does not require adjustment.

For other servicing requirements, see the nameplate.

(Additional information regarding the GMS is contained in Appendix Section [4.2.3.1.6.7](#) of this manual.)

3.4.1.6.8 Air-to-Air Heat Exchangers

The air-to-air Heat Exchangers, labeled HX-1 and HX-2, are used to transfer energy from one airstream to the other. This reduces the amount of fuel needed to heat spaces throughout the Waste Water Treatment Plant.

WARNING:
HAZARDOUS VOLTAGE - Failure to disconnect power before servicing can cause severe personal injury or death.

The air to air Heat Exchangers should be inspected periodically for dirt accumulation on the surface and if appreciable, cleaned with hot water and a detergent that will not attack aluminum.

Perform inspection and servicing of the exchangers in accordance with PM #0112FA.

The heat exchanger is manufactured of commercial quality materials with no moving parts. The housing is fabricated of heavy gauge galvanized steel (unless otherwise specified) with integral drain pans, duct flanges, mounting flanges and removable panels for easy access to maintain the heat transfer surface.

The heat transfer surface is made of Series 1100 aluminum alloy (unless otherwise specified). Small amounts of dust and dirt accumulation should not deteriorate the surface nor alter its performance. If appreciable amounts of dirt accumulation occur, the heat exchanger should be cleaned with hot water and a detergent that will not attach aluminum. If semi-automatic water-wash is part of the system, then the washdown is done by simply flipping the toggle switch (SI) on the control panel to the ***On*** position and setting the manual timer to the desired setting. Even with automatic water-wash, routine checks should be made to see that the heat exchanger surfaces are being cleaned properly. This is easily done by removing the four (4) sheet metal screws securing removable panels.

During manual washdown, care should be taken not to force sharp objects against the heat exchanger core, as this could cause a puncture. Also, wash water cannot have excessively high pressure, as this may also result in damage to the surfaces.

(Additional information regarding the heat exchangers is contained in Appendix Section [4.2.3.1.6.8](#) of this manual.)

3.4.2 Ventilation Systems

3.4.2.1 Air Handling Units

The Air Handling Units in the Waste Water Treatment Plant, labeled AHU-1 (Equip. # AH00199) and AHU-2 (Equip. # AH00200), require periodic inspections and maintenance to ensure proper operation. The manufacturer recommends a weekly observation for any changes in running condition or unusual noise.

WARNING:

Disconnect all electrical power, including remote disconnects, secure drive sheaves/impellers, and allow all rotating equipment to stop completely before: inspecting, servicing, performing any maintenance including motor lubrication, connecting or disconnecting electrical wires for test procedures, and before opening any service access doors or ductwork for this unit. Failure to do so can cause severe personal injury or death from electrical shock or rotating parts.

Before lubricating the motor, disconnect the unit power source. Failure to do so may cause injury or death from electrical shock or moving parts.

Some chemical cleaning compounds are caustic, toxic, or may contain hazardous agents. To avoid personal injury or equipment damage use these substances only in accordance with the manufacturer's instructions. Failure to do so may result in injury, death, or equipment damage.

Secure drive sheaves to ensure the motor cannot freewheel. Failure to do so can result in severe personal injury or death.

Disconnect electrical power and allow rotating parts to stop before servicing the unit. Exercise caution if unit must be on for test or maintenance procedures. Failure to do so may result in injury or death from electrical shock or entanglement in moving parts.

Disconnect electrical power prior to access into a fan or ductwork. Even when locked out electrically, fans may cause injury or damage if the impeller is subject to "windmilling". The impeller should be secured to physically restrict rotational movement. Failure to secure impeller can cause severe personal injury or death.

CAUTION:

Use copper conductors only. Unit terminals are not designed to accept other types of conductors. Failure to use copper conductors may result in equipment damage.

Do not use acidic chemical coil cleaners. Also, do not use alkaline chemical coil cleaners with a pH value greater than 8.5 (after mixing) without using an aluminum corrosion inhibitor in the cleaning solution. Using these type cleaners may result in unit damage.

Failure to properly drain and vent coils when not in use during freezing temperatures may result in coil freeze-up damage.

Inadequate lubrication of fan motor or bearings may result in premature bearing or motor failure.

Improper lubrication can result in premature bearing failure.

Do not mix greases with different bases within the bearing. This can cause an audible squealing noise that may be transmitted through the system ductwork. Premature bearing failure may result.

Do not stretch the belts over the sheaves. Over tensioning of the belt may shorten belt life and cause bearing and fan shaft failure or premature belt wear.

Follow all directions provided with chemical cleaners to avoid personal injury and/or coil damage. Commercially available chemical cleaners may contain caustic or hazardous agents.

Never use steam or hot water to clean a refrigerant coil. Dangerous pressures may be built up by the improper application of heat resulting in equipment damage or personal injury.

Use caution when removing header plugs from P2, P4 and P8 coils. Over torquing may result in twisted tubes.

NOTE:

Filters must have an airtight seal to prevent air bypass. If using other than manufacturer supplied filters, apply foam gasket to the vertical edges of the filter.

Check and adjust belt tension at least twice daily the first days of new belt operation. Belt tension will rapidly decrease until the belts are run in.

The manual output test is not an automatic cycle. You must press the *Test* button to proceed through each step.

If the service push button is held down for more than 15 seconds, the Tracer ZN controller will uninstall itself from the ICSTTM communication network and shut down all unit operation. This mode is indicated by the red Service LED flashing once every second. See the Red Service LED Section. Use RoverTM Service tool to restore the unit to normal operation. Refer to the RoverTM product literature for more information.

Non-latching diagnostics automatically reset when the input is present and valid.

The automatic diagnostic reset function does not operate during the manual output test sequence.

The controller implements the automatic diagnostic reset function only once every 24 hours. For the controller to increment the 24 hour timer, you must maintain power to the controller. Cycling power resets all timers and counters.

Monthly inspections are performed in accordance with PM #3408FM and PM #6302FM.

Quarterly inspections are performed in accordance with PM #3408FQ.

Semi-Annually inspections are performed in accordance with PM #6302FS.

Besides the required inspections listed on the previous page, the manufacturer recommends the following maintenance schedule:

Weekly:

1. Observe unit for any change in running condition and unusual noise.

Monthly:

1. Check Air Filters. Clean or replace if clogged or dirty. Coat permanent filters with oil after cleaning.
2. Change bag filters when the pressure drop is 1-inch water gauge (W.G.)
3. Lubricate fan bearings if operating conditions include high speeds, moist or dirty air, or high temperatures.

4. Lubricate motor bearings in accordance with motor manufacturer's recommendations if operating conditions include high speeds, moist or dirty air, or high temperatures.
5. Check and adjust fan belt tension.

Every 3 to 6 Months:

1. Check fan bearing grease line connections. Lines should be tight to the bearings.
2. Lubricate fan bearings.
3. Check motor lubrication. Recommendations are provided on the motor tag or on a unit sticker.
4. Check bearing and motor bracket bolt torque.
5. Align fan and motor sheaves. Tighten sheave set screws to the proper torque.
6. Check and adjust fan belt tension.
7. Inspect and clean drain pans.
8. Tighten electrical connections.
9. Inspect coils for dirt build-up or coil freeze up.

Annually:

1. Inspect the unit casing for corrosion. If damage is found, clean and repaint the surface with a rust-resistant primer and vinyl chlorinated lacquer.
2. Clean the fan wheels and fan shaft. Remove rust with an emery cloth and apply a coat of heavy duty rust inhibitor (LPS Laboratories LPS 3, or an equivalent).
3. Inspect the condensate drain pan and drain line, remove sludge or foreign materials that might obstruct proper drainage. Remove obstacles.
4. Check damper linkages, set screws and blade adjustment. Clean, but do not lubricate, the nylon damper rod bushings.
5. Clean damper operators.

6. Inspect the control and power box wiring for secure connections and insulation.
7. Rotate the fan wheel and check for obstructions in the fan housing. The wheel should not rub on the fan housing. Adjust the center if necessary and tighten wheel set screws to the proper torque.
8. Check condition of the gasket and insulation around unit, door and dampers.
9. Examine flex connections for cracks or leaks. Repair or replace damaged material.

(For manufacturer's maintenance instructions and more information on air handlers, See Appendix [4.2.3.2.1.](#))

3.4.2.2 Intake-Exhaust Fans

The intake fans supply outside air for the blower system while the exhaust fans remove odors and fumes from the process tanks and from the rest room located on the second floor.

WARNING:

Do not attempt maintenance on a fan unless the electrical supply has been completely disconnected.

HIDDEN DANGER— In addition to the normal dangers of rotating machinery, fans represent an additional hazard in their ability to suck in not only air, but loose material as well. Solid objects can pass through the fan and be discharged by the impeller as potentially dangerous projectiles. Therefore, intake duct work should be screened, whenever possible, to prevent the accidental entrance of solid objects. Access doors to a duct system should never be opened with the fan running.

Failure to follow this warning can cause serious personal injury, death or property damage.

CAUTION:

Do not over grease – most lubricants deteriorate motor windings, thereby reducing motor life and presenting a fire hazard.

Failure to follow this caution can cause personal injury or property damage.

WASTE WATER TREATMENT PLANT INTAKE-EXHAUST FANS			
ARCHITECTURAL TAG	EQUIP. MODEL	MANUFACTURER	EQUIP. NUMBER
F-1	BSQ-160	Greenheck	FN00129
F-2	BSQ-160	Greenheck	FN00130
F-3	BSQ-140	Greenheck	FN00131
F-4	BSQ-140	Greenheck	FN00132
F-5	BSQ-70	Greenheck	FN00133

Lubrication, V-belts, and cleaning of the exterior surfaces are the primary maintenance responsibility. All bearings should be checked periodically. Where applicable, V-belts should be inspected periodically for proper tension, alignment, and overall condition.

Maintenance recommendations can be found in the manufacturer's *Operation and Maintenance Instructions*, in Appendix Section [4.2.3.2.2](#) of this manual.

Perform maintenance in accordance with PM#0385FQ.

(For additional information regarding exhaust fans, refer to Appendix Section [4.2.3.2.4](#) of this manual.)

3.4.2.3 Exhaust Hoods

The exhaust hoods were designed and built to remove odors and fumes from the process tanks located on the first floor.

During performance of the annual building inspection (PM #3405FM), inspect the exhaust hoods for damage and repair as necessary.

(For additional information regarding the exhaust hoods, refer to Appendix Section [4.2.3.2.3](#) of this manual.)

3.4.2.4 Outside Air Hood

The air hood was designed and built to exhaust odors and fumes from the process tanks located on the first floor.

During performance of the annual building inspection (PM #3405FM), inspect the air hood for damage and repair as necessary.

(For additional information regarding the exhaust hoods, refer to Appendix Section [4.2.3.2.4](#) of this manual.)

3.4.2.5 Air Outlets and Inlets

Check all grilles, registers, and diffusers periodically for obstructions and accumulation of dirt and debris. Inspect for any corrosion or damage. Check adjustable louvers and diffusers for proper positioning.

(See Appendix Section [4.2.3.2.5](#) for additional information on air outlets and inlets.)

3.4.2.6 Air Cleaning Devices

NOTE:

Filters must have an airtight seal to prevent air bypass. If using other than original-equipment-manufacturer filters, apply foam gasket to the vertical edges of the filter.

Air filters are provided to remove particulates from the air and protect the fans of air handling equipment from dirt and debris build-up, which can adversely affect the performance of the equipment. Filter replacement is recommended when the pressure drop reaches 0.9" water gauge.

Air cleaning filters should be checked and replaced if necessary during performance of PM #3408FM, PM #3408FQ, PM #6302FM and PM #6302FS.

(Additional information on air cleaning devices is available in Appendix Section [4.2.3.2.6](#) of this manual.)

3.4.2.7 Dampers

To maintain proper volume control, air balance, and fire boundary integrity, dampers must operate properly. To ensure proper operation, dampers should be checked regularly.

WARNING:

Before servicing dampers, be sure to disengage any electric or pneumatic actuators. Keep fingers and clothing away from damper blades as much as possible. Failure to do so may result in serious injury or death from moving parts.

Inspect damper actuators, louvers, linkages, springs, counterweights, and seals for damage and operability. Verify parts intended to move freely do so.

Check back draft dampers for spring-return full closure in the absence of airflow to prevent air infiltration.

Check volume control dampers for smooth, full-range operation. If dampers are motorized, check dampers for full-range, motor-driven operation.

Periodically lubricate all moving parts using a moli-spray oil or similar graphite based oil as regular lubricating oil will attract dirt. Dampers furnished with stainless steel side seals should also have the seals lubricated generously.

Fire dampers shall be maintained at intervals as stated in *NFPA 90A* and *NFPA 2A*.

(For additional information about dampers, refer to Appendix Section [4.2.3.2.7](#) of this manual.)

3.4.3 Plumbing Systems

3.4.3.1 Plumbing Equipment

3.4.3.1.1 Sanitary Waste Lift Station / Sump Pump

The Sanitary Waste Lift Station (equipment #SP-1 and #SP-1A) is a duplex sewage ejector system containing duplex sewage ejector pumps located on the first floor in Bldg. 199. Inspect the pumps to ensure that they are working properly, and lubricate the pump shaft sleeve bearings once per month or as needed depending on operational conditions.

WARNING:

Read all instructions before starting any operation on the pump. Always disconnect the pump and controls from its power source before handling.

Do not smoke or use electrical devices which create a spark or flame in a septic or possible septic sump. A septic sump condition may exist and if entry into the sump is necessary then: Provide proper safety precautions per latest OSHA requirements; Do not enter pump until these precautions are strictly adhered to. Failure to heed these warnings could result in injury or death.

Never work alone. Use a lifting harness, safety line and a respirator as required. Do not ignore the risk of drowning.

Make sure that there is sufficient oxygen and that there are no poisonous gasses present.

Failure to follow these instructions could cause serious personal injury, death or property damage.

WARNING:

Check the explosion risk before welding or using electric hand tools.

Do not ignore health hazards. Observe strict cleanliness.

Bear in mind the risk of electrical accidents.

Make sure that the lifting equipment is in good condition.

Provide a suitable barrier around the work area, for example a guard rail.

Make sure you have a clear path of retreat!

All personnel who work with sewage systems shall be vaccinated against diseases that can occur.

Read all instructions before starting any operation on the pump.

Always disconnect the pump and controls from its power source before handling.

Do not smoke or use electrical devices which produce a spark or flame in a septic (gaseous) or possible septic sump.

Failure to follow these instructions could cause serious personal injury, death or property damage.

CAUTION:

Lubricate the bearings with high grade multi-purpose lithium No. 1 or a calcium complex No. 1 soap grease. Intermixing different greases than those listed may cause a harmful chemical reaction.

Never reuse old seal parts. Always replace with complete new seal.

Always turn off power before working on impeller or pump.

Failure to follow these instructions could cause personal injury or property damage.

(Additional information on the waste lift station is available in Appendix Section [4.2.3.3.1.1](#) of this manual.)

3.4.3.1.2 Backflow Preventers

Backflow preventers are installed at points where auxiliary systems are connected to the domestic water supply system. Their purpose is to prevent reverse-flow contamination of the water supply system.

The backflow preventer (Equip. #RP00199) should be inspected and tested annually using PM #5204FA. The backflow preventer should periodically be inspected for evidence of discharge from the relief valve and replaced if necessary.

WARNING:

Spring assembly is factory assembled. DO NOT DISASSEMBLE!

NOTE:

Rubber seat disc can be replaced. However, the disc holder and disc retainer are permanently bonded to prevent failure.

Align holes and insert pin or small screwdriver to hold in open position.

(Additional information regarding the backflow preventers is available in Appendix Section [4.2.3.3.1.2](#) of this manual.)

3.4.3.1.3 Water Heater

Water Heaters (WH-1 and WH-2) are an induction type water heater. WH-1 (Equip. # HT00850) is used to heat the domestic water supply and WH-2 (Equip. # HT00861) is used to heat the water supplied to the Belt Filter Press. Water from the boiler is used to heat a double plated heat exchanger coil inside the water heater. Both water heaters used in the Waste Water Treatment Plant are constructed of stainless-steel, insulated, and are enclosed in a galvanized steel shell.

The water heaters should be inspected and serviced annually using PM #6210FA. The manufacturer recommends monthly inspecting the switch mechanisms, terminals, and all piping connections for corrosion and tightness. The manufacturer also recommends inspecting the tank on a yearly basis.

DANGER:

Do not over-drain the tank. Improper thermostatic control could result and lead to damage to the heater.

Electrocution hazard, the heater must be electrically grounded.

