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WATER FILTRATION PLANT

OPERATION AND

MAINTENANCE MANUAL

CHARLEVOIX, MICHIGAN

December 1988

U.S. Army Corps of Engineers
Omaha District

Prepared by

McNamee, Porter and Seeley
Engineers/Architects
Ann Arbor, Michigan

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I. INTRODUCTION

A. User Guide

The Operation and Maintenance (O&M) manual for the Charlevoix Water Treatment Plant consists of this 10 chapter volume, separately bound manufacturer/supplier manuals, and a set of construction drawings conforming to construction records. The chapters within this portion of the O&M manual make reference to and are supplemented by the manufacturers' manuals and construction drawings. The Contents contains descriptive titles of the chapters and a breakdown of their contents. The chapter titles with associated page numbers are the guides to locating sections of the manual containing desired information. Cross references within the sections give additional guidance. System and subsystem diagrams or schematics in Chapter 10 which are especially helpful to understanding plant operations are referenced throughout the manual. These diagrams should be viewed while reading Chapter III, Progress Description, Operation and Control.

The manual contains information available prior to start-up in January 1987. As experience with the plant and its equipment is acquired, the facts learned should be incorporated into the manual. Preventive Maintenance Job lists should be updated and current lists of tools and spare parts should be added. Chapter VI, Safety, must be updated by adding new resources for emergency aid and by updating emergency telephone lists. Detailed supplemental information should be included in Chapter X, Appendices, as this information becomes available.

B. General Description

The unit processes of the plant are described in detail in Chapter III, Major Subsystems. The following is a brief history and overview of the facility.

1. History

Charlevoix's previous water supply system was contaminated by toxic chemicals (most notably trichloroethylene). The system consisted of approximately 420-ft. of collection gallery under the beach adjacent to the new plant, a receiving well with air diffuser, 4 high service pumps and a small chlorine supply facility. The City hired McNamee, Porter and Seeley, Engineers/Architects of Ann Arbor, to study water supply needs and to prepare a basis of design for a water supply system. A report titled "City of Charlevoix, Michigan, Water Treatment Plant, Preliminary Engineering," was

prepared in 1983. Anticipated future flows from projected population were reported and formed the basis of design for a water filtration plant. A summary of the design basis is as follows:

Design Year:	2005
Design Population:	4830 - permanent
	7926 - seasonal
Design Flows:	1.0 mgd - annual average
	1.9 mgd - maximum monthly flow
	2.4 mgd - maximum daily flow
Plant Design Capacity:	3.0 mgd

The new facility was to have been constructed in several phases. The first phase was to eliminate the contamination source by construction of a new intake structure. A low service pump station and storage reservoir providing for adequate chlorine contact time was to have been constructed next. Finally, a filtration system with chemical feed subsystems, mixers, flocculation tank and sand filters were to have been built.

After completion of the preliminary engineering report, the Environmental Protection Agency completed a study and concluded that a new intake and water filtration plant were the cost-effective alternative to providing a water supply to the City of Charlevoix. Superfund money was allocated to the project for funding the design and construction of the plant.

The intake was completed in 1985 and construction of the water plant started in the fall of 1985.

2. Facility Overview

The filtration plant is an assembly of pipes, pumps, tanks, wiring and building structures which receives water from Lake Michigan, coagulates particles within the water through mixing of injected chemicals, filters out the particles through a granular filter, and delivers potable water to a storage reservoir ready for distribution. The primary process is the growth of particles or flocs in a flocculation tank and removal of these flocs in the granular filters. This process, along with disinfection by chlorine injection,

produces potable water. Other systems and processes serve this primary process. Pipes, pumps, channels and tanks transport the water from Lake Michigan through the flocculation tanks and filters to a storage reservoir. Exhibits A-1 and B-1 in the Appendices are schematics showing the path of water through the major equipment. From the intake (upper left of Exhibit A-1), water flows to a wet well to be pumped by low service pumps through a flowmeter and mixers to the flocculation tanks. From these tanks, water flows by gravity through the granular filters to the filtered water reservoir, where it is pumped by high service pumps to the distribution system.