WARNING:

Scalding Hazard: If the water temperature is over 120° F, users can suffer serious or fatal scalding and painful and permanent injury. The consumer products safety commission recommends an initial setting of 100° F, but notes a slower response time of infants, aged, disabled and other persons increases the hazard to them and may require lower settings. Always check the water temperature before using, including washing, bathing or showering.

Temperature limiting valves are available from your plumbing supplier.

Scalding Hazard: If the thermostat is not working properly or if this product is not installed in accordance with the manual, water temperature can reach excessive levels that may cause serious scalding, even if the temperature setting is correct. After installation and any servicing of the unit, verify that the thermostat is working and firmly inserted in the thermostat well by the following the thermostat testing instructions in the manual after installation and any servicing of the unit.

Scalding Hazard: A check valve must be installed in the boiler return line to prevent gravity flow through the heat exchanger. This can cause over heating and result in serious scalding.

If not installed by the boiler manufacturer, install a low water cut-off or pressure reducing valves must be installed on your boiler so that leaking from any plumbing fixture will not result in a dry boiler; If the boiler continues to fire, an explosion hazard exists.

Prevent pressure build-up in any existing internal tankless coil. Do not plug incoming or outgoing tappings in the internal tankless coil plate. Leave the coil in the boiler and leave system connections open, to prevent pressure build-up.

Electrocution Hazard: First disconnect all electrical power before doing any electrical work.

Electrocution Hazard: The water heater must be electrically grounded.

Do not over-drain the tank. Improper thermostatic control could result if the tank is over-drained and cause damage to the tank.

Failure to follow this warning can cause serious personal injury, death or major property damage.

WARNING:

Avoid risk of ingesting a toxic fluid. The heat transfer medium should be water. If glycol must be used, it should be used with double walled heat exchangers.

This tank, like most tanks under pressure, will over time corrode or fail and/or may burst and/or leak or flood (and in rare cases explode) which can cause serious or fatal personal injury and property damage. To minimize risk, a licensed professional must install and periodically inspect and service the unit. A drip pan, connected to an adequate drain must be installed if leaking or flooding can cause property damage.

Follow all of the instructions and recommendations contained in this manual, and the following additional specific warnings. Failure to do so is unsafe and can cause serious scalding, explosion, serious or fatal personal injury and property damage.

Do not connect the water heater's domestic supply with baseboard or other space heating units or elements. Any contaminants in the baseboard units will contaminate the potable water in the water heater and also adversely affect its performance.

Electrical supply must come from the boiler side of the boiler's emergency shut-off switch in order to prevent unsafe boiler operation.

Do not drain this appliance before shutting off the supply valve and opening the relief valve or another downstream fixture, as it will damage this unit. A vacuum breaker should be installed to avoid damaging the liner.

In limited circumstances, space heating can be lost when the water heater is used in the priority mode. Any demand for space heating is postponed until the water heater has reached its set temperature. This delay in supplying the space heating zones is usually not noticed by the inhabitants of the living spaces. However, in the event of certain malfunctions such as circulator or thermostat failure, space heating could be delayed indefinitely. If undetected and uncorrected, freezing damage to piping could result.

Explosion Hazard: Do not install to a high pressure steam boiler greater than 15 psig. An explosion could occur.

Explosion Hazard: The pressure of the heat transfer medium must be limited to a maximum of 30 psig by an approved safety or relief valve on your boiler. The tank pressure must be limited to 150 psig maximum by the installation of a temperature and pressure relief valve.

Damage to the unit and leakage can occur if a vacuum breaker is not installed.

Failure to follow this warning can cause serious personal injury, death or major property damage.

WARNING:

This unit must be installed as a separate heating zone. Do not connect this unit to an existing heating zone or feed boiler water directly through the coil as dangerous over-heating will result.

Failure to use the correct replacement parts may make your unit unsafe.

Painful scalding with possible serious and permanent injury can occur if the temperature is set too high or the thermostat is not functioning properly.

Some new boilers contain materials that may adversely affect heat transfer. To avoid causing poor performance, do not make the initial purge of a new boiler through the water heater.

Failure to follow this warning can cause serious personal injury, death or major property damage.

NOTE:

As in all plumbing products and water storage vessels, bacteria can grow in your hot water maker, especially during times of non-use. Consult your local plumbing official regarding any steps you may wish to take to safely disinfect your home's plumbing system.

If a steel hydropneumatic tank is in place, replace it with a properly sized expansion tank. Otherwise, significant heat transfer system has an expansion tank and the boiler temperatures are being changed, resize the expansion tank.

(For additional information regarding the water heater tank, refer to Appendix Section [4.2.3.3.1.3](#) of this manual.)

3.4.3.1.4 Valves

The Wastewater Treatment Plant uses a variety of valves in the plumbing systems, including mixing, balance, check, butterfly, plug, drain, and so on.

Monthly:

Externally inspect valves to verify:

- (a) The gauges indicate normal supply water pressure is being maintained.
- (b) The valve is free of physical damage.
- (c) All valves are in the appropriate open or closed position.
- (d) There is no leakage or corrosion present.

Every 5 years:

Valves and any associated strainers, filters, or restriction orifices shall be inspected internally (unless tests indicate a greater frequency is necessary).

Valves shall be inspected internally to verify that all components operate properly, move freely, and are in good condition.

Internal components shall be cleaned, repaired, or replaced as necessary in accordance with the manufacturer's instructions.

(For additional information regarding valves, refer to Appendix Section [4.2.3.3.1.4](#) of this manual.)

3.4.3.1.5 General Piping

Perform visual inspections weekly of the sanitary sewer/vent piping for evidence of damage or leaks in accordance with PM #0189FW.

(For additional information regarding general piping and fittings, refer to Appendix Section [4.2.3.3.1.5](#) of this manual.)

3.4.3.2 Plumbing Fixtures

3.4.3.2.1 Water Closets

The water closets are part of the Sanitary Waste System. Check periodically for leaks, proper flush valve operation, and cleanliness.

(See Appendix Section [4.2.3.3.2.1](#) of this manual for information regarding water closets.)

3.4.3.2.2 Lavatories

The lavatories are a part of the Sanitary Waste System. Check the sinks, faucets and drain plumbing periodically for leaks, corrosion, and damage.

Clean and polish the work surfaces regularly with finishing oil, do not use wax on epoxy work surfaces or sinks.

CAUTION:

Epoxy resin work surfaces are heavy. Always have assistance when moving and placing them and always use proper lifting techniques. Bend at the knees and keep your back straight when lifting.

Epoxy resin products are subject to Thermal Shock, and are not warranted against damage from liquid nitrogen or dry ice. Abuse caused by the improper use of these materials could cause cracking and sink failure.

Failure to follow this caution can cause personal injury or major property damage.

(Appendix Section [4.2.3.3.2.2](#) of this manual contains additional information regarding Lavatories.)

3.4.3.2.3 Laboratory

The sinks, faucets, and cabinets are a part of the Sanitary Waste System. Check the sinks, faucets and the drain plumbing (where accessible) periodically for leaks, corrosion, and damage.

Clean and polish the work surfaces regularly with finishing oil, do not use wax on epoxy work surfaces or sinks.

CAUTION:

Epoxy resin work surfaces are heavy. Always have assistance when moving and placing them and always use proper lifting techniques. Bend at the knees and keep your back straight when lifting.

Epoxy resin products are subject to Thermal Shock, and are not warranted against damage from liquid nitrogen or dry ice. Abuse caused by the improper use of these materials could cause cracking and sink failure.

Failure to follow this caution can cause personal injury or major property damage.

(See Appendix Section [4.2.3.3.2.3](#) for additional information regarding sinks, faucets, and cabinets in the Laboratory.)

3.4.3.2.4 Emergency Eyewash / Shower

The emergency eyewash unit (Equip. # ES00034) is located in the Laboratory (RM205) on the second floor. The emergency eyewash unit is part of the Sanitary Waste System. The emergency eyewash unit should be checked periodically for leaks, corrosion, or damage.

Clean and polish the emergency eyewash unit regularly with a quality silver cream, mild detergent liquid soap, or commercial chrome polish. Do not use abrasive or caustic cleaners.

NOTE:

The eyewash unit should be tested weekly per American National Standards Institute (ANSI) Standard Z358.1 (latest issue).

ANSI Standard Z358.1-1998, paragraph 5.5.2, requires a weekly activation of plumbed eyewash equipment to verify proper operation

(See Appendix Section [4.2.3.3.2.3](#) for additional information regarding the eyewash and shower station.)

3.4.4 Fuel Oil System

The Fuel Oil System provides JP-5 heating fuel to the boiler located on the first floor of the Waste water treatment Plant. The boiler then provides hot water to heating devices located throughout the plant for the comfort of the personnel.

3.4.4.1 Fuel Tanks

The 2000-gallon, horizontal, cylindrical, fuel-storage tank supplies JP-5 heating fuel to the boiler located on the first floor of the Waste Water Treatment Plant. The tank is fitted with a clock level gauge used to measure the liquid level in the tank, and a leak detector.

Annually:

- Drain water and sediment from the tank. If less than one full tank of fuel has been consumed within the year, the tank should be drained and refilled with fresh fuel.
- Remove the inspection port from the tank and examine the tank interior. Using an inspection lamp, inspect all internal components. With tank drained, test sending unit operation. Install a new inspection port gasket and replace the inspection port cover. Inspect all plumbing connections for leaks and repair if necessary.

(Fuel tank information is available in Appendix Section [4.2.3.4.1](#) of this manual.)

3.4.4.2 Fuel Oil Filters

The fuel oil filter has a mesh surface loading element with a large surface area for long life between cleaning.

Weekly:

Drain water separator (if equipped).

Every 250 operating hours:

The filter should be checked, cleaned or replaced.

NOTE:

Do NOT fill the fuel filter with fuel before installing it. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to the fuel system.

(Additional information regarding fuel oil filter is available in Appendix Section [4.2.3.4.2](#) of this manual.)

3.4.4.3 Fuel Oil De-Aerators

The De-Aerator is mounted near the boiler between the burner and the fuel oil tank. The De-Aerator eliminates air from the fuel oil before it enters the boiler.

(Additional information regarding the fuel oil De-Aerator is available in Appendix Section [4.2.3.4.3](#) of this manual.)

3.4.4.4 Fuel Oil Valves

The valves and connections should be inspected weekly for leakage, damage, and corrosion. All leaks should be repaired and defective valves replaced.

NFPA Code 30A, Automotive and Marine Service Station Code, requires that the automatic closing feature of emergency shut-off valves be checked at least once per year by manually tripping the hold-open linkage.

NOTE:

As per NFPA 30A, electrical supply to the submersible pump must always be disconnected before servicing meters, dispensers, or emergency shut-off valves.

(Additional information regarding fuel oil valves is available in Appendix Section [4.2.3.4.4](#) of this manual.)

3.4.5 Control Systems

3.4.5.1 Direct Digital Control Systems

3.4.5.1.1 Control Valves

The term *control valve* shall mean valves controlling flow to water-based systems. Three control valves labeled TVC1 - TVC3 are used for water regulation in the Waste Water Treatment Plant.

WARNING:

These valves are not for combustible gas applications as leaks and explosions could result. Sound engineering practices need to be applied, especially in low temperature applications with respect to condensation and ice buildup.

NOTE:

Upon power failure the actuator will initialize and seek out angle of rotation and return to control position.

All system valves shall be protected from physical damage and shall be accessible.

Before opening a test or drain valve, it shall be verified that adequate provisions have been made for drainage.

The general appearance of all valves shall be observed and noted, and it shall be verified that all valves are in the appropriate open or closed position.

Each normally open valve shall be secured by means of a seal or a lock or shall be electrically supervised.

Normally closed valves shall be secured by means of a seal or shall be electrically supervised.

NOTE:

Sealing or electrical supervision is not required for hose valves.

Inspection of Control Valves.

Weekly:

All valves shall be inspected weekly.

The valve inspection shall verify that the valves are in the following condition:

- (a) In the normal open or closed position
- (b) Properly sealed, locked, or supervised
- (c) Accessible
- (d) Provided with appropriate wrenches
- (e) Free from external leaks
- (f) Provided with appropriate identification.

NOTE:

After any alterations or repairs, an inspection shall be made by the owner to ensure that the system is in service and all valves are in the normal position and properly sealed, locked, or electrically supervised.

Testing of Control Valves.

Quarterly:

Conduct a main drain test at each water-based system riser to determine whether there has been a change in the condition of the water supply piping and control valves.

Semi-annually:

Valve supervisory switches shall be tested. A distinctive signal shall indicate movement from the valve's normal position during either the first two revolutions of a hand wheel or when the stem of the valve has moved one-fifth of the distance from its normal position. The signal shall not be restored at any valve position except the normal position.

Annually:

Each control valve shall be operated through its full range and returned to its normal position. Post indicator valves shall be opened until spring or torsion is felt in the rod, indicating that the rod has not become detached from the valve. Post indicating and outside screw and yoke valves shall be backed a one-quarter turn from the fully open position to prevent jamming.

NOTE:

This test shall be conducted every time the valve is closed.

A main drain test shall be conducted annually and any time the valve is closed at each system after the control valve has been closed to determine whether there has been a change in the condition of the water supply piping and control valves.

Whenever a Valve is Returned to Service:

A drain test (of either the main or sectional drain as appropriate) shall be conducted to determine that the valve is open.

Maintenance of Control Valves.

Annually:

The operating stems of outside screw and yoke valves shall be lubricated. The valve then shall be completely closed and reopened to test its operation and distribute the lubricant.

(Additional information regarding control valves is available in Appendix Section [4.2.3.5.5.1](#) of this manual.)

3.4.5.1.2 Damper Operators

Damper actuators (Equipment labeled D1 - D7) provide true spring return operation for reliable fail-safe application and positive close/open on the dampers used for air intake and air exhaust. The seven damper operators are distributed among the mechanical room, the boiler room, the blower room, and the toilet room.

No lubrication or periodic servicing of the damper operators is required. The exterior case and cover should be kept clean.

(Additional information regarding damper operators is available in Appendix Section [4.2.3.5.5.2](#) of this manual.)

3.4.5.1.3 Input/Output Sensors

Although the data sheets provided by the various manufacturers of the input/output sensors indicates these devices do not require routine maintenance, personnel should adhere to the following warning note for the HSP121BT series surge protector and the caution note for the ET 134 temperature detection thermostat.

WARNING:

For continued protection against risk of fire, replace only with the same type and rating of fuse.

The low temperature detection thermostat is designed for use only as an operating control. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety limit controls) or systems (alarm supervisory systems) that protect against, or warn, of control failure.

Disconnect the power supply before wiring connections are made to avoid possible electrical shock or damage to the equipment.

CAUTION:

Use terminal screws furnished (#8-32 x 1/4-inch binder head screws). Substitution of other screws can cause problems in making proper connections.

NOTE:

The reset lever must be depressed manually and released to resume normal fan system operation on the low temperature detection thermostat.

(Additional information regarding sensors is available in Appendix Section [4.2.3.5.5.3](#) of this manual.)

3.4.5.1.4 Transmitters

Although the data sheet provided by the manufacturer of the pressure transmitter indicates this device does not require routine maintenance, personnel should adhere to the following caution note.

CAUTION:

If the P100B/P200G is to be subjected to fluid hammer, pressure surges, or pulsations, a Model 47 Snubber is recommended.

(Additional information regarding transmitters is available in Appendix Section [4.2.3.5.5.4](#) of this manual.)

3.4.5.2 Process Instrumentation and Control Systems

The BacTalk Integrator and Global Controllers do not require maintenance.

(Additional information regarding instrumentation and control systems is available in Appendix Section [4.2.3.5.6](#) of this manual.)

3.5 ELECTRICAL SYSTEMS

3.5.1 Interior Distribution System

3.5.1.1 Panelboards

Panelboards (Equip. # PP00647 through PP00652) are used to control general electrical lighting and power distribution. The following table lists Panelboards by electrical designation and location:

WASTE WATER TREATMENT PLANT PANELBOARDS	
ELECTRICAL DESIGNATION	PANEL LOCATION
DP-1	Electrical Room RM104
DP-2	Electrical Room RM104
LPA	Electrical Room RM104
LPB	Electrical Room RM104
IPA	Electrical Room RM104
MPA	Electrical Room RM104

WARNING:

Hazardous voltages in electrical equipment can cause severe personal injury or death. Energizing a panelboard for the first time after initial installation or maintenance is potentially dangerous.

Hazardous voltages in electrical equipment can cause severe personal injury or death. Unless otherwise specified, inspection and maintenance should only be performed on panelboards to which power has been turned-off, disconnected and electrically isolated so that no accidental contact can be made with energized parts. Follow all manufacturer's warnings and instructions.

Annual preventive maintenance on panelboards includes the following:

- A panelboard which has been carrying its regular load for at least 3 hours just prior to inspection should be field tested by feeling the dead front surfaces of circuit breakers, switches, interior trims, doors, and enclosure sides with the palm of the hand. If the temperature of these surfaces does not permit you to maintain contact for at least 3 seconds, this may be an indication of trouble and investigation is necessary.

CAUTION:

Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the panelboard manufacturer before using these products to clean, dry, or lubricate panelboard components during installation or maintenance.

- Inspect the panelboard once each year or after any severe short circuit.
- If there is an accumulation of dust and dirt, clean out the panelboard by using a brush, vacuum cleaner, or clean lint-free rags. Avoid blowing dust into circuit breakers or other components. Do not use a blower or compressed air.
- Carefully inspect all visible electrical joints and terminals in the bus and wiring system.
- Visually check all conductors and connections to be certain that they are clean and secure. Loose and/or contaminated connections increase electrical resistance which can cause overheating. Such overheating is indicated by discoloration or flaking of insulation and/or metal parts. Pitting or melting of connecting surfaces is a sign of arcing due to a loose, or otherwise poor connection. Parts which show evidence of overheating or looseness should be cleaned and re-torqued or replaced if damaged. Tighten bolts and nuts at bus joints to manufacturers torque specifications.

CAUTION:

Do not remove plating from aluminum parts in joints or terminations. Damage to plating can result in overheating. Replace damaged aluminum parts.

- Examine fuse clip contact pressure and contact means. If there is any sign of overheating or looseness follow the manufacturer's maintenance instructions or replace the fuse clips. Loose fuse clips can result in overheating.
- Re-tighten plug fuses.
- Be sure that all conditions which caused the overheating have been corrected.
- Check circuit breakers, switches, and fuses to ensure they have the proper ampere, voltage and interrupting ratings. Ensure that noncurrent-limiting devices are not used as replacements for current-limiting devices. Never attempt to defeat rejection mechanisms which are provided to prevent the installation of the incorrect class of fuse.
- Operate each switch or circuit breaker several times to ensure that all mechanisms are free and in proper working order. Replace as required. See NEMA AB-4 for maintenance of molded case circuit breakers.
- Check the operation of all mechanical components. Replace as required.
- Exercise switch operating mechanisms and external operators for circuit breakers to determine that they operate freely to their full on and off positions.
- Check the integrity of all electrical and mechanical interlocks and padlocking mechanisms.
- Whenever practical, check all devices for missing or broken parts, proper spring tension, free movement, corrosion, dirt, and excessive wear.
- Adjust, clean, and lubricate or replace parts according to the manufacturers instructions. Use clean nonmetallic light grease or oil as instructed. Do not oil or grease parts of molded case circuit breakers.
- If no instructions are given on the devices, sliding copper contacts, operating mechanisms, and interlocks may be lubricated with clean, light grease.
- Wipe off excess lubrication to avoid contamination.

CAUTION:

Hydrocarbon spray propellants and hydrocarbon based sprays or compounds will cause degradation of certain plastics. Contact the panelboard manufacturer before using these products to clean, dry, or lubricate panelboard components during installation or maintenance.

- Clean and dress readily accessible copper electrical contacts, blades, and jaws according to the manufacturer's instructions when inspection indicates the need.
- Look for and replace deteriorated insulating material and assemblies where sealing compounds have melted.
- Look for any moisture or signs of previous wetness or dripping inside the cabinet. Condensation in conduits or dripping from outside sources is one known cause of panelboard malfunction.
- Seal off any conduits which have dripped condensate, and provide means for further condensate to drain away from the panelboard.
- Seal off any cracks or openings which have allowed moisture to enter the enclosure. Eliminate the source of any dripping on the enclosure and any other source of moisture.
- Replace or thoroughly dry and clean any insulating material which is damp or wet or shows an accumulation of deposited material from previous wettings.
- Inspect all component devices. Replace any component device which shows evidence of moisture damage or has been subjected to water damage or flooding. Additional information may be found in the NEMA document "Guidelines for Handling Water Damaged Electrical Products.
- In the event of water damage, e.g., flooding or sprinkler discharge, the manufacturer should be consulted before clean up and corrective action is attempted.
- If a severe electrical short circuit has occurred, the excessive currents may have resulted in structural component and/or bus and conductor damage due to mechanical distortion, thermal damage, metal deposits, or smoke. Examine all devices and bus supports for cracks or breakage. The manufacturer should be consulted before clean up and correction is attempted.
- Test the ground fault protection system (if furnished) in accordance with the manufacturer's instructions. See Section 230-95 of the *National Electrical Code* and *NEMA Standards Publication PB 2.2, Application Guide for Ground Fault Protective Devices for Equipment*.

- Check insulation resistance under any of the following conditions:
 - If a severe short circuit has occurred;
 - If it has been necessary to replace parts or clean insulating surfaces;
 - If the panelboard has been exposed to high humidity, condensation, or dripping moisture.

Perform annual panelboard maintenance in accordance with PM #6216FA.

(For additional information about the panelboards, see Appendix section [4.2.4.1.1.](#))

3.5.1.2 Motor Control Centers

Motor Control Centers (MCC) are the primary location of motor starters for equipment in the Waste Water Treatment Plant.

NOTE:

All personnel involved in handling, installation, testing, operation, and maintenance should be thoroughly familiar with the information in the manufacturer's manual and the reference documents listed in the manual before working on this equipment. Personnel must have a thorough understanding of electrical equipment in general, the specific operation of this particular equipment, and the degree of severity of potential injury.

Perform the prescribed annual maintenance in accordance with PM #6216FA. Before performing any maintenance on the MCC, the following general warnings, cautions and dangers should be reviewed and adhered to.

DANGER:

Hazard Of Electric Shock, Burn, Or Explosion

This equipment must be installed and serviced only by qualified electrical personnel.

Turn off all power supplying this equipment before working on or inside.

Always use a properly rated voltage sensing device to confirm that power is off.

Replace all devices, doors, and covers before turning on the power to this equipment.

Do not install this equipment on a circuit capable of delivering more than 65,000 Amps. of short circuit current at 480 VAC, or 208 VAC.

Failure to follow these instructions will result in death or serious injury.

Examine the interior and exterior of the MCC for moisture, oil, or other foreign material. Eliminate all foreign material and clean the interior and exterior of the MCC with a vacuum cleaner.

NOTE:

Do not use compressed air to clean the MCC; it will redistribute contaminants to other surfaces.

CAUTION:

Hazard Of Equipment Damage

Never brush or use sandpaper on the bus; doing so will remove plating and cause oxidation.

Use a cleaning fluid approved for such use. Do not use cleaning fluid on insulators.

Do not attempt to clean bus bars or connectors that are damaged in any way. Replace them with new parts.

Failure to follow these instructions will result in death or serious injury.

Accomplish the prescribed maintenance of bus bars, incoming line compartments, and control unit.

WARNING:

Hazard Of Electric Shock, Burn, Or Explosion

Do not attempt to remove the control unit from the structure with the disconnect in the *on* position.

The control unit is interlocked with the MCC structure to prevent the unit from being withdrawn while the disconnect is in the *on* position. Do not attempt to override the mechanism-to-structure interlock.

Failure to follow these instructions will result in death or serious injury.

After removing control unit, perform prescribed maintenance on the following components:

- Stab Assemblies

CAUTION:

Hazard of Equipment Damage

Do not remove the protective lubricant from the stabs. If additional lubricant is required, order Square D electrical joint compound #PJC-7201.

Failure to follow these instructions will result in death or serious injury.

- Circuit Breaker or Disconnect Switch

DANGER:

Hazard Of Electric Shock, Burn, Or Explosion

Never operate the switch with the door open.

Turn OFF all power supplying the switch before doing any work on or inside the switch.

Failure to follow these instructions will result in death or serious injury.

- Operator Mechanism
- Fuses

DANGER:

Hazard Of Electric Shock, Burn, Or Explosion

Turn OFF the switch before removing or installing fuses or making load side connections.

Always use a properly-rated voltage sensing device at all line and load side fuse clips to confirm that the switch is OFF.

Use only Class J or Class L fuses to provide correct short circuit protection.

Failure to follow these instructions will result in death or serious injury.

- Starter Contacts
- Control Devices
- Overload Relay
- Wiring and Electrical Connections
- Starter Interlocks
- Barriers/Insulators
- Special Units.

Before the MCC is re-energized, perform resistance checks.

CAUTION:

HAZARD OF EQUIPMENT DAMAGE

Do not use megohmmeter on solid state devices, capacitor units, or any devices that are not designed to withstand megohmmeter voltage.

Disconnect all solid state devices before performing megohmmeter tests on the MCC.

Failure to follow these instructions will result in death or serious injury.

Although the manufacturer of the overload relay device has not listed an maintenance, the device should be checked periodically to make sure all the front panel controls and indicator are operational and not damaged. The unit should also be checked for excessive heat.

DANGER:

HAZARDOUS VOLTAGE

Turn off all power supplying this equipment before working on it.

HAZARDOUS VOLTAGE

The ground fault current threshold (GF) functions as a Class II ground fault detector.

- GF indicates motor degradation for maintenance purposes only.
- GF does not provide ground fault protection for personnel.

Electric shock will result in death or serious injury.

WARNING:

UNEXPECTED OUTPUT ACTUATION

Use hard-wired safety interlocks where personnel and/or equipment hazards exist.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

CAUTION:

LOSS OF MOTOR PROTECTION

Removing power from the overload relay resets the thermal memory, resulting in a longer trip time.

Do not remove power to reset a trip condition.

Failure to follow these instructions can result in motor overheating and equipment damage.

(For additional information about the motor control center, see Appendix Section [4.2.4.1.2.](#))

3.5.1.3 Enclosed Disconnect Switches

Disconnect switches provide a means of isolating the electrical power supply from the load to support de-energizing during maintenance activities.

WARNING:

Hazard Of Electrical Shock Or Burn

Hazardous voltages in electrical equipment can cause severe personal injury or death. Before installing, inspecting, performing preventive maintenance, or replacing parts, turn off all power to the switches. Ensure the switches are electrically isolated so no accidental contact can be made with energized parts. Only qualified persons familiar with the construction and operation of the switches should perform work on the switches. Read manufacturer's instruction bulletin(s) completely before working on switches.

Failure to follow this warning can cause serious personal injury, death or major property damage.

With normal use, the switch should require minimal maintenance. Inspect the blade after approximately every 100 operations. If approximately $\frac{1}{3}$ of the blade arcing tip is burned away, replace the blade and arc chute assembly.

Using Shell Alvania #2 grease, lubricate the switch between the blade and the hinge and between the blade and arc chute.

NOTE:

If grease accumulates on the inside of the arc chute, the switch may fail to interrupt properly. *Never put grease directly in the arc chute assembly.*

WARNING:

Hazard Of Electric Shock, Burn, Or Explosion

Never operate the switch with the door open.

Turn off the switch before removing or installing fuses or making load-side connections.

Always use a properly rated voltage sensing device at all line and load-side fuse clips to confirm the switch is off.

Turn off the power supplying the switch before doing any other work on or inside the switch.

Failure to follow this warning can cause serious personal injury, death or major property damage.

Verify on/off operation of the disconnect. Check terminations for secureness and for signs of overheating. Clean cabinet.

(For additional information about disconnect switches, see Appendix section [4.2.4.1.3.](#))

3.5.1.4 Enclosed Motor Controllers and Contactors

Motor controllers and contactors are typically used to provide overload protection and manual and/or automatic control on motor driven equipment.

WARNING:

Hazard Of Electrical Shock Or Burn

Hazardous voltages in electrical equipment can cause severe personal injury or death. Before installing, inspecting, performing preventive maintenance, or replacing parts, turn off all power to the switches. Ensure the switches are electrically isolated so no accidental contact can be made with energized parts. Only qualified persons familiar with the construction and operation of the switches should perform work on the switches. Read manufacturer's instruction bulletin(s) completely before working on switches.

Read and understand maintenance procedures before maintaining or servicing the controller. Only qualified personnel should install, adjust, service, and maintain the controllers.

Many parts in this controller, including printed circuit boards, operate at line voltage. DO NOT TOUCH. Use personal protective equipment and follow precautions and measurement procedures referenced in the User's Manual when making any measurements on energized equipment. Use instruments and insulated tools approved for the job.

Failure to follow this warning can cause serious personal injury, death or major property damage.

WARNING:

Hazardous Voltage

Observe and follow all applicable lock-out and tag-out procedures for specific installation.

Confirm that the controller has been correctly selected, installed, and applied before performing any service or maintenance.

Verify that all controller overcurrent protective devices, conductors, enclosures and other circuit elements have been correctly selected for application and that controller is properly grounded in accordance with equipment instruction bulletin recommendations and applicable code requirements.

Install all covers before applying power or starting and stopping controller.

Failure to follow this warning can cause serious personal injury, death or major property damage.

Check equipment for proper operation. Inspect wiring connections for secureness and for signs of overheating. Verify proper overload sizing in accordance with motor nameplate specifications. Clean cabinet spaces. Check contacts for signs of excessive wear.

NOTE:

Contacts are not harmed by discoloration and slight pitting. DO NOT FILE THEM as dressing wastes contact material. Replacement is necessary only when contact has worn thin.

(For additional information on enclosed motor controllers and contactors, see Appendix section [4.2.4.1.4](#).)

3.5.1.5 Variable Frequency Drives

Variable Frequency Drives (VFD) are typically utilized to provide overload protection, starting, stopping, and speed control on electric motors. Operating parameters are monitored and maintained by the VFD.

WARNING:

Hazardous Voltage

Read and understand User's Manual in its entirety before installing or operating the drive controllers. Installation, adjustment, repair and maintenance of these drive controllers must be performed by qualified personnel.

Disconnect all power before servicing drive controller. WAIT ONE MINUTE until DC bus capacitors discharge, then measure DC bus capacitor voltage between PA and (-) terminals to verify DC voltage is less than 45 volts. The DC bus LED is not an accurate indication of the absence of DC bus voltage.

DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.

Many parts of this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Install all covers and close door before applying power or starting and stopping the drive controller.

User is responsible for conforming to all applicable code requirements with respect to grounding all equipment.

Disconnect all power.

Place a "DO NOT TURN ON" label on drive controller disconnect.

Lock disconnect in open position.

Failure to follow this warning can cause serious personal injury, death or major property damage.

The following preventive maintenance procedures are recommended at regular intervals:

- Check the condition and tightness of the connections.
- Make sure the ventilation is effective and temperature around the drive controller remains at an acceptable level.
- Remove dust and debris from the drive controller.

(For additional information on variable frequency drives, see Appendix Section [4.2.4.1.5.](#))

3.5.1.6 Transformers (Interior / Exterior)

The Wastewater Treatment Plant uses two transformers for power into the plant. Main power comes from the secondary windings of a 300 KVA, pad mounted, transformer (Equip.#PD00646) The transformer is a 3 phrase, 60 Hertz, Class GA-H, 150° C rise, with a rated primary volts of 4160 delta (30 KV BIL) and secondary volts of 480y/277 (10 BV BIL). The second transformer, T-3 (Equip. #PD00651), is a 30 KVA, 480 - 120/208 Volt, 3 phrase, 4W rated, transformer located in the mechanical panel (MPA).

Like other electrical equipment, these dry-type transformers require periodic inspections and maintenance to assure successful operation. Inspections should be made at regular intervals. The frequency of the inspections and required maintenance will depend on the site and operating conditions. Clean, dry installations should be inspected at least twice annually. Transformers exposed to poor conditions such as air contaminated by dust or chemical fumes, dampness and temperature variances should be inspected more frequently and will require more maintenance.

After completing inspections and maintenance in accordance with PM #0311FS, the manufacturer also recommends the following inspections and maintenance be performed. The purpose of testing is to ensure the condition of the transformer is satisfactory for operation, and to provide test data for future comparison.

All service personnel are reminded to read and adhere to all safety warnings, cautions, and notes contained in this manual and the manufacturer's manual before and during maintenance procedures.

A. Periodic Inspection & Maintenance:

WARNING:

The transformer must be de-energized and the enclosure panels removed to perform an internal inspection.

Do not use liquid cleaners or solvents. These materials can cause deterioration of insulating materials.

Never attempt to check the output voltage at the transformer since dangerous high voltage may be present within the transformer enclosure.

Discharge all static charges held by coils.

Failure to follow this warning can cause serious personal injury, death or major property damage.