The subsystems serving this primary system are numerous. Chemicals must be added to the water at the various locations shown in Exhibit A-1. Ammonia, polymer, alum, chlorine, and fluoride storage and feed systems shown in Exhibits C-1 through C-5 are the chemical treatment subsystems. These subsystems inject chemicals into the water to cause coagulation of solids within the raw water, to kill organisms in the water or to enhance the quality of the water.

Systems to remove accumulated solids from the filter are the backwash subsystems. Backwash pumps and blowers deliver water and air under the filters during the filter wash cycle. Filter backwash water carrying the solids drains to an infiltration bed or lagoon where the solids are stored until ultimate disposal.

The plant also has subsystems for ensuring water quality and informing operators of plant efficiency. Water turbidity is sensed in continuous samples by turbidity meters. A schematic of this subsystem is shown in Exhibit D-2. A laboratory in the plant is used to check water quality and explore ways of increasing water quality and plant efficiency through modification of chemicals and process rates.

Instrumentation and control subsystems sense the state of processes and control equipment. Water levels, flow rates, and pressures are sensed to give information to operators, activate equipment or trigger alarms. Equipment On/Off states are sensed and switches are changed to energize or de-energize systems. A diagram of some of the instrumentation is shown in Exhibits G-1

and G-2 of the Appendix G. The instrumentation and control systems are primarily electromechanical. Pressurized air, however, is used in bubbler controllers in the low service pump wet well, the alum tanks, the boiler and the storage reservoir. A schematic of the air subsystem is shown on Exhibit D-3.

Energy subsystems provide power to the previously described system and subsystems. Electricity powers the motors of pumps, mixers, blowers and compressors as well as energizing solenoid valves, controls and lights.

Electrical circuit diagrams for the plant are shown in Exhibits F-1, F-2 and F-3. Natural gas, shown in Appendix D, Exhibit D-1, is utilized for building heat, hot water and certain laboratory uses.

Buildings provide protection for the process equipment and operators. The Filtration Building and High Service Pump Building have subsystems typical of most buildings. They have subsystems of plumbing, i.e. hot water supply, cold water supply and drainage with associated fixtures. They have heating and ventilating subsystems. Hot water is distributed from the boiler to the unit heaters and equipment as shown in Exhibit E-1. Blowers and ducts distribute or collect the heated or cooled air in the Filter Building. The buildings have typical electrical subsystems with circuits to outlets, lights and miscellaneous equipment. Exhibit F-3 in Appendix F shows the lighting panel schedules for the Control Room, the Garage, and the High Service Pump Building.

In summary, the filtration plant is a set of interlocking subsystems serving the obvious function of transforming raw lake water into potable water.

II. PERMITS AND STANDARDS

A. General

The City of Charlevoix Water Filtration Plant has been designed to meet Federal and the Michigan Department of Public Health Standards, as promulgated in the Safe Drinking Water Act, Act 399, P.A. 1976 and Administrative Rules established.

A copy of the Safe Drinking Water Act is in Appendix J. Additional copies of the Safe Drinking Water Act are available from the Michigan Department of Public Health, 3423 N. Logan Street, P.O. Box 30035, Lansing, Michigan 48909.

Charlevoix is currently designated as part of Region 1, District 8, which is administered by Michael P. Kovach, P.E. (517-335-8325, Regional Engineer), and Ira Gabin, P.E. (517-335-8330, District Engineer).

The permit to construct the Charlevoix Water Filtration Plant was granted by the MDPH under provisions of Section 4 of Act 399 on July 30, 1985, Permit Number W850863. A copy of the permit is contained on pages II-2 through II-4.

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

DIVISION OF WATER SUPPLY

Bureau of Environmental and Occupational Health

THIS PERMIT IS ISSUED UNDER PROVISIONS OF SEC. 4 OF ACT 399 P.A. 1976, FOR CONSTRUCTION, OR ALTERATION, OF A WATER WORKS SYSTEM OR PORTIONS THEREOF DESCRIBED HEREON. IT DOES NOT OBVIATE THE NEED TO SATISFY VARIOUS REQUIREMENTS OF OTHER AGENCIES.