CAUTION:

Experience indicates that if a shutdown exceeding 12 hours occurs, and especially if high humidity conditions exist, then the following precautions should be taken:

Small strip heaters may be placed in the bottom of the unit shortly after shutdown to maintain the temperature of the unit a few degrees above that of the outside air.

Constant attendance during the drying process is recommended. It is advisable to have a suitable fire extinguisher convenient for use in the event of an emergency.

Before returning to service, the unit should be inspected for evidence of moisture, and insulation resistance should be checked.

If there is evidence of moisture, or if the insulation resistance is low, the transformer should be dried out by one of the methods described in this Section. It is recommended that the air temperature used for drying the transformer not exceed 110° C (230° F).

Failure to follow this caution can cause personal injury or property damage.

1. Inspect for dirt, especially accumulations on insulating surfaces, or those which tend to restrict air flow. Pay particular attention to the top and bottom ends of winding assemblies and ventilating ducts.
2. Check for loose connections, for the condition of tap changers or terminal boards, and for the general condition of the transformer.
3. Look for signs of overheating and of voltage creepage over insulating surfaces. Signs of voltage creepage include tracing or carbonization on the insulating surface.
4. Clean the windings with a vacuum, blower, or compressed air. Vacuum cleaning is the preferred first step of cleaning, followed by the use of compressed air. The compressed air should be clean and dry, and should be applied at relatively low pressure (not over 25 psi).
5. Lead supports, tap changers, terminal boards, bushings and other major insulating surfaces should be brushed or wiped with a dry cloth.
6. Inspect for damage that reduces electrical clearances.
7. Inspect for signs of internal condensation, corrosion or deterioration of the paint on the enclosure. If condensation is present, the manufacturer recommends one (1) of the following three (3) drying methods be used.

CAUTION:

Before returning to service, the unit should be inspected for evidence of moisture, and insulation resistance should be checked.

If there is evidence of moisture, or if the insulation resistance is low, the transformer should be dried out by one of the methods described in this Section. It is recommended that the air temperature used for drying the transformer not exceed 110° C (230° F).

Constant attendance during the drying process is recommended. It is advisable to have a suitable fire extinguisher convenient for use in the event of an emergency.

Failure to follow this caution can cause personal injury or property damage.

Drying of The Core & Coil Assembly:

The core and coil assembly must be dry before it is placed into service for the first time or after an extended shut down. Humid conditions at the installation site make dry out a necessity especially after an extended shut down. Three dry out methods are presently used:

1. External heating. (Preferred method)
2. Internal heating.
3. External and Internal heating.

In all cases, the free moisture visible on the unit should be blown or wiped off to reduce drying time.

External Heat Drying:

External heating is the preferred method of dry out. The heat can be applied to the transformer using one of the three processes listed below:

- Directing heated air into the bottom air inlets of the transformer enclosure.
- Placing the core and coil assembly into a non-flammable enclosure with openings in the top and bottom through which heated air can be circulated.
- Placing the core and coil assembly in a suitable, ventilated oven.

When directing heated air into the transformer enclosure as required by either of the first two methods, it is important that the air passes through the windings and not around the sides.

Good ventilation will ensure that condensation does not occur in the core and coil assembly or the enclosure. The air flow through the enclosure should result in equal inlet and outlet temperatures.

The heat source can be space heaters or resistance grids placed inside the enclosure, or placed outside the enclosure with the heated air blown into the bottom of the enclosure.

Protect the core and coil assembly from direct radiation from the heaters. The maximum safe air temperature for any of the methods described above is 110°C.

Drying By Internal Heat:

Drying by internal heat is fast and safe. An adequate source of impedance voltage is required.

Heat is generated by shorting one winding and applying sufficient voltage to the other winding to circulate 50 to 100% of normal current. Generally, the voltage required will be the rated voltage times the per unit impedance.

Provision should be made to control the rate of temperature rise and limit the maximum temperature. The winding temperature must not exceed 100°C as measured by resistance or thermometers placed in the duct between the windings. Thermometers used for this purpose should be the spirit type, not the mercury type as eddy currents can heat the mercury and produce unreliable readings. A broken mercury thermometer can also contaminate the windings and cause a health hazard. The thermometer should be in physical contact with the winding insulation.

Use the line end terminals of the windings, not the tap terminals, to circulate current through the entire winding.

Drying by Internal & External Heat:

This method is a combination of the two methods previously described. It is also the quickest method of drying.

Heat is applied as described in External Heat Drying.

The applied current is less than that required when external heat is not used. It will vary with the unit size and site conditions and will be determined by temperature observation.

The winding temperature must not exceed 100°C.

B. Pre-Operational Testing:

Dry-type transformers should be tested before the unit is placed in service. The purpose of testing is to ensure the condition of the transformer is satisfactory for operation, and to provide test data for future comparison.

The following is a list of recommended pre-service tests;

1. Insulation resistance test.
2. Ratio test.

The following additional tests may be conducted if desired;

1. Polarity and phase relation.
2. Insulation power factor test.
3. Applied voltage test at 75% of factory test values. (Consult factory before testing)
4. Resistance measurements of windings.

The insulation resistance test provides data for future comparison and determines the suitability of the transformer for the application of the high potential test. Insulation resistance tests are made before applying the high potential test, by means of a 1000 volt megger.

Variable factors affecting the construction and use of dry-type transformers make it difficult to set limits for the insulation resistance.

Experience has indicated that 20 megohms per 1000 volts of nameplate voltage rating, is a satisfactory value of insulation resistance for the application of the high potential test and for operation of the transformer. The test reading is done over one minute at 25°C. The minimum acceptable value for both insulation resistance and core to ground resistance is 20 megohms.

Low insulation resistance readings should be investigated. Possible causes may be the presence of dust or dirt, moisture, leakage through insulation and creep on exposed conductors.

Transformers known to be wet or that have been subjected to unusually damp conditions must be dried out before the application of the high potential test or before placing in service regardless of the insulation resistance.

(For more information on transformers used at the Wastewater Treatment Plant, see Appendix [4.2.4.1.6.](#))

3.5.2 Lighting

3.5.2.1 Site Lighting

The site lighting typically consists of incandescent fixtures mounted on the outside of the plant to provide lighting for the exterior deck areas and stairways. Many of the exterior site lighting fixtures are enclosed with a glass globe or lens. Some of these fixtures incorporate gasket-type seals.

Periodically check the fixtures for moisture infiltration and inspect the globes, lenses, and seals for damage or deterioration.

Operational testing of the lights should be performed during the annual building inspection (PM #3405FM).

(For additional information on site lighting, see Appendix section [4.2.4.2.1.](#))

3.5.2.2 Interior Luminaries

Interior luminaries typically consist of fluorescent units for general area lighting with a mixture of incandescent and compact fluorescent fixtures used for mood and special purpose lighting. Operational testing of the lights should be performed during the annual building inspection (PM #3405FM).

(For additional information regarding interior luminaries, see Appendix Section [4.2.4.2.2](#) of this manual.)

3.5.2.3 Emergency Lighting Units

Emergency lighting units (Equip. #LI01127 through LI01157, and #LI01186) include a combination of fluorescent fixtures containing emergency back-up power supplies (back-up ballasts). The incandescent fixtures are typically used in unheated areas where extreme cold makes fluorescent lighting impractical.

The back-up ballasts typically incorporate a **PRESS-TO-TEST** push button, which transfers the ballast from building power to the ballast's back-up power supply.

In accordance with NFPA 101, *Life Safety Code*, conduct periodic testing of the emergency lighting units.

Annual Inspection:

Inspect battery for visible signs of corrosion or physical damage and clean.

Check all connections.

Conduct a functional test for a 1-1/2 hour duration. In accordance with NFPA 101, all emergency lighting units must remain illuminated for the entire duration.

Operational testing of the emergency lighting units should be performed during the annual building inspection (PM #3405FM).

(For additional information regarding emergency lighting units, see Appendix Section 4.2.4.2.3 of this manual.)

3.5.2.4 Exit Lighting/Signs

The exit lighting (Equip. #LI01158 through LI01185) consists of fluorescent, dual-voltage lighting fixtures with maintenance-free, nickel-cadmium batteries that provide 90 minutes of back-up operation.

The signs should be checked periodically for damage, and the exterior wiped clean with a dry cloth.

Inspect casing for damage.

Test function of the back-up battery.

Inspect interior of the unit to insure connections are tight, clean, and free of corrosion. Wipe the outside of the unit with a dry cloth.

(Inspect the exit lighting units monthly in accordance with PM #3405FM.)

No other maintenance of the signs is necessary.

(For additional information regarding exit lighting and signs, see Appendix Section 4.2.4.2.4 of this manual.)

3.5.3 Heat Trace

3.5.3.1 Vent-Thru-Roof / Water Piping

The electric heat trace system maintains the temperature in protected piping above the building slab to prevent freezing of the liquids inside the piping and/or to prevent ice build-up on the exterior surface of the piping. Heat tracing is also used on exhaust/intake vents to prevent condensation build up and freezing.

WARNING:

Damage to cables or components can cause sustained electrical arcing or fire. Do not attempt to repair damaged heating cable. Do not energize cables that have been damaged by fire. Replace damaged cable at once by removing the entire damaged section and splicing in a new length using appropriate splice kits.

Failure to follow this warning can cause serious personal injury, death or major property damage.

WARNING:

Damaged heating cable can cause electrical arcing or fire. Do not use metal attachments such as pipe straps or tie wire. Use only manufacturer approved tapes and cable ties to secure the cable to the pipe.

Do not reuse grommets. Use new grommets whenever the heating cable has been pulled out of the terminations. Reuse of the grommet, or use of the wrong grommet, can cause leaks, cracked components, shock, or fire. Be sure the type of grommet is correct for the heating cable being installed. Use a new grommet whenever the cable has been pulled out of the termination.

The manufacturer and the 1996 National Electrical Code Sections 426 and 427 require ground-fault equipment protection on each heating cable branch circuit. To reduce the risk of fire caused by damage or improper installation, circuit breakers with a 30-mA trip level should be used. please substitute these breakers whenever reference is made to conventional breakers in the vendor's documentation. Alternate designs providing comparable levels of ground-fault protection may also be acceptable.

Failure to follow this warning can cause serious personal injury, death or major property damage.

NOTE:

Avoid abusing, cutting, twisting, or tugging the heating cables during maintenance. The cable is intended to be reinstalled after the equipment is serviced. Therefore, be careful when removing the cable from pipe and equipment.

After maintenance work is done and the cable is reinstalled, be sure to test the circuit with a megohmmeter before reenergizing.

Periodically inspect the pipe, insulation, and connections of the heating cable to make sure that no damage has occurred.

After turning off all branch circuits, test the system with a meg. ohmmeter to determine whether damage has occurred that may not be readily visible.

With the system operating normally, measure the voltage, amperage, ambient temperature, and pipe temperature for each circuit and record the values in the Inspection Record for future maintenance and troubleshooting reference.

NOTE:

On ambient-sensing controlled systems, allow a minimum of five minutes operation before taking electrical and temperature measurements.

On line-sensing controlled systems, allow sufficient time for the system to reach the set point before taking electrical and temperature measurements. This may take as long as 4 hours for most circuits. Large, liquid-filled pipes may take longer.

(For additional information regarding heat tracing on vents and piping, see Appendix Section [4.2.4.3.1](#) of this manual.)

3.5.3.2 Below Slab

The electric heat trace system maintains the temperature in protected piping below the building slab to prevent freezing of the liquids inside the piping and/or to prevent ice build-up on the exterior surface of the piping. Heat tracing is also used on drains and drain piping to prevent condensation build up and freezing.

Typically water lines are double heat traced and drains are single heat traced.

WARNING:

Damage to cables or components can cause sustained electrical arcing or fire. Do not attempt to repair damaged heating cable. Do not energize cables that have been damaged by fire. Replace damaged cable at once by removing the entire damaged section and splicing in a new length using appropriate splice kits.

Do not reuse grommets. Use new grommets whenever the heating cable has been pulled out of the terminations. Reuse of the grommet, or use of the wrong grommet, can cause leaks, cracked components, shock, or fire. Be sure the type of grommet is correct for the heating cable being installed. Use a new grommet whenever the cable has been pulled out of the termination.

Damaged heating cable can cause electrical arcing or fire. Do not use metal attachments such as pipe straps or tie wire. Use only manufacturer approved tapes and cable ties to secure the cable to the pipe.

Failure to follow this warning can cause serious personal injury, death or major property damage.

WARNING:

The manufacturer and the 1996 National Electrical Code Sections 426 and 427 require ground-fault equipment protection on each heating cable branch circuit. To reduce the risk of fire caused by damage or improper installation, circuit breakers with a 30-mA trip level should be used. please substitute these breakers whenever reference is made to conventional breakers in the vendor's documentation. Alternate designs providing comparable levels of ground-fault protection may also be acceptable.

Failure to follow this warning can cause serious personal injury, death or major property damage.

NOTE:

Avoid abusing, cutting, twisting, or tugging the heating cables during maintenance. The cable is intended to be reinstalled after the equipment is serviced. Therefore, be careful when removing the cable from pipe and equipment.

After maintenance work is done and the cable is reinstalled, be sure to test the circuit with a megohmmeter before reenergizing.

Periodically inspect the pipe, insulation, and connections of the heating cable to make sure that no damage has occurred.

After turning off all branch circuits, test the system with a megohmmeter to determine whether damage has occurred that may not be readily visible.

With the system operating normally, measure the voltage, amperage, ambient temperature, and pipe temperature for each circuit and record the values in the Inspection Record for future maintenance and troubleshooting reference.

NOTE:

On ambient-sensing controlled systems, allow a minimum of five minutes operation before taking electrical and temperature measurements.

On line-sensing controlled systems, allow sufficient time for the system to reach the set point before taking electrical and temperature measurements. This may take as long as 4 hours for most circuits. Large, liquid-filled pipes may take longer.

(For additional information regarding heat tracing below the slab, see Appendix Section 4.2.4.3.2 of this manual.)

3.5.4 Signal Systems

3.5.4.1 Telephone

Maintenance of the telephone system, wiring, and configuration is provided by the Information Technology (IT) Technical Operations Group. The IT Group maintains a user support Help Desk on station. All maintenance issues involving the telephone system, wiring, and configuration should be referred to the Help Desk. No user maintenance of telephone system equipment is required.

3.5.4.2 Public Address System

Since the Wastewater Treatment Plant does not have a public address system, no maintenance can be performed.

3.5.4.3 Local Area Network (LAN)

Maintenance of the LAN, wiring, and configuration is provided by the Information Technology (IT) Technical Operations Group. The IT Group maintains a user support Help Desk on station. All maintenance issues involving the LAN, wiring, and configuration should be referred to the Help Desk. No user maintenance of LAN equipment is required.

3.5.4.4 Fire Detection and Alarm Systems

In compliance with *National Fire Protection Agency Publication 72H*, Chapter 3, *Periodic Equipment and Circuit Testing Procedures*, perform periodic tests of the fire alarm system in accordance with the schedules in *NFPA 72H*, Chapter 4, *Recommended Schedules and Methods for Testing Procedures*.

Periodic inspection, testing, and maintenance of the fire detection and alarm system are performed monthly in accordance with PM #0132FM, semi-annually in accordance with PM #0132FS, and annually in accordance with PM #0132FA.

3.5.4.4.1 Fire Detection and Alarm Control Panel

The fire detection and alarm control panel (FACP), Equip. # AP00211, is a microprocessor-based, advanced-protection system capable of stand-alone operation. The FACP monitors both temperature sensors and smoke detection devices located throughout the plant. All modules and devices annunciated on the control panel are identified by an address. The system enables a qualified technician to test the operation of input points with or without disabling the entire fire alarm system. Testing can be silent or with audible feedback.

Maintenance and repair of the FACP is extremely simple. Because the entire system is of modular construction, service is easily accomplished by using board level swap-out techniques. This procedure allows even the most inexperienced maintenance personnel to return the system, including the power supply, to full service within minutes.

CAUTION:

Do not touch electrical connections before you first ensure that power has been disconnected using an approved lockout/tagout and/or proper personal protective equipment (PPE) is utilized. Electrical shock can cause serious or fatal injury.

Only qualified personnel should attempt the operation and maintenance of this equipment.

Chassis must be connected to earth ground. Hot and neutral polarity MUST be observed when connecting AC Power.

All test and service areas should be equipped with 120 VAC to 120 VAC isolated transformers and ground fault detecting circuit breakers, if possible.

DO NOT remove or install any circuit boards or field wiring while the panel is under power.

NOTE:

Before beginning tests, all parties, which may receive an alarm signal, should be notified so that there will not be an unnecessary response. At the conclusion of testing, all parties should again be notified. All equipment should be returned to normal condition and control panels locked.

The fire detection and alarm system has separate requirements and forms for inspections and for testing. For the purposes of this section:

An INSPECTION is a visual examination of the fire detection and alarm system to verify that it appears to be in good operating condition and free of physical damage. The visual inspection is generally done from floor level by walking through the protected premises.

A TEST is an actual operation of the equipment to verify that it functions as intended.

Routine Testing:

The KFRTI-20/52 Panels should be tested on a regular basis. It is recommended that each panel be tested every 3 to 6 months or whenever user maintenance programs require. The following should be checked:

- TRIP each zone by activating alarm initiating devices. Confirm their transmission at the base receiving station.
- OPERATE each switch. Trip a zone into alarm. Acknowledge the alarm (steady the LEDs) by momentarily placing the “ACK” switch in the up position. Silence the alarm audibles. Reset the alarm circuits and devices.
- PRESS the test switch and check for two rounds of test at the console receiver.
- DISCONNECT the batteries and check the voltage of each (approximately 13 to 14 vdc.).
- REMOVE AC power and check the operation of panel on battery backup for a few minutes.

RETURN ALL SWITCHES AND DEVICES TO NORMAL BEFORE LEAVING THE PANEL.

Perform inspections of the fire alarm control panel monthly, and semi-annually, in accordance with PM #0132FM, and PM #0132FS, respectively.

Document inspection results on Forms 1-A (Monthly) and 1-B (Semi-annual).

Perform tests of the fire alarm control panel monthly, semi-annually, and annually in accordance with PM #0132FM, PM #0132FS, and PM #0132FA, respectively.

Document test results on Forms 1-C (Monthly); 1-E and 1-F (Semi-annual); and 1-G (Annual).

(For sample forms, see end of Appendix Section [4.2.4.4.4.1](#) of this manual.)

(For more information, see the Control Panel *Operation, Installation and Maintenance Manuals* in Appendix [4.2.4.4.4.1](#).)

3.5.4.4.2 Initiating Devices

All alarm initiating appliances (e.g. manual stations, smoke detectors, heat detectors, gas detectors, air duct detectors) are connected to and controlled by the Fire Alarm Control Panel.

NOTE:

Before beginning tests, all parties which may receive an alarm signal should be notified so that there will not be an unnecessary response. At the conclusion of testing, all parties should again be notified. All equipment should be returned to normal condition and control panels locked.

Perform inspections of the fire alarm initiating appliances monthly in accordance with PM #0132FM. Document results on Form 1-A.

Perform tests of the fire alarm initiating appliances monthly, semi-annually, and annually in accordance with PM #0132FM, PM #0132FS, and PM #0132FA, respectively. Results shall be documented on Forms 1-C (Monthly); 1-E and 1-F (Semi-annual); and 1-G (Annual).

(For sample forms, see end of Appendix Section [4.2.4.4.4.2](#) of this manual.)

In addition to the monthly, semi-annual, and yearly inspections above, the manufacturers of several initiating devices recommend completing the maintenance procedures listed in their manuals. These manuals can be found in Appendix Section [4.2.4.4.4.2](#) of this manual.

Hydrocarbon Gas Detector

The hydrocarbon gas detector should be inspected periodically to ensure that its performance is not impaired by fouled optics or by clogging of the filter or hydrophobic screen. Appendix Section [4.2.4.4.4.2](#) of this manual contains detailed maintenance instructions from the manufacturer.

CAUTION:

The hydrocarbon gas detector contains semiconductor devices that are susceptible to damage by electrostatic discharge. An electrostatic charge can build up on the skin and discharge when an object is touched. Therefore, use caution when handling the device, taking care not to touch electronic components or terminals. If the electronics assembly is removed, it should be placed in an anti-static bag or box while stored or transported. A static safeguarded work area is highly recommended (if available) for disassembly and cleaning.

IMPORTANT:

Remove power before disconnecting and removing The hydrocarbon gas detector for maintenance.

The hydrocarbon gas detector contains semiconductor devices that are susceptible to damage by electrostatic discharge. An electrostatic charge can build up on the skin and discharge when an object is touched. Therefore, use caution when handling the device, taking care not to touch electronic components or terminals. If the electronics assembly is removed, it should be placed in an anti-static bag or box while stored or transported. A static safeguarded work area is highly recommended for disassembly and cleaning of the hydrocarbon gas detector.

The hydrophobic screen should be replaced whenever the mirror assembly and reflector tubes are cleaned or replaced, or when the screen appears fouled upon visual inspection.

If the optics system is disassembled, calibration is required after re-assembly.

Do not insert any sharp objects into the mirror assembly. Scratching of the mirrors will void the warranty. Do not use cotton tipped swabs or buds as they are likely to leave fiber residue.

NOTE:

In applications where both the hydrocarbon gas detector and catalytic type sensors are used, ensure that the silicone grease used to lubricate the hydrocarbon gas detector's threads does not come into contact with the catalytic sensors or poisoning of the catalytic sensors will result.

Hydrocarbon-based grease will emit hydrocarbon vapors, which will be measured by the hydrocarbon gas detector and will cause inaccurate gas level readings. Use only silicone grease when lubricating threads on the hydrocarbon gas detector and associated junction box.

Maintenance personnel should wash their hands before handling the catalytic sensors.

It is recommended to keep spare IR modules for field replacement in the event of a malfunction.

Check the new hydrophobic screen to ensure that the overall length matches the length of the existing screen, or the reflector tubes if no screen was present. If the new screen appears longer than the existing screen, trim off 0.23 inch (slightly less than 1/4 inch) of material from the new screen using a scissors. Take care to not trim the screen too short, as this will allow contaminants direct access to the PointWatch optics and cause nuisance optics faults.

The IR Module fits correctly only in one orientation. If it is not seating into place, rotate it 180° and try again.

Combustible Gas Controller

The gas controller is not designed to be repaired in the field. If a problem should develop, first carefully check for proper wiring, programming and calibration. If it is determined that the problem is caused by a defect in the controller's electronics, the device must be returned to the factory for repair.

The gas controller requires virtually no routine maintenance, except for periodic checks to assure proper system function and calibration. The frequency of these checks is determined by the requirements of the particular installation.

Fault detection circuitry continuously monitors for a sensor problem, excessive negative zero drift, wiring problems, and various other problems that could prevent proper response to a dangerous level of gas. It does not monitor external response equipment or the wiring to these devices. It is important that these devices be checked initially when the system is installed, as well as periodically during the ongoing maintenance program.

The periodic checks must be made while the controller is in the "Normal" operating mode to ensure that those items not checked by the controller diagnostic are functioning properly.

CAUTION:

Be sure to secure all output devices that are actuated by the system to prevent unwanted activation of this equipment, and remember to place these same output devices back into service when the checkout is complete.

NOTE:

It is recommended that power be removed prior to performing maintenance, repair, or replacement.

(Additional maintenance information for the gas controller can be found in Appendix Section [4.2.4.4.4.2](#) in this manual.)

Air Duct Detectors

Maintenance of the detector is easily accomplished by the removal of the Series 11 duct housing sampling chamber cover. The detector then can be removed and cleaned.

(For more information on all initiating devices, see Appendix Section [4.2.4.4.4.2](#) in this manual.)

3.5.4.4.3 Signaling Appliances

All alarm signaling/notification appliances (strobe lights, horn/strobe alarms, and speaker/strobe alarms) are connected to and controlled by the Fire Alarm Control Panel.

NOTE:

Before beginning tests, all parties which may receive an alarm signal should be notified so that there will not be an unnecessary response. At the conclusion of testing, all parties should again be notified. All equipment should be returned to normal condition and control panels locked.

Perform inspections of the fire alarm signaling/notification appliances monthly and semi-annually in accordance with PM #0132FM and PM #0132FS, respectively. Document results on Forms 1-A (Monthly) and 1-B (Semi-annual).

Perform testing of the fire alarm signaling/notification appliances monthly, semi-annually, and annually in accordance with PM #0132FM, PM #0132FS, and PM #0132FA, respectively. Document results on Forms 1-C (Monthly); 1-E and 1-F (Semi-annual); and 1-G (Annual).

Maintenance of air duct detectors is easily accomplished by removal of the sampling chamber cover. The detector, which plugs into the housing, is easily removed for cleaning.

(For sample forms, see end of Appendix Section [4.2.4.4.4.3](#) of this manual.)

(For more information on signaling appliances, see Appendix Section [4.2.4.4.4.3](#) in this manual.)

3.5.4.4.4 Miscellaneous Electrical Devices

Perform annual and semi-annual PMs 0501FA and 0501FS on the auto-dialer. The manufacturer has not listed any maintenance to be performed.

No maintenance is required for the other devices in this section.

(For more information on the auto-dialer and the other devices included in this section, see Appendix Section [4.2.4.5](#) in this manual.)

3.6 WASTE WATER TREATMENT PROCESS SYSTEMS

3.6.1 Preliminary and Secondary Treatment

As a general rule the preliminary/secondary treatment process is a very humid environment, therefore, all tanks, boxes and basins should be drained, inspected for scale buildup, rust, corrosion, and cleaned as necessary annually. Any painted surfaces should be inspected for rust or corrosion, cleaned and re-painted if necessary.

NOTE:

The tanks, boxes and basins are constructed of 304 stainless steel which will not stand up well to a mixture containing chloride. If a high degree of rust or corrosion is noticeable, verify the solution does not contain chloride.

The valves, pumps, and piping should be inspected on a weekly basis for evidence of leakage, rust or corrosion in accordance with PM #0192FW.

The following sections contain more detailed maintenance instructions.

3.6.1.1 Eccentric Valves

The eccentric valves serve as bypass valves routing raw sewage to the outfall in the event the plant is out of service.

The valves should be inspected on a weekly basis for evidence of leakage, in accordance with PM #0192FW.

WARNING:

This valve is a pressure vessel. Pressure must be completely released before disassembly. The bonnet will blow off if the bonnet bolts are removed with pressure in the valve.

This valve is a pressure vessel. Failure to release pipeline pressure may result in personal injury and/or flow system damage. Completely release pipeline pressure before removing the actuator from the valve or removing the valve from the pipeline.

Moving parts from accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

When an eccentric valve is mounted in a vertical pipeline or mounted in a horizontal pipeline with the plug stem horizontal - gravity can cause the plug to swing to a lower position in the valve body when the actuator is removed. Place the plug in the lowest position before removing the actuator.

Excessive pipeline pressure can propel the loose packing, and can cause personal injury or equipment damage. If possible, relieve the pressure in the pipeline to 0 psi before removing the packing gland.

Caustic, toxic, or hot material in the pipeline can cause personal injury or death if leakage occurs. Confirm that the material is not harmful.

The manufacturer recommends the following maintenance for these valves:

- Lubrication is only required in the event the valve is disassembled.
- Check valves periodically for proper position setting, signs of leakage, corrosion, or damage.

(For additional information regarding eccentric valves, refer to Appendix Section [4.2.5.1.1](#) of this manual.)

3.6.1.2 Macerators

The macerators (Equip. #MA0003 and MA00004) are a solids reduction device that pulverizes influent solids into a particle size that facilitates free flow and easy disposal of sludge. Besides performing project work order PW0232, the manufacturer recommends inspections and maintenance be performed on the macerator itself and the following major components:

- the cutter cartridge,
- the motor controller, and
- the speed reducer and motor.

The manufacturer recommends the following inspections and maintenance criteria for the macerators:

- The macerators should be inspected on a weekly basis for evidence of fluid leakage or fluid accumulation.

The manufacturer recommends the following inspections and maintenance criteria for the cutter cartridge:

- Quarterly inspect the cutter stack for tightness. If required, tighten the cutter stacks through the access opening.

The motor controller is a logic controlled power panel designed to control and protect the macerator. The manufacturer recommends the following inspection criteria for the motor controller:

- Inspect the inside of the controller for moisture every three (3) months, and
- Inspect the inside of the controller for dust every three (3) months.
- The controller be inspected quarterly for moisture and dust accumulation.

The speed reducer and the motor are lubricated with grease or oil, or sometimes both, depending on the unit configuration. The manufacturer recommends the following inspections and maintenance criteria for the speed reducer and gear motor:

NOTE:

DO NOT OVERFILL the unit. Overfilling will likely result in excessive operating temperatures and/or seal leakage.

Too much and too little grease can both raise the operating temperature of the unit. However, a temperature rise of the ring gear housing surface of approximately 100° F (40° C) above ambient is acceptable.

Use a low viscosity oil for winter.

- Units designed as “maintenance free” use a special long-life grease. Even these units must have a complete grease replacement every 20,000 hours of operation (or every 4-5 years) to ensure continued service life.
- The manufacturer recommends the reducer and gear motor be lubricated (non-maintenance free units) and the oil changed every 20,000 hours of use (or every 4-5 years).
- Single reduction units should be overhauled every 20,000 hours of use (or every 4-5 years). Overhaul consists of disassembling the unit, cleaning the internal parts, replacing the seals and gaskets, and then repacking the unit with grease.

NOTE:

Disconnect all power services, stop the motor and let it cool before servicing.

For single phase motors, discharge the start and/or run capacitors before servicing.

Do not by-pass or render inoperative any safety device.

Keep grease clean. Mixing dissimilar grease is not recommended.

Check the motor's name or identification plate for lubrication instructions from the manufacturer. Follow all instructions.

- Motors that do not have re-grease capability are factory lubricated for the normal life of the bearings. Motors that are re-grease capable have a grease fitting or grease hole present. If the motor requires greasing, clean the grease fitting (or area around grease hole, if equipped with slotted grease screws). If the motor has a purge plug, remove it. Motors can be re-greased while stopped (at less than 80° C). Apply grease gun to fitting (or grease hole). Too much grease or injecting grease too quickly can cause premature bearing failure. Slowly apply the recommended amount of grease, taking one (1) minute or so to apply. Operate motor for 20 minutes, reinstall purge plug if previously removed.
- New motors that have been stored for a year or more should be lubricated again.

Appendix Section [4.2.5.1.2](#) of this manual contains detailed information for the inspection, removal, and replacement of the macerator and all of its major components.

Since the following warnings and cautions pertain to any maintenance, or servicing, performed on the macerators and its components including the motor controller, all maintenance personnel should read and adhere to these warnings and cautions before, during, and after any performed maintenance or servicing.

WARNING:

Keep personnel and unauthorized material clear of cutting chamber.

Electrical hazards exist. Verify and assure power to the controller is open, locked out, and tagged before performing any installation, service, or maintenance task.

Electrical shock hazards exist. Compliance to all OSHA and applicable safety requirements and regulations is mandatory to assure safety of personnel.

Physical hazards exist. Assure that adequate assistance is available and utilized when lifting and/or transporting the equipment, tools, and support equipment/materials. Do not lift heavy equipment overhead of personnel.

Controller indicators use long life bulbs. If an indicator bulb failure is suspected, open, lockout, and tag power to the controller before troubleshooting.

Open, lockout, and tag power to the controller before removing or attempting to remove any obstruction(s).

Controller panel controls do not disconnect power within the controller. Service controllers and connected devices only when power to the controller has been opened, locked out, and tagged.

Do not use any start/stop push button as a power disconnect.

The equipment may start, stop, reverse, or restart automatically after power loss and recovery. Do not attempt any maintenance on the equipment during a power loss. Electrical lockout procedures must be performed prior to servicing any equipment or connected equipment.

The manufacturer shall not be held liable for any damages resulting from controller functions that are triggered as a result of incorrect wiring connections, wiring shielding errors, and/or other wiring errors not in compliance with OSHA, federal, state, or local regulations.

Avoid injury. Wear gloves when removing or otherwise handling cutters and spacers.

Verify and assure power to the controller is locked out and tagged.

Personal and mechanical hazards exist during the performance of the grind test.

WARNING:

Avoid serious injury from accidental startup. Always Open, lockout, and tag power to the controller before installing or servicing the macerator or opening the controller cover.

Use care when sling lifting the macerator. Do not lift heavy equipment overhead or personnel. Verify and assure all personnel safety regulations and equipment safe guards are observed and enforced when lifting heavy objects.

Inspection ports are not intended for hand access, keep personnel and unauthorized material clear of the inspection port when the inspection port cover has been removed.

Personal and mechanical hazards exist during the performance of a grind test. keep personnel and unauthorized material clear of the cutting chamber.

CAUTION:

Avoid mixing brands and/or types of lubricants. If the lubricant identified does not meet your requirements, contact the factory.

Failure to follow this caution can cause personal injury or major property damage.