William A. Kelley, P.E. — CHIEF, DIVISION OF WATER SUPPLY

City of Charlevoix
210 State Street
Charlevoix, Michigan 49720
Attention: Mr. Michael Wiesner
City Manager

Cletus L. Courchaine, P.E., Chief
Northern Peninsula Division, Escanaba
Lee E. Jager, P.E., Chief, Bureau of
Environmental and Occupational Health
Bailus Walker, Ph.D., Director

PERMIT NUMBER	DATE ISSUED	ISSUED TO	
W850863	July 30, 1985	City of Charlevoix	1330

ISSUED BY

Timothy A. Benton, P.E., District Engineer

August 5, 1985

This permit is for construction of the following water treatment plant and related facilities in the City of Charlevoix in accordance with plans and specifications prepared by McNamee, Porter and Seeley, Engineers and Architects.

A direct filtration water treatment plant including the following:

Raw Water Line

24 inch diameter pipe from the valve vault to the low service suction well.

Low Service Pump Station

2 - low service pumps each rated at 1400 gpm at 40 feet TDH.

Treatment Plant

1 - inline 12 inch diameter mechanical mixer.

2 - upflow flocculation basins, one basin equipped with draft tube, variable speed propeller mixer, flocculation cylinder, and circular collection launder.

This permit consists of 3 page(s).

This permit is valid for 2 years from date of issuance. If construction is not commenced within 2 yrs., a permit extension may be applied for in writing by identifying the project and the number on the permit for which the extension is requested.

It is a condition of this permit that the permittee give notice to public utilities pursuant to Act No. 53 of the Public Acts of 1974, as amended (MCLA 460.701 et seq.), and comply with the requirements of that Act.

Issuance of this permit is in compliance with the provisions of Executive Order 1974-4 and Guidelines of the Michigan Environmental Review Board issued pursuant thereto.

Treatment Plant (continued)

4 - filter cells, three cells equipped as rising head filters each with an area of 182 square feet and constructed with 20 inches of anthracite, and 12 inches of sand.

Chemical Feed Equipment

2 - raw water chlorinators each rated at 500 pounds per day (relocated equipment).

1 - finished water chlorinator rated at 100 pounds per day.

1 - raw water ammoniator rated at 45 pounds per day.

2 - positive displacement liquid alum feed pumps each with a recommended capacity rated of 12 gallons per day.

1 - 6000 gallon liquid alum storage tank.

2 - positive displacement fluoride feed pumps each with a recommended capacity of 12 gallons per day.

2 - mixing tanks, mixers, and positive displacement type feed pumps for the addition of polymer or activated carbon.

Filter Backwash Equipment and Facilities

2 - backwash assist pumps, each rated at 600 - 930 gpm at 14 to 4 feet TDH.

2 - air blowers for air backwash of filters each rated at 350 - 550 cfm at 4 psi.

1 - two cell backwash water infiltration basin.

High Service Pump Station

2 - high service pumps each rated at 1000 gpm at 225 feet TDH.

1 - high service pump rated at 2000 gpm at 240 feet TDH.

Finished Water Storage Reservoir

1 - two cell 500,000 gallon finished water storage reservoir.

Related Equipment and Facilities

A complete laboratory for potable water bacteriology and chemistry analyses.

This permit is subject to the following conditions:

The city shall submit for review and approval plans and specifications for providing standby power for the treatment plant and pumping facilities.

The city shall submit a schedule for completing the equipping of the second flocculation basin and fourth filter cell and for providing a firm low service pumping capacity of a minimum 2.4 mgd.

This project has been reviewed according to departmental guidelines for the implementation of Executive Order 1974-4 and no significant environmental impact is expected.

Since one copy was received, we are retaining it for our records.