(For additional information regarding the macerators, the controller, the gear reducer, and motor, refer to Appendix Section [4.2.5.1.2](#) of this manual.)

3.6.1.3 Influent Flow System

3.6.1.3.1 Trapezodial Flume

The trapezodial flume is used to measure the Influent and Effluent sewage at the Waste Water Treatment Plant.

No maintenance is required for these devices.

(For additional information regarding flumes, refer to Appendix Section [4.2.5.1.3.1](#) of this manual.)

3.6.1.3.2 Flow Metering

The flow meter is a single or dual point measuring device used to measure the volume of influent and effluent sewage through the flumes.

No maintenance is required for this device.

(For additional information regarding flow metering, refer to Appendix Section [4.2.5.1.3.2](#) of this manual.)

3.6.1.3.3 Ultrasonic Level Metering

Because the transducer uses non-contacting technology it is not subject to material build-up.

The pulsing action makes the face self-cleaning. Therefore, the transducer requires no maintenance.

(For additional information regarding ultrasonic metering, refer to Appendix Section [4.2.5.1.3.3](#) of this manual.)

3.6.1.4 Raw Sewage Bypass and Secondary Treatment Bypass

3.6.1.4.1 Raw Sewage Bypass Valve

The eccentric valves serve as bypass valves routing raw sewage to the outfall in the event the plant is out of service.

The valves should be inspected on a weekly basis for evidence of leakage, in accordance with PM #0192FW.

WARNING:

This valve is a pressure vessel. Pressure must be completely released before disassembly. The bonnet will blow off if the bonnet bolts are removed with pressure in the valve.

This valve is a pressure vessel. Failure to release pipeline pressure may result in personal injury and/or flow system damage. Completely release pipeline pressure before removing the actuator from the valve or removing the valve from the pipeline.

Moving parts from accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

When an eccentric valve is mounted in a vertical pipeline or mounted in a horizontal pipeline with the plug stem horizontal - gravity can cause the plug to swing to a lower position in the valve body when the actuator is removed. Place the plug in the lowest position before removing the actuator.

WARNING:

Excessive pipeline pressure can propel the loose packing, and can cause personal injury or equipment damage. If possible, relieve the pressure in the pipeline to 0 psi before removing the packing gland.

Caustic, toxic, or hot material in the pipeline can cause personal injury or death if leakage occurs. Confirm that the material is not harmful.

The manufacturer recommends the following maintenance for these valves:

- Lubrication is only required in the event the valve is disassembled.
- Check valves periodically for proper position setting, signs of leakage, corrosion, or damage.

(For additional information regarding bypass valves, refer to Appendix Section [4.2.5.1.4.1](#) of this manual.)

3.6.1.4.2 Secondary Treatment Bypass Valve

The eccentric valves serve as bypass valves routing raw sewage to the outfall in the event the plant is out of service.

The valves should be inspected on a weekly basis for evidence of leakage, in accordance with PM #0192FW.

WARNING:

This valve is a pressure vessel. Pressure must be completely released before disassembly. The bonnet will blow off if the bonnet bolts are removed with pressure in the valve.

This valve is a pressure vessel. Failure to release pipeline pressure may result in personal injury and/or flow system damage. Completely release pipeline pressure before removing the actuator from the valve or removing the valve from the pipeline.

Moving parts from accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

When an eccentric valve is mounted in a vertical pipeline or mounted in a horizontal pipeline with the plug stem horizontal, gravity can cause the plug to swing to a lower position in the valve body when the actuator is removed. Place the plug in the lowest position before removing the actuator.

WARNING:

Excessive pipeline pressure can propel the loose packing, and can cause personal injury or equipment damage. If possible, relieve the pressure in the pipeline to 0 psi before removing the packing gland.

Caustic, toxic, or hot material in the pipeline can cause personal injury or death if leakage occurs. Confirm that the material is not harmful.

The manufacturer recommends the following maintenance for these valves:

- Lubrication is only required in the event the valve is disassembled.
- Check valves periodically for proper position setting, signs of leakage, corrosion, or damage.

(For additional information regarding bypass valves, refer to Appendix Section [4.2.5.1.4.2](#) of this manual.)

3.6.1.5 Anoxic Basin Mixing

The anoxic basin, located at the head end of the aeration basin, is used for denitrification and alkalinity recovery.

3.6.1.5.1 Anoxic Basins

No maintenance is required for this device beyond periodic cleaning.

(For additional information regarding the anoxic basin tanks, refer to Appendix Section [4.2.5.1.5.1](#) of this manual.)

3.6.1.5.2 Anoxic Basin Mixers

The anoxic basin mixers (Equip. # MA00005, MA00006, MA00007) are located in the anoxic chambers. Each mixer is of the continuous duty type. The mixers (one for each anoxic chamber) are mounted at a 20° angle near the center of the anoxic chamber. The mixers push the wastewater down into the chamber by rotating a propeller mounted at the end of a 1^{1/4}" shaft.

Besides performing project work order PW0229, periodic inspection, testing, lubrication, and maintenance of the mixer should be performed monthly in accordance the manufacturer's recommendations.

The mixers are provided with properly designed lifting devices and safety covers to avoid potential injury and/or equipment damage. All safety instructions should be THOROUGHLY REVIEWED AND ADHERED TO before operating or performing maintenance.

IMPORTANT:

DO NOT connect the motor to the power source until all components are assembled, the mixer is installed, and all hardware is tightened to the proper torque which is specified in the operation and maintenance manuals supplied by the manufacturer.

DO NOT operate shaft scaling devices at temperatures or pressures higher than those specified in the manual or on the nameplates.

DO NOT service the mixer until you have followed your “*Control of Hazardous Energy Sources*” (lockout, tagout procedure) as required by OSHA 29 CFR Part 19 10.

DO NOT touch rotating mixer parts.

DO NOT operate mixer for service other than its intended use.

DO NOT make any field changes or modifications (horsepower, output speed, shaft lengths, impellers, etc.) without reviewing the changes with the manufacturer.

Failure to lift the mixer as described in these instructions may cause personal injury or property damage.

DO NOT install an aftermarket variable frequency drive without first consulting the manufacturer to determine the compatibility of the existing motor with the variable frequency drive.

Before starting the motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off.

Angle mount series 10 mixers.

The greatest cause of bearing failure is over-greasing rather than under-greasing.

Use only the lifting device provided on your unit to install the mixer. Use shouldered eyebolts and tighten securely to handle component parts. We strongly recommend that the hoist rings be of safety swivel type with 360° rotational capability.

Before starting up, be sure the coupling guard is replaced and properly secured. Elastomer sleeves can be thrown from the assembly when subjected to a severe shock load.

The frames and other metal exteriors of motors should be grounded to limit their potential to ground in the event of accidental connection or contact between live electrical parts and the metal exteriors. Explosion-proof motors should be grounded through the conduit box.

Bearings and grease must be kept free of dirt.

Failure to follow these instructions could result in serious injury.

IMPORTANT:

DO NOT operate the mixer until you have checked the following items:

- A. Make sure the mixer is properly grounded.**
- B. Ensure all protective guards and covers are installed.**
- C. Ensure all detachable components are securely coupled to the mixer.**
- D. Thoroughly REVIEW and ADHERE TO the mixer operating instructions supplied by the manufacturer.**
- E. Ensure the mixer output shaft rotates freely by hand.**
- F. Ensure all personnel and equipment are clear of rotating parts.**
- G. Ensure all external connections (electrical, hydraulic, pneumatic, etc.) have been completed in accordance with all applicable codes and regulations.**

DO NOT enter the mixing vessel **UNLESS:**

- A. The mixer power supply is locked out.**
- B. The mixer shaft is firmly attached to the mixer drive or the shaft is supported securely from below.**
- C. You have followed applicable confined space regulations.**

Unless specifically listed elsewhere in the detailed instructions, tighten the mixer and mounting hardware to the recommended torques listed in the manufacturer's documentation.

Failure to follow these instructions could result in serious injury.

WARNING:

Eye protection must be worn at all times while servicing this mixer.

The mixer assembly for angle mount series 10 mixers must be in a level position before performing any shaft maintenance.

The impeller assembly/blades may require removal from the shaft during installation or removal and to prevent the impeller from contacting the tank wall.

The frames and other metal exteriors of motors should be grounded to limit their potential to ground in the event of accidental connection or contact between live electrical parts and the metal exteriors. Explosion-proof motors should be grounded through the conduit box.

Before starting motor, remove all unused shaft keys and loose rotating parts to prevent them from flying off.

Failure to follow these instructions could result in serious injury.

CAUTION:

Due to lubrication considerations, maximum allowable input speed is 2000 RPM.

The greatest cause of bearing failure is over-greasing rather than under-greasing.

Bearings and grease must be kept free from dirt.

Dipstick D21946 was not designed to register the lower oil level. To ensure proper low oil level reading, dipstick D219649 must be used.

Failure to follow these instructions could result in serious injury.

(For additional information regarding mixers, refer to Appendix Section [4.2.5.1.5.2](#) of this manual.)

3.6.1.5.3 Influent Splitter Box

The influent splitter box should be drained, inspected for scale buildup, rust, corrosion, and cleaned as necessary annually. Any painted surfaces should be inspected for rust and corrosion, cleaned and re-painted if necessary.

NOTE:

The splitter box is constructed of 304 stainless steel which will not stand up well to a mixture containing chloride. If a high degree of rust or corrosion is noticeable, verify the solution does not contain chloride.

(For additional information regarding the influent splitter box, refer to Appendix Section [4.2.5.1.5.3](#) of this manual.)

3.6.1.6 Mixed Liquor Recycle Pumping

Internal mixed liquor recycle pumps are used to return mixed liquor from the aeration basin to the anoxic basins.

3.6.1.6.1 Mixed Liquor Recycle Pumps

Periodic inspection, testing, lubrication, and maintenance of the recycle pumps (Equip. #PU00629 through PU00631) should be performed in accordance the manufacturer's recommendations listed in Appendix Section [4.2.5.1.6.1](#) of this manual.

WARNING:

For your protection, always disconnect pump and panel from its power source before handling.

Never enter the basin until it has been properly vented and tested. Any person entering a basin should be wearing a harness with safety rope extending to the surface so that they can be pulled out in case of asphyxiation. Sewage water gives off methane and hydrogen sulfide gases, both of which can be highly poisonous.

Installation and checking of electrical circuits and hardware should be performed by a qualified electrician.

Pump is never to be lifted by power cord.

Unit must be flushed and disinfected, inside and out, prior to servicing.

Wiring and grounding must be in accordance with the national electrical code and all applicable local codes and ordinances.

Before servicing a pump, always shut off the air power breaker to the panel and then disconnect the pump - making sure you are wearing insulated protective sole shoes and are not standing in water. Under flooded conditions, contact your local electric company or a qualified licensed electrician for disconnecting electrical service prior to pump removal.

Submersible pumps contain oils which become pressurized and hot under operating conditions - allow 2^{1/2} hours after disconnecting before attempting service.

Pumps should be at room temperature. Seal and motor housing may be pressurized. Care should be used in removing pipe plugs so that oil is not sprayed.

Do not touch sealing face of the rotating section or the stationary section of the rotary seal when removing or installing the seal. Seal replacement should be done in a shop atmosphere if possible.

When lubricating, do not over fill.

Failure to follow these instructions can cause serious personal injury, death or major property damage.

CAUTION:

Do not touch sealing face of the rotating section or the stationary section of the rotary seal when removing or installing the seal. Seal replacement should be done in a shop atmosphere if possible.

Make sure all seal faces remain free of dirt particles. Apply a light coat of oil to seal faces before installing.

Failure to follow these instructions can cause personal injury or property damage.

(For additional information regarding the recycle pumps, refer to Appendix Section [4.2.5.1.6.1](#) of this manual.)

3.6.1.6.2 Magnetic Flow Meter

According to the manufacturer's recommendations, the magnetic flow meter is maintenance free.

(For additional information regarding the flowmeter, refer to Appendix Section [4.2.5.1.6.2](#) of this manual.)

3.6.1.7 Return Activated Sludge and Waste Activated Sludge Pumping

3.6.1.7.1 Final Clarifiers

The clarifiers separate activated sludge from the mixed liquor suspended solids.

The final clarifiers do not require maintenance.

(For additional information regarding clarifiers, refer to Appendix Section [4.2.5.1.7.1](#) of this manual.)

3.6.1.7.2 Airlift

The airlift system does not require maintenance.

(For additional information regarding the airlift system, refer to Appendix Section [4.2.5.1.7.2](#) of this manual.)

3.6.1.8 Scum Removal System

The scum removal system does not require maintenance.

(For additional information regarding the scum removal system, refer to Appendix Section [4.2.5.1.8](#) of this manual.)

3.6.2 Tertiary Treatment

3.6.2.1 Ultraviolet Light (UV) Disinfection

The Ultraviolet Light (UV) Disinfection System requires very little maintenance beyond cleaning and lamp replacement.

3.6.2.1.1 UV Light Banks

Replacement of the UV lamps should be completed according to the manufacturer's recommendations listed in Appendix Section [4.2.5.2.1.1](#) of this manual.

WARNING:

Exposure to a burning UV lamp can damage eyes and skin.

Electrical Hazard!

LOCKOUT and TAG all sources of power before performing any maintenance, cleaning or repairs on any piece of equipment.

Handle the UV Sensor with care. Avoid touching the end of the UV Sensor.

CAUTION:

Non-abrasive rubber gloves must be worn during procedure to protect sleeve and lamp.

All personnel must read and adhere to the safety warnings and data sheets included in this section.

Over-exposure can cause burns to eyes and skin.

Keep illuminated lamps submerged in the channel.

Turn off power supply to lamps before servicing UV lamps.

Each lamp in the UV Module is a powerful source of ultraviolet light. UV light can cause serious damage to unprotected skin and eyes, but is safe when the proper precautions are taken. The best protection is to prevent exposure to UV light. The UV Modules pose no health threat when submerged and in their support racks.

If it becomes necessary to work with an open source of UV light, gloves, protective clothing and UV face shield should be worn. Ordinary eye glasses are not adequate protection. Neither are safety glasses with plastic lenses, or goggles that do not cover the entire face. No part of the body should be exposed to UV light.

It is strongly recommend posting a sign in visible places near the equipment and in the general area to warn of the hazard and to instruct the use of glasses, as a minimum precaution.

(For additional information regarding the Ultraviolet Light (UV) Disinfection System, refer to Appendix Section 4.2.5.2.1.1 of this manual.)

3.6.2.1.2 UV Washer

The UV washer simply consists of a metal cleaning rack designed to hold the UV Lamp assembly during cleaning.

Cleaning of the quartz sleeves should be completed according to the manufacturer's recommendations listed in Appendix Section 4.2.5.2.1.2 of this manual.

Power to the UV bank must be shut off before removal and cleaning of the UV bank can be completed. Power can be removed by switching off the appropriate breaker in the IPA Instrument Panel. Reference Drawing Sheet E9 in Appendix Section 4.1.2.1 of this manual to find the correct breaker.

WARNING:

Exposure to a burning UV lamp can damage eyes and skin.

Electrical Hazard!

LOCKOUT and TAG all sources of power before performing any maintenance, cleaning or repairs on any piece of equipment.

Handle the UV Sensor with care. Avoid touching the end of the UV Sensor.

CAUTION:

Rubber gloves must be worn when cleaning the quartz sleeves or replacing the UV lamps.

Non-abrasive gloves must be worn during procedure to protect sleeve and lamp.

All personal must read and adhere to the safety warnings and data sheets included in this section.

Over-exposure can cause burns to eyes and skin.

Keep illuminated lamps submerged in the channel.

Turn off power supply to lamps before servicing UV lamps.

Each lamp in the UV Module is a powerful source of ultraviolet light. UV light can cause serious damage to unprotected skin and eyes, but is safe when the proper precautions are taken. The best protection is to prevent exposure to UV light. The UV Modules pose no health threat when submerged and in their support racks.

If it becomes necessary to work with an open source of UV light, gloves, protective clothing and UV face shield should be worn. Ordinary eye glasses are not adequate protection. Neither are safety glasses with plastic lenses, or goggles that do not cover the entire face. No part of the body should be exposed to UV light.

It is strongly recommend posting a sign in visible places near the equipment and in the general area to warn of the hazard and to instruct the use of glasses, as a minimum precaution.

(For additional information regarding the Ultraviolet Light (UV) washer, refer to Appendix Section [4.2.5.2.1.2](#) of this manual.

3.6.2.2 Effluent Flow System

3.6.2.2.1 Trapezodial Flume

The trapezodial flume is used to measure the influent and effluent sewage at the Waste Water Treatment Plant.