TAB:iv
cc: McNamee, Porter & Seeley -
Engineers and Architects
cc: U.S. Army Corps of Engineers
Attention: Mr. Stan Carlock
cc: U.S. Environmental Protection Agency
Attention: Mr. Jack Kratzmeyer
cc: Department of Natural Resources
Attention: Mr. T. Eftaxiadis
cc: District Health Department No. 3 (Charlevoix)

III. PROCESS DESCRIPTION, OPERATION AND CONTROL

This section describes in detail the various processes required for effective water treatment. Process flow diagrams are given in Chapter X, APPENDICES, and will be referred to throughout this chapter. It is strongly recommended that these diagrams be used in conjunction with the text to aid in understanding the written material.

In general, the operation and maintenance manuals provided by the manufacturers of the equipment should be referred to for basic maintenance and lubrication, instructions, parts lists, etc. The maintenance items in this manual are basically general and intended to supplement the specific items required by the equipment manufacturers.

Each individual section of this chapter is divided into 3 parts as listed below:

- General Description
  This part contains an overall description of the particular process and equipment involved.

- Specifications
  This part lists the major components of the particular system, applicable equipment data and individual equipment manufacturer.

- Normal Operation
  This part describes methods of control and anticipated daily operations.

A. Raw Water Intake

1. Description (See Exhibits A-1 and B-1)
   The raw water intake is the piping and infiltration bed located upstream of the low service pump wet well. It consists of 24-inch pipe, valves, valve vault, and infiltration bed with 14-inch diameter horizontal well screens under granular filter material located approximately 1400 feet offshore of the plant site. The intake was designed to filter lake water and provide a low turbidity source of water for the plant. A chlorine diffuser for prechlorination was installed 200-ft. downstream of the filter bed to provide a means of prechlorination.

2. Specifications

a. Piping

Diameter	Approx. Length	Class	Material	Mfr.
24"	40'	52	MJ DIP	NAPPCO
24"	1485'	SDR17	High density polyethylene	NIPAK

b. Valves

Size	Type	Label	Location	Jt.	Operator	Accessories	Mfr.
24"	Butterfly	B-1-1	Valve vault	FJ	WN	ES, WB, FB	Mueller
24"	Butterfly	B-1-2	Valve vault	FJ	WN	ES, WB, FB	Mueller
16"	Butterfly	B-2-1	Infiltration Bed	FJ	WN	ES, VB	Mueller
16"	Butterfly	B-2-2	Infiltration Bed	FJ	WN	ES, VB	Mueller

c. Appurtenances

1) Valve vault with access for chlorine supply line.

2) Emergency intake (i.e., end tee with blind flange on riser)

3) Concrete flotation collars

d. Intake Bed

Dimensions: 32-ft. x 66-ft.

Area: 212 sq. ft.

Screen:

Manufacturer: Johnson Division
Material: Type 304 stainless steel
Capacity: 26.83 gpm/ft
Size: 4-25-ft. 14-inch O.D. sections
Slot Size: #30 (0.030 inch)

Filter Material:

Supplier:	**American Materials Corp.**
Type:	**Granular**
Effective Size:	**0.036-inch - 0.05-inch**
Uniformity Coefficient:	**less than 2**

e. Design

1) Provide an infiltration rate of 1.3 gpm/sq.ft. through filter material and into intake pipe.

2) Provide means of early prechlorination.

3) Provide an emergency intake at end of line during periods when filter screens are disabled.

4) Allow backwashing of screens and filter material from bypass piping to high service pumps.

3. Normal Operation

During normal operation, the 24-inch butterfly valve, B-1-2, in the valve vault and both 16-inch butterly valves in the infiltration bed would be full open. Enough raw water would flow by gravity from Lake Michigan through the filter bed, screen, and piping to the wet well. The pores in the filter bed may clog as lake water with silt and debris is drawn. Eventually, the resistance to flow or headloss could prevent sufficient water from reaching the wet well to either provide minimum submergence of the pumps or sufficient suction head for the pumps. When the headloss becomes too great, the filter bed must be backflushed. Backflushing is not a normal operation and may never be required. Its description can be found in Section IV.