No maintenance is required for these devices.

(For additional information regarding flumes, refer to Appendix Section [4.2.5.2.2.1](#) of this manual.)

3.6.2.2.2 Flow Metering

The flow meter is a single or dual point measuring device used to measure the volume of influent and effluent sewage through the flumes.

No maintenance is required for this device.

(For additional information regarding flow metering, refer to Appendix Section [4.2.5.2.2.2](#) of this manual.)

3.6.2.2.3 Ultrasonic Level Metering

Because the transducer uses non-contacting technology it is not subject to material build-up. The pulsing action makes the face self-cleaning. Therefore, the transducer requires no maintenance.

(For additional information regarding ultrasonic metering, refer to Appendix Section [4.2.5.2.2.3](#) of this manual.)

3.6.3 Digestion

3.6.3.1 Blower System

The low pressure blower system provides air to the coarse bubble diffuser, the aerobic digesters as well as air for the airlifts in the aerobic digesters and the secondary clarifiers. A good program of inspection and maintenance servicing, followed consistently, is the most reliable method of minimizing repairs to the blower system.

3.6.3.1.1 Blower

Blower Assembly

Besides performing project work orders PW0226 and PW0228, the primary maintenance responsibilities include lubrication, checking oil level, checking V-belts and valves, and cleaning of the exterior surfaces.

Lubrication is normally the most important consideration. Unless operating conditions are unusually severe, a weekly check of oil levels in the gearbox, with addition of oil as required, should be sufficient. Complete oil changes should be made at intervals of 1000 operating hours, or more frequently if oil condition becomes poor.

All bearings, bushings, and couplings should be checked periodically, lubricated if necessary, or replaced if damaged. Gradual shaft bearing wear may allow a shaft position to change slightly, until rubbing develops between the impeller and the cylinder headplate. This will cause spot heating, which can be detected by feeling these surfaces.

CAUTION:

Keep fingers away from impellers and gears.

Do not by-pass or render inoperative any safety device

Couplings as well as sheave bushings must have a slide fit with the blower shaft such that they can be installed in place by hand. Any force used to install them will change blower end clearances resulting in blower damage. If an interference fit is desired for the coupling, the coupling hub should be heated and shrunk on the shaft. For engine drives, use "Locktite" between the coupling hubs and the blower/engine shafts and on the threads of the coupling set screws.

Where applicable, blower V-belts should be inspected periodically for proper tension, alignment, and overall condition. Belts that appear to be frayed or cracked should be immediately replaced.

Valves, seals, and all connections should be inspected weekly for leakage or damage in accordance with PM #0195FW. Leaking valves and seals should be replaced. The shaft seals should be considered expendable items, to be replaced whenever drainage from the headplate vent cavity becomes excessive, or when the blower is disassembled for any reason.

Blower Motor

Blower motors are pre-greased, normally with Polyrex EM (Exxon Mobile). Motors that do not have grease capability are factory lubricated for the normal life of the bearings. Motors that are grease capable have a grease fitting or grease hole present. If the motor requires greasing, clean the grease fitting (or area around grease hole, if equipped with slotted grease screws). If the motor has a purge plug, remove it. Motors can be greased while stopped (at less than 80° C).

Apply grease gun to fitting (or grease hole). Too much grease or injecting grease too quickly can cause premature bearing failure. Slowly apply the recommended amount of grease, taking one (1) minute or so to apply. Operate motor for 20 minutes, reinstall purge plug if previously removed.

New motors that have been stored for a year or more should be lubricated again.

CAUTION:

Only qualified personnel trained in the safe installation and operation of this equipment should install this motor. When improperly installed or used, rotating equipment can cause serious or fatal injury. Equipment must be installed in accordance with local codes and the following publications:

“National Electrical Code” (NEC)”

“NEMA MG2 Safety Standards for Construction”

“Guide for Selection Installation”

“Use of Electric Motors and Generators”

When eyebolts are provided, they must be fully tightened and are intended to lift the motor and its included accessories only.

Ground the motor according to NEC and local codes.

Provide a permanent guard to prevent accidental contact of body parts or clothing with rotating or moving parts or burns if motor is hot.

Shaft key must be secured before starting motor.

Do not apply power to the motor until the motor is securely mounted by its mounting holes.

This motor must only be connected to the proper line voltage, line frequency and load size.

Motors are not to be used for load holding or restraining unless a properly sized brake is installed. If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure.

Disconnect all power services, stop the motor and allow it to cool before servicing.

For single phase motors, discharge the start and/or run capacitors before servicing.

Do not by-pass or render inoperative any safety device

When using AC motors with frequency inverters, be certain that the maximum speed rating (on nameplate) is not exceeded.

CAUTION:

Couplings as well as sheave bushings must have a slide fit with the blower shaft such that they can be installed in place by hand. Any force used to install them will change blower end clearances resulting in blower damage. If an interference fit is desired for the coupling, the coupling hub should be heated and shrunk on the shaft. For engine drives, use "Locktite" between the coupling hubs and the blower/engine shafts and on the threads of the coupling set screws.

Mounting bolts should be high tensile steel. Be sure to use a suitable locking device on each bolt (spring washer or thread lock compound)

A guard of suitable dimensions must be constructed and installed around the motor and gear motor. This guard must prevent personnel from coming in contact with any moving parts of the motor or drive assembly but must allow sufficient cooling air to pass over the motor.

If a motor mounted brake is installed, provide proper safeguards for personnel in case of brake failure.

Brush inspection plates and electrical connection cover plates or lids, must be installed before operating the motor.

Silencer and Air Filter

The silencer requires no regular maintenance, however, the mesh filter element does require periodic cleaning and inspection. To clean wire mesh elements, wash in solvent or warm water and detergent in a container large enough for complete immersion of element. Rinse completely, drain and either air dry or use compressed air. After cleaning and drying, re-treat the element with oil-free adhesive or oil as described. For best efficiency, wire mesh elements must be treated when new and after each cleaning. For oil-free adhesive, spray the element on both sides with an universal oil-free adhesive following directions on container. For oil treatment, dip the element in SAE 30-50 motor oil and drain thoroughly before using.

Pressure Relief Valves

Pressure relief valves are designed to protect pressure vessels against over-pressure conditions. Check the operating condition of the safety relief valves every 30 days, or after any prolonged period of inactivity.

WARNING:

Leakage or damage to pressure relief valves are indications the valve may fail to provide over pressurization protection. Every 30 days the safety relief valve must be inspected and if any of the above conditions are noted it must be replaced.

Attempts to change pressure relief valve setting will prevent it from relieving at rated capacity and thus causing the system/component to explode. Do not attempt to adjust the pressure setting of the safety relief valve.

Improper safety relief valve installation can prevent the valve from protecting the system against over pressure conditions.

Failure to follow this warning can cause serious personal injury, death or major property damage.

(Detailed maintenance recommendations and specifications for the blower system can be found in Appendix Section [4.2.5.3.1.1](#) of this manual.)

3.6.3.1.2 Thermal Mass Flowmeter

CAUTION:

To avoid hazards to personnel, ensure that all environmental isolation seals are properly maintained.

NOTE:

The flow transmitter contains electrostatic discharge (ESD) sensitive devices. Use standard ESD precautions when handling the flow transmitter.

This flowmeter requires little maintenance. There are no moving parts or mechanical parts subject to wear in the instrument. The sensor assembly which is exposed to the process media is all stainless steel construction.

Without detailed knowledge of the environmental parameters of the application surroundings and process media, the manufacturer cannot make specific recommendations for periodic inspection, cleaning, or testing procedures. However, some suggested general guidelines for maintenance steps are offered below.

- Use operating experience to establish the frequency of each type of maintenance.
- Periodically verify the calibration of the output and re-calibrate if necessary. Calibration should be completed every 18 months at a minimum.
- Periodically inspect cable connections on terminal strips and terminal blocks. Verify that terminal connections are tight and physically sound with no sign of corrosion.
- Verify that the moisture barriers and seals protecting the electronics in the local and remote enclosures are adequate and that no moisture is entering those enclosures.
- FCI recommends occasional inspection of the system's interconnecting cable, power wiring and flow element wiring on a "common sense" basis related to the application environment. Periodically, the conductors should be inspected for corrosion and the cable insulation checked for signs of deterioration.
- Verify that all seals are performing properly and that there is no leakage of the process media. Check for deterioration of the gaskets and environmental seals used.
- Periodically remove the flow element for inspection based on historical evidence of debris, foreign matter, or scale build-up and appropriate plant shutdown schedules and procedures. Check for corrosion, stress cracking, and/or build-up of oxides, salts, or foreign substances. The thermowells must be free of excessive contaminants and be physically intact. Any debris or residue build-up could cause inaccurate switching. Clean the flow element, as necessary, with a soft brush and available solvents (compatible with stainless steel).

(Additional maintenance recommendations and specifications can be found in Appendix Section [4.2.5.3.1.2](#) of this manual.)

3.6.3.2 Aeration and Digestion Air Supply System

The extended aeration system is a low-loaded, activated sludge system where diffusers provide oxygen and mixing to the basin contents.

3.6.3.2.1 Aeration Basins

The aeration basins should be drained, inspected for scale buildup, rust, corrosion, and cleaned as necessary annually. Any painted surfaces should be inspected for rust or corrosion, cleaned and re-painted if necessary.

NOTE:

The aeration basins are constructed of 304 stainless steel which will not stand up well to a mixture containing chloride. If a high degree of rust or corrosion is noticeable, verify the solution does not contain chloride.

The valves should be inspected on a weekly basis for evidence of leakage, rust or corrosion in accordance with PM #0192FW.

(Additional information on the aeration tanks, piping, and valves can be found in Appendix Section [4.2.5.3.2.1](#) of this manual.)

3.6.3.2.2 Aerobic Digesters

The aerobic basin tanks themselves do not require any maintenance beyond periodically draining and cleaning.

The valves should be inspected on a weekly basis for evidence of leakage, in accordance with PM #0192FW.

Because of their unique design, the coarse bubble diffusers require no maintenance.

(Additional information on the aerobic tanks, piping, and valves can be found in Appendix Section [4.2.5.3.2.2](#) of this manual.)

3.6.3.2.3 Aeration Basin Air Inlet Valves

The resilient-seated butterfly valves (Equip. #VA00074) used in the air delivery system require no maintenance other than inspecting the valves on a weekly basis for evidence of leakage in accordance with PM #0192FW, and lubrication if the valve has been disassembled.

Maintenance of the actuator is covered in Section [3.6.3.2.5](#) of this Manual.

WARNING:

Pipeline pressure with the actuator removed can cause the valve disc to rotate suddenly causing personal injury or equipment damage. Relieve the pressure in the pipeline before removing the actuator.

Moving parts from accidental operation of a powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

Loosening the flange bolts on a pressurized valve can allow the valve to suddenly shift position and release uncontrolled pipeline fluid. To avoid personal injury or pipeline damage, relieve the pressure in the pipeline before loosening the pipeline flange bolts.

CAUTION:

Lifting larger size valves incorrectly can damage them. Do not fasten lifting devices to the actuator or disc, or through the seat opening in the body. Lift the valve with slings fastened around the valve body, or attach them to bolts or rods run through holes for the pipeline flanges.

(Additional information on the butterfly valves can be found in Appendix Section [4.2.5.3.2.3](#) of this manual.)

3.6.3.2.4 Aerobic Digester Air Inlet Valves

The resilient-seated butterfly valves (Equip. #VA00074) used in the air delivery system require no maintenance other than inspecting the valves on a weekly basis for evidence of leakage in accordance with PM #0192FW, and lubrication if the valve has been disassembled.

Maintenance of the actuator is covered in Section [3.6.3.2.5](#) of this Manual.

WARNING:

Pipeline pressure with the actuator removed can cause the valve disc to rotate suddenly causing personal injury or equipment damage. Relieve the pressure in the pipeline before removing the actuator.

Moving parts from accidental operation of a powered actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

Loosening the flange bolts on a pressurized valve can allow the valve to suddenly shift position and release uncontrolled pipeline fluid. To avoid personal injury or pipeline damage, relieve the pressure in the pipeline before loosening the pipeline flange bolts.

CAUTION:

Lifting larger size valves incorrectly can damage them. Do not fasten lifting devices to the actuator or disc, or through the seat opening in the body. Lift the valve with slings fastened around the valve body, or attach them to bolts or rods run through holes for the pipeline flanges.

(Additional information on the butterfly valves can be found in Appendix Section [4.2.5.3.2.4](#) of this manual.)

3.6.3.2.5 Actuators

The rotary actuators used in the air delivery system require no maintenance other than refilling the gear case section with lubrication if the valve is disassembled; and checking the actuator weekly for binding, leakage, and unusual noises.

CAUTION:

To prevent ignition of hazardous atmospheres, do not remove actuator cover while circuits are live.

If the pressure switch actuators are exposed to system or surge pressures greater than the maximum pressure rating on the device nameplate, leakage from the actuator and/or a change of operating set points may result.

Pressure on a switch, during use, should be within the catalog listed range of the switch. For optimum life maximum system pressure on a continual basis, including surges, should not exceed maximum range. Life of any diaphragm actuated switch will be decreased if pressure exceeds the stated maximum range value. The more frequent the application and the greater the valve of excessive pressure, the more actuator life will be decreased.

***Potentiometer:* During initial field installation of actuators incorporating our standard potentiometer range, care must be taken to avoid overstepping the pre-set travel limits. This is to avoid damage to the potentiometer. RCS has a very unique mounting bracket for holding the pot, such that even when the pre-set position is overshoot, the pot will not be damaged. However, good field installation practice would and should dictate the avoidance of this whenever possible to avoid any possible damage to the pot, also possibility of over twisting the pot wire leads. Potentiometer specs - as per customer requirements.**

(Additional information on the actuators can be found in Appendix Section [4.2.5.3.2.5](#) of this manual.)

3.6.3.2.6 Dissolved Oxygen Analyzers

Maintenance for the dissolved oxygen analyzer is very simply. Periodic calibration, and cleaning or replacement (if necessary) of the sensor is all that is needed.

Under normal conditions, the sensor will operate for 2-3 years and can be replaced in a few minutes. General maintenance of the sensor is limited to cleaning about every 2-3 months and calibration about every 6 months.

During cleaning, the sensor must not be allowed to remain pointing upwards for more than 3 minutes at a time if the function is enabled, otherwise a calibration cycle will start. The function can be disabled.

1. Lift the transmitter out of the medium.
2. Clean the sensor with pure water, to which a little cleaning agent/washing up liquid can be added.
3. Dry the sensor with a soft cloth.
4. Immerse the transmitter into the medium to be measured.

(Additional information for the oxygen analyzer can be found in Appendix Section [4.2.5.3.2.6](#) of this manual.)

3.6.4 Biosolids Handling

3.6.4.1 Digested Sludge

Digested sludge is removed by a submersible non-clogging pump and pumped to the belt filter press for further processing. The pump is located on the belt filter press.

3.6.4.1.1 Pumps

Maintenance requirements for the progressive cavity pump (Equip. #PU97393) can be found in the *Operating and Maintenance Instructions* Manual in Appendix Section [4.2.5.4.1.1](#).

WARNING:

For maintenance and inspection specifications, see the appended manufacturer's documentation, Point 10.

Before commencing the re-assembly, fasten the latern (200) in such a way that it cannot tip over or fall down during the re-assembly of the drive and all pump components.

Wear protective goggles when squeezing out the two halves of the holding band loop (SCL).

Failure to follow these instructions could lead to danger for life or limb.

CAUTION:

The pin joint should be lubricated using manufacturer's recommended grease. Usage of other grease types will lead to premature joint failure and render invalid any right to claims under guarantee. See "*Index*" portion of manufacturer's "*Operation and Maintenance Instructions*" Manual.

To guarantee the proper function of the joints, it is advisable to renew the coupling rod pins (402), guide bushes (403) and coupling rod bushes (404) all at the same time.

As a precaution against incorrect re-assembly of coupling rod bushes (404), we recommend the employment of coupling rods (400) whose coupling rod bushes (404) have been pressed in by the manufacturer.

Never tap or hammer against the loop of the holding band (SCL), otherwise damage to the universal joint sleeve may occur.

Usage of grease types other than those recommended by the manufacturer will lead to premature joint failure and render invalid any right to claims under guarantee.

Failure to follow these instructions could jeopardize the pump and its functions.

NOTE:

To avoid expenses incurred by lengthy stop periods of the pump, the manufacturer recommends the acquisition of a set of wearing parts and a set of gaskets.

(Additional information for the progressive cavity pump can be found in Appendix Section [4.2.5.4.1.1](#) of this manual.)