B. Wet Wells

1. Description (See Appendices A and B, Exhibits A-1 and B-1)

Pumps draw water from small reservoirs called wet wells. Wet wells, usually made of formed concrete, are sized to permit spacing of pumps and piping for good hydraulics and maintenance, to allow a sufficient volume of water for proper pump cycling, and to minimize detention time if the water can

become septic. In the water plant, the shapes of the wet wells are controlled by need for good hydraulic flow from influent pipes or channels and around pump intake bells. The bottoms of the wells are nearly level, since solids deposition is not a common problem in a direct filtration water plant.

The Charlevoix Plant has wet wells for low service pumps, high service pumps, backwash pumps and sump pumps. The sump pump well is normally called a sump, which accumulates flood drainage at the low point.

The low service pump wet well receives water by gravity flow from the plant intake. The flow into this well will match the discharge rate so that additional storage for proper pump cycling time is unnecessary.

The well for the wash pumps is supplied by filters not being washed, and if necessary, reverse flow from the reservoir supply line. Its water level will be approximately equal to that in the high service pump well. The inflow to the well will match the discharge of the wash pumps.

The high service pump wet well is open to and can be considered to include the two halves of the filtered water reservoir. This well is divided in half so that each half can be in use while the other is removed from operation.

Both low and high service pump wells have entrance hatches, vents to allow the wells to breath as the volume of water within them changes, alarm floats and bubbler tubes. Water level data is sensed by the bubblers and transmitted to recorders for a permanent record of fluctuation.

2. Normal Operation

The water level in the wet well for the low service pumps will be the same as Lake Michigan before the pumps start. The water level will drop several feet after the pumps start and then return to a couple feet below the lake level during pump runs. These levels will be sensed by a bubbler and recorded.

The backwash pumps and high service pump wells will have a water level about the same as that for the reservoir before, during and after pump runs.

The water level will be sensed by a split bubbler in the high service pump wet well and transmitted to a recorder.

The wells require no maintenance. They need to be checked if sand is migrating into the wells from the intake or filter bed, or if equipment such as alarm floats, bubblers or pumps is malfunctioning.

C. Low Service Pumps

1. Description (See Appendices A, F, and G, Exhibits A-1, F-1, F-2 and G-1)

The low service pumps are vertical turbine pumps which lift raw water from their wet well through piping containing valves and rapid mixers to an elevation in the flocculator tanks sufficient to permit flow by gravity through the treatment plant. Air relief valves at the top of the discharge pipe provide exhaust of air trapped in columns and piping. Check valves prevent backflow in the pump and butterfly valves provide means of pump isolation.

2. Specifications

a. Pumps

Designation:	LS-1	LS-2	LS-3	LS-4 (future)
Manufacturer:	Aurora	Aurora	Aurora	—
Model:	Verti-line	Verti-line	Verti-line	—
Series:	1110	1110	1110	—
Number of Stages:	1	1	1	
Capacity:				
GPM:	1400	1400	1700	—
Head:	40	40	40	
Motors				
Manufacturer:	USEM	USEM	USEM	—
Horsepower:	20	20	25	—
RPM:	1150	1150	1750	—
Type:	TEFC	TEFC	WP-1	—
Voltage:	380	380	380	
Phase:	3	3	3	—
Frequency:	60 Hz	60 Hz	60 Hz	—
Butterfly Valves				
Designation:	B-2-1	B-2-2	B-2-3	B-2-4
Size (inch):	12	12	12	—
Manufacturer:	Allis-Chalmers	Allis-Chalmers	Allis-Chalmers	—
Model:	12-150B-F	12-150B-F	12-15B-F	—

Check Valves

Designation:	RC-1-1	RC-1-2	RC-1-3	RC-1-4
Size (inch):	12	12	12	—
Manufacturer:	G.A. Ind.	G.A. Ind.	G.A. Ind.	—
Model:	Fig. 280D	Fig. 280D	Fig. 280D	—

Relief Valves

Manufacturer:	Multiplex Mfg. Co. Crispin
Model:	2" deep well air vent

3. Normal Operation

At the start of each working day two pumps will be turned on. These will operate until sufficient water has been stored in the reservoir to satisfy potential needs of the day or needs until succeeding start-up. At the end of the operating period, both pumps are turned off. A detailed explanation of power and controls for the pumps is as follows.

Low Service Pumps 1, 2 and 3 receive power from MCC-A (1), B (2) and A (3), respectively. These pumps may be operated in the Hand or Remote mode as selected on a Hand-Off-Remote selector switch located at the motor starter. In the Hand position, the operator starts and stops each pump using a push button station located at the pump. When operating in this mode, the pump will run continuously until power is discontinued. In the Remote position, the pumps are independently operated in the On position as selected using On-Off selector switches HS-1-1, HS-1-2 and HS-1-3, located at the main control panel. The pumps will run in the On position if the water level in the wet well is higher than the Low Water Cut-off (elevation 567.5) and the water level in either of the filter water reservoirs is lower than elevation 601.0. If the level in either of the filter water reservoirs exceeds 601.0, it will activate the Reservoir High alarm located at the main control panel. When this occurs, reset button HS-5, located at the MCP, must be pushed before the pumps will

operate again. If the pumps should stop due to a loss of power, a 0-15 second timer (set at 5 seconds) will allow for automatic restart. Each pump is provided with an Elapsed Time Indicator and a Red Running Light which are located at the motor starter. Running indication is provided at the Main Control Panel by green pilot lights.

D. Rapid Mix Units

1. Description (See Appendices A, F and G, Exhibits A-1, F-1 and G-1)

Particles in the raw water must be gathered together or coagulated before they can be filtered. The first step of coagulation, the destabilization of particles, occurs in a rapid mix unit. These in-line mixers cause destabilization of particles by inducing particle collisions in the presence of a "sticky" coagulant chemical such as alum, ferric chloride, ferric sulfate or various anionic or nonionic polymers. For efficient use of the alum, it is injected just upstream of the mixing element. After the alum has been mixed, a polymer may be added to grow larger particle clumps or flocs and sometimes to aid the filter. Two types of in-line rapid mixers are present in the plant. One is a mechanical mixer with motor-driven dual opposed propellers and the other is a static mixer consisting of a series of fixed, helical elements enclosed within a tubular housing.

2. Specifications

a. Mechanical Mixer

Manufacturer:	Tonka Equipment Co.
Model/Series:	12-inch In-line Mechanical
Capacity:	Effective dispersion of 0.25 gpm to 2.5 gpm of coagulant solution per mgd flow of water. Sized for 3 mgd.
Motor Data:	3/4 Hp, 1725 rpm 3 Ph, 60 Hz, 460V, NEMA 56C Frame Class F Insulation

b. Static Mixer

Manufacturer:	Chemineer
Model/Series:	12-inch KME-FRP 2 w/integral flange and injector
Capacity:	Effective dispersion of 0.25 gpm to 2.5 gpm of coagulant solution per mgd flow of water. Sized for 3 mgd.
Pressure Rating:	50 psi

3. Normal Operation

With a near optimal feed rate for alum and/or polymer selected, the raw water is pumped through either mixer while the coagulant is injected. If the mechanical mixer is the selected mixer, its motor must be on to violently agitate the water as it passes through the mixer. Nothing is required for the static mixer except to ensure that the chemical feed system is running with an optimal feed rate. Control of the mechanical rapid mixer is as follows:

The mixer receives power from the MCC-A(13). This mixer may be operated in the Hand or Remote mode as selected on a Hand-Off-Remote selector switch located at the motor starter. In the Hand position, the plant operator starts and stops the mixer using a push button station located at the mixer. When operating in this position, the mixer will run continuously until power is discontinued. In the Remote position, the mixer operates using On-Off switch HS-2 located at the Main Control Panel. The mixer will operate in the Remote position at the motor starter by selecting the On position at the Main Control Panel. Running indication is provided at the Main Control Panel by green pilot lights, and at the motor starter by red pilot lights.