3.6.4.2 Polymer Mixer Chamber

3.6.4.2.1 Mixer

The polymer mixing chamber requires periodic inspection and cleaning. Preventative maintenance and maintenance procedures are detailed in the manufacturer's *Operation & Maintenance Manual* found in Appendix Section [4.2.5.4.2.1](#).

WARNING:

To prevent the possibility of personal injury or property damage, turn off electrical power, depressurize the valve, and vent fluid to a safe area before servicing the solenoid valve.

To prevent the possibility of personal injury or property damage, check valve for proper operation before returning to service. Also, perform internal seat and external leakage tests with a non-hazardous, non-combustible fluid.

Turn off electrical power and depressurize valve before making repairs. It is not necessary to remove valve from pipeline for repairs.

CAUTION:

Valves with suffix "HW" in the catalog number are equipped with ethylene propylene elastomers which can be attacked by oils and greases. Use on oil-free systems only. Wipe the threads clean of cutting oils.

Do not remove body plug on 2" or 2^{1/2}" NPT valves. The body plug has been sealed in place at the factory. Removal is not necessary for cleaning or rebuilding.

Solenoid must be fully reassembled as the housing and internal parts are part of and complete the magnetic circuit. Place insulating washer at each end of coil if required.

Check the operating condition of the bleeder pressure relief valve every 30 days, or after any prolonged period of inactivity. Inspect the safety relief valve for signs of corrosion, damage, or scale buildup

The check valve should be cleaned monthly using a polymer solvent or kerosene to dissolve emulsion or dispersion polymers. In most cases, the male section can remain installed in the mixing chamber while the disassembly/cleaning/reassembly is done.

The solenoid valve should be inspected and cleaned periodically. Depending on the medium and service conditions, periodic inspection of internal valve parts for damage or excessive wear is recommended. Thoroughly clean all parts. If parts are worn or damaged, install a complete rebuild kit.

The Rotameter should be cleaned with a mild soap solution as needed.

(Additional maintenance information for the mixing chamber can be found in Appendix Section [4.2.5.4.2.1](#) of this manual.)

3.6.4.2.2 Polymer Pump

The polymer metering pump was designed for trouble-free operation, yet routine maintenance of elastomeric parts is essential for optimum performance. This involves replacing the Liquifram™, cartridge valves or seal rings/valves balls, multi-function valve cap assemblies and the injection check valve spring. These parts should be replaced annually; however, frequency will depend on the particular application.

CAUTION:

ALWAYS wear protective clothing, face shield, safety glasses and gloves when working near or performing any maintenance or replacement on your pump. See *MSDS* information from solution supplier for additional precautions.

Be careful not to scratch the Teflon® face of the new Liquifram™.

IMPORTANT: Before disassembling the check valves, note the orientation of the valve.

IMPORTANT: Note correct orientation of each check valve.

Depressurize and drain pipeline (or isolate I.C.V. point using valves) so that I.C.V. can safely be disassembled.

Read all of the warnings and cautions listed in the manufacturer's maintenance section.

Be sure the relief tubing is connected to your multi-function valve and runs back to your solution drum or tank.

(Additional information for the polymer pump can be found in Appendix Section [4.2.5.4.2.2](#) of this manual.)

3.6.4.2.3 Polymer Flowmeter

This device is designed to monitor the Polymer output flow from the Polymer pump. It may be set to deliver a pulse signal output for each successful pump stroke registered. If the flow stops or lessens, the pulse outputs will cease. With the flowmeter connected to the flow monitor input located on the pump, the presence or lack of pulses can be detected.

CAUTION:

The valve fitting on the discharge portion of the flow monitor must be a flange type fitting to ensure a proper seal with the O-Ring. Using a winged type valve fitting will not create a seal and leakage of solution will occur.

Check the operating condition of the flowmeter every 30 days. Inspect it for signs of corrosion, damage and leaks.

(Additional information for the flowmeter can be found in Appendix Section [4.2.5.4.2.3](#) of this manual.)

3.6.4.3 Belt Filter Press

Detailed inspection and maintenance instructions for the belt filter press (Equip. # CT09003) are divided into sections for the functional components of the belt filter press in Appendix Section [4.2.5.4.3](#). Drawings, cut sheets, and schematics are also included in this Section.

The major functional sections of the belt filter press requiring routine maintenance are the:

Frame	Drainage Section
Rollers	Wash Station,
Bearings	Scrappers
Tensioning Assembly	Drive Train
Hydraulic Power Unit, (Grundfos water pump Equip. #PU97394)	Dewatering Belts

The suggested maintenance intervals are based on an operating schedule of forty hours per week. The maintenance intervals are broken down into Daily, Weekly, Monthly, and Semi-Annually tasks. Besides performing project work orders

PW0234, PW0235, PW0236 and annual maintenance on the drainage section per PM #5204FA, the manufacturer recommends the following inspections and maintenance:

Daily Maintenance

1. Clean belts by running belt drive and wash system without sludge or polymer for a minimum period of 45 minutes.
2. Clean spray nozzles on wash box.
3. Check fluid level in hydraulic unit. Fill as required.
4. Lubricate bearings.

Weekly Maintenance

1. Inspect wear items specifically chicanes, scraper blade, gravity drainage grid, dewatering belt, rubber seals on the sludge restrainers - and the wash station. Replace as required. Follow lubrication requirements on motor nameplates.
2. Inspect frame and roller coatings for wear.
3. Inspect belt guides and wiper bars for cleanliness/wear. Clean as required.
4. Check for any loose bolts.

Monthly Maintenance

1. Verify daily and weekly items have been completed.
2. Clean belts with a soap and bleach mixture.
3. Inspect belt seam wires for breaks. Replace if broken.

Semi-annually Maintenance

1. Verify monthly items have been completed.
2. Clean hydraulic filter screen.
3. Check oil level in drive unit gear box.
4. Inspect polymer mixer/injection ring assembly and clean as required.
5. Replace belt seam wires.

Every Two Years

1. Change the oil in the drive unit gear box. If the drive unit gear box is being used in a high humidity, or corrosive environment, the lubricate will have to be changed more frequently.
2. Drain, flush and grease the gearcase.

WARNING:

Failure to follow safety instructions while installing or servicing the dewatering belts can result in severe injuries or loss of limbs. Use extreme caution when working with the belts.

Use extreme caution when working around the moving belt. Never reach into the machine while it is running. Avoid loose clothing that might become caught in the belt.

Do not disable any alarms on the machine by disconnecting wires at the control panel or the junction box. The alarms exist to protect yourself and the equipment.

The belt drive must not be operated unless the hydraulic pump is running and the belts are tensioned. The tension yoke will move to its fully extended position when the tension valve is placed in the tension position. Ensure no personnel or equipment is in the path of the tension yoke as it extends.

Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation, and maintenance of this equipment.

To avoid damage to motor bearings, grease must be kept free of dirt. For an extremely dirty environment, contact the manufacturer or an authorized service center of the manufacturer for additional information.

NOTE:

Installing the dewatering belt can be done in a safe and timely manner, however, it does present a situation where carelessness can cause injuries.

The frame may be under warranty. Contact the manufacturer before repairing the frame.

If the operating temperature rises, supply grease immediately. The information on this page applies only if the cyclo-portion is grease lubricated. Standard cyclo lubrication is oil, except for Models AA, A and B, and double reduction cyclos.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

Change hydraulic fluid after 1500 hours of use or anytime fluid appears colored or cloudy. The hydraulic oil can absorb moisture from the atmosphere.

NOTE:

Lubricate bearings daily with enough grease to purge the housing. Wipe off excess grease that comes out around the shaft. Use only the lubricants the manufacturer recommends. Failure to lubricate the bearings will invalidate the bearing warranty.

Change oil and clean filter screen semi annually (every six months).

Replace grid strips before belt contacts metal support grid.

DO NOT steam clean the belts. Steam cleaning will damage the belts. Use a maximum of 1,500 psi water at a maximum of 140 degrees F.

When using marine epoxy, ensure belt is clean and dry before applying epoxy. Apply epoxy to both belt and patch as evenly as possible. Let the epoxy thoroughly dry before operating. Dewatering will not occur in an area coated with marine epoxy.

Installing the dewatering belt can be done in a safe and timely manner, however, it does present a situation where carelessness can cause injuries. To ensure a safe operation, the manufacturer recommends:

The smooth side of the belt should face the sludge when installed. Failure to have this side facing the belt will cause improper dewatering and premature belt failure. The warranty from the manufacturer does not cover belts installed incorrectly.

Frame sizes 4085-4125 are maintenance free units. Grease replenishment is not necessary. Where longer life of the drive is expected or if relubricating is preferred before recommended period of time.

Replenish grease to the reduction mechanism 1/3 to 1/2 of quantities for the first reduction stage.

If excessive grease is added, agitation heating of the grease will raise the operating temperature of the unit. Avoid excessive greasing; however, when the grease is insufficient it will raise the operating temperature due to the breakdown of the lubrication films on the eccentric bearing.

The Cyclo-portion and Bevel-portion, where applicable, must be filled with oil separately. Oil does not flow from one section to the other.

When the unit is disassembled for overhauling, refill with grease in quantities indicated in Table 11. Or alternatively, 80% of the space around reduction mechanism and slow speed shaft bearings of single reduction units and 50% around reduction mechanism of both first and second stage of double reduction units.

(Additional information for the belt filter press can be found in Appendix Section 4.2.5.4.3 of this manual.)

3.6.4.4 Filtrate Drain

The filtrate drain and associated valves (Equip. #RP04003) should be inspected periodically for evidence of leakage and weekly on the following components:

- Inspect the chicanes.
- Inspect the gravity drainage grid.
- Inspect the wiper bar strip.
- Inspect the seals on the sludge restrainers for wear and replace if necessary.

(Additional information for the filtrate drain can be found in Appendix Sections [4.2.5.4.3](#) and [4.2.5.4.4](#) of this manual.)

3.6.4.5 Biosolids Loading Station

The loading station should be inspected periodically for evidence of leakage or damage. It should be cleaned weekly.

(Additional information for the loading station can be found in Appendix Section [4.2.5.4.5](#) of this manual.)

3.6.5 Waste Station Unloading / Transfer

3.6.5.1 Waste Station Pumps

The Waste Station pumps (Equip. #PU97391 and PU97392) require little service other than performing project work orders PW0230 and PW0231. However, should it be necessary to inspect or replace the wearing parts, follow the instructions listed in the manufacturer's *"Installation, Operation, and Maintenance Manual"* in Appendix Section [4.2.5.5.1](#).

Many service functions may be performed by draining the pump and removing the back cover assembly. If major repair is required, the piping and/or power source must be disconnected.

Before attempting to service the pump, disconnect or lock out the power source and take precautions to ensure that it will remain inoperative. Close all valves in the suction and discharge lines.

Although the "Notes" listed in the manufacturer's maintenance manual were not duplicated in this manual, personnel are required to read and adhere to them while performing maintenance procedures.

WARNING:

Before attempting to open or service the pump:

- Familiarize yourself with the vendor's manual.
- Disconnect or lockout the power source to ensure that the pump will remain inoperative.
- Allow the pump to completely cool if overheated.
- Check the temperature before opening any covers, plates, or plugs.
- Close the suction and discharge valves.
- Vent the pump slowly and cautiously.
- Drain the pump.

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment.

Most cleaning solvents are toxic and flammable. Use them only in well-ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

Do not operate the pump without the guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.

CAUTION:

Shaft and bearing disassembly in the field is not recommended. These operations should be performed only in a properly equipped shop by qualified personnel.

To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected in place. It is strongly recommended that the bearings be replaced any time the shaft and bearings are removed.

Bearings must be kept free of all dirt and foreign material. Failure to do so will greatly shorten bearing life. DO NOT spin dry bearings. This may scratch the balls or races and cause premature bearing failure.

When installing the bearings onto the shaft, never press or hit against the outer race, balls, or ball cage. Press only on the inner race.

When installing the shaft and bearings into the bearing bore, push against the outer race. NEVER hit the balls or ball cage.

A new seal assembly should be installed any time the old seal is removed from the pump. Wear patterns on the finished faces cannot be realigned during reassembly. Reusing an old seal could result in premature failure.

CAUTION:

This seal is not designed for operation at temperatures above 160° F (71° C). Do not use at higher operating temperatures.

New cartridge seal assemblies are equipped with mylar storage tabs between the seal faces. These storage tabs must be removed before installing the seal.

Do not attempt to separate the rotating portion of the seal from the shaft sleeve when reusing an old seal. The rubber bellows will adhere to the sleeve during use, and attempting to separate them could damage the bellows.

The shaft and impeller threads must be completely clean before reinstalling the impeller. Even the slightest amount of dirt on the threads can cause the impeller to seize to the shaft, making future removal difficult, or impossible, without damage to the impeller or shaft.

Monitor the condition of the bearing lubricant regularly for evidence of rust or moisture condensation. This is especially important in areas where variable hot and cold temperatures are common.

(Additional information regarding the waste station pumps can be found in Appendix Section [4.2.5.5.1](#) of this manual.)

3.6.6 Lift Station (Building 200)

3.6.6.1 Lift Station Pumps

The lift station pumps (Equip. #PU00638 and PU00639), located in Building 200, require very little maintenance. The seal requires no lubrication and the inlet elbow can be easily removed to inspect the impeller. The pumps themselves have no bearings.

Two motor bearings support the shaft rotor and the impeller. These bearings are properly greased when leaving factory and should not require greasing for two years.

WARNING:

Read all instructions before starting any operation on the pump. Always disconnect the pump and controls from its power source before handling.

Do not smoke or use electrical devices which produce a spark or flame in a septic (gaseous) or possibly septic sump.

CAUTION:

**Never reuse old seal parts. Always replace with a complete new seal.
Always turn off power before working on the impeller or pump.**

The pump controller requires no maintenance.

(Additional information regarding the lift station pumps can be found in Appendix Section [4.2.5.6.1](#) of this manual.)

3.6.7 Process System Valves/Ancillary Equipment

The valves used throughout the process system should be inspected on a weekly basis for evidence of leakage, in accordance with PM #0192FW.

WARNING:

This valve is a pressure vessel. Pressure must be completely released before disassembly. The bonnet will blow off if the bonnet bolts are removed with pressure in the valve.

This valve is a pressure vessel. Failure to release pipeline pressure may result in personal injury and/or flow system damage. Completely release pipeline pressure before removing the actuator from the valve or removing the valve from the pipeline.

Moving parts from accidental operation of power actuator can cause personal injury or equipment damage. Disconnect and lock out power to actuator before servicing.

When an eccentric valve is mounted in a vertical pipeline or mounted in a horizontal pipeline with the plug stem horizontal - gravity can cause the plug to swing to a lower position in the valve body when the actuator is removed. Place the plug in the lowest position before removing the actuator.

Excessive pipeline pressure can propel the loose packing, and can cause personal injury or equipment damage. If possible, relieve the pressure in the pipeline to 0 psi before removing the packing gland.

Caustic, toxic, or hot material in the pipeline can cause personal injury or death if leakage occurs. Confirm that the material is not harmful.

The manufacturer recommends the following maintenance for these valves:

- Lubrication is only required in the event the valve is disassembled.
- Check valves periodically for proper position setting, signs of leakage, corrosion, or damage.

Any actuators used in the process system require no maintenance other than refilling the gear case section with lubrication if the valve is disassembled; and checking the actuator weekly for binding, leakage, and unusual noises.

CAUTION:

To prevent ignition of hazardous atmospheres, do not remove actuator cover while circuits are live.

If the pressure switch actuators are exposed to system or surge pressures greater than the maximum pressure rating on the device nameplate, leakage from the actuator and/or a change of operating set points may result.

Pressure on a switch, during use, should be within the catalog listed range of the switch. For optimum life maximum system pressure on a continual basis, including surges, should not exceed maximum range. Life of any diaphragm actuated switch will be decreased if pressure exceeds the stated maximum range value. The more frequent the application and the greater the valve of excessive pressure, the more actuator life will be decreased.

***Potentiometer:* During initial field installation of actuators incorporating our standard potentiometer range, care must be taken to avoid overstepping the pre-set travel limits. This is to avoid damage to the potentiometer. RCS has a very unique mounting bracket for holding the pot, such that even when the pre-set position is overshoot, the pot will not be damaged. However, good field installation practice would and should dictate the avoidance of this whenever possible to avoid any possible damage to the pot, also possibility of over twisting the pot wire leads. Potentiometer specs - as per customer requirements.**

(For additional information regarding eccentric valves, actuators, and any ancillary equipment refer to Appendix Section [4.2.5.1.1](#) of this manual.)

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