E. Floculation Tanks

1. Description (See Appendices A, B, F and G, Exhibits A-1, B-1, F-1, F-2 and G-1)

The second step in the coagulation of particles in the water is flocculation. For approximately 30 minutes, the raw water treated with dispersed coagulant is gently agitated to gather the small particles and coagulate them into large floc particles. Unlike a conventional water treatment plant, the Charlevoix direct filtration plant does not have a clarifier or settling basin for the flocs. The flocs are transported from the flocculation tanks directly to the filter bed where they are either absorbed or strained until they are backwashed from the bed.

The bottom of the tank was designed to be the same elevation as the filter floor slab. To ensure mixing in a tank of this depth, a draft tube flocculator is used. The water enters the center draft tube near its bottom. A variable speed propeller draws the water entering the flocculator along with recirculating water entering the ports of the draft tube bottom up through the tube.

At the top of the tube, the water exits through ports. To prevent short-circuiting, i.e. flow of fresh water directly to the tank outlet, a 9.5 foot diameter cylinder shell or shroud is placed around the draft tube. The water leaves the outlet ports of the draft tube, flows down either to the entrance ports of the draft tube or around the shroud bottom, and then rises vertically to a peripheral collection launderer. The launderer is attached to the outside top of the shroud. The launderer collects the water and conveys it to a channel which discharges at the filter.

Water velocities through the flocculation tanks are important to the growth, size, and transport of the flocs. The velocities throughout the tank must be kept above 0.3 to 0.4 feet/minute to prevent settlement of flocs to the tank bottom. A minimum of 0.7-ft. per minute occurs during a flow of 1 mgd through the tank. A maximum average rate from time of entrance to exit of the tank must be 1.5-ft. per minute. At 3 mgd, the average rate is 0.44-ft. per minute. Recirculating velocities may need to be increased if the floc size grows too large for good filter efficiencies. This can be accomplished by increasing the speed of the variable speed mixer.

3. Specifications

a. Two High Energy Flocculation Tanks

Design Flow Rates for each tank:	
Design:	2.0 mgd
Average:	1.5 mgd
Minimum:	1.0 mgd
Maximum:	3.0 mgd:
Each Basin Size:	14-ft. x 14-ft.
Side Water Depth:	21-ft. - 4-inch
Total Basin Wall Depth:	22-ft. - 0-inch
Each Basin Volume:	31,228 gallons
Detention Time in Basin:	
At Design Flow:	22.5 minutes
At Average Flow:	30 minutes
At Minimum Flow:	45 minutes
At Maximum Flow:	15 minutes

b. Flocculator Details

Manufacturer:	Tonka Equipment Co.
Motor Type:	Eurodrive D-32, Varimot Variable Speed
Motor Size:	5 Hp, 460V, 3 Ph, 60 Hz
Speed Variator:	Traction disc type, 5:1 turndown
Gear Reducer:	Parallel-helical type
Impeller:	Marine type propeller

Recirculation Rate:	8328 gpm max., 2020 gpm min.
Velocity Gradient, G:	158 Sec^{-1} max., 21 Sec^{-1} min. (based on flocculation cylinder volume)
Draft Tube:	50-inch diameter, 1/4-inch aluminum
Flocculation Cylinder:	9-ft. - 6-inch dia., 1/4-inch aluminum
Launder Size:	11-ft. - 6-inch OD x 9-ft. - 6-inch ID x 1-ft. - 11-inch deep, 1/4-inch aluminum construction, with 20-inch wide discharge channel

c. Velocities

Draft Tube:	1.4 ft/sec*
Between Draft Tube and Flocculation Cylinder:	0.32 ft/sec* *Based on maximum recirculation rate of 8328 gpm
From Floccuation Cylinder to Basin Floor:	
At 3.0 mgd:	2.1 ft/min.
At 1.5 mgd:	1.1 ft/min.
At 2.0 mgd:	1.4 ft/min.
At 1.0 mgd:	0.7 ft/min.
Between Flocculation Clyinder and Basin Walls:	
At 3.0 mgd:	2.23 ft/min.
At 1.5 mgd:	1.11 ft/min.
At 2.0 mgd:	1.48 ft/min.
At 1.0 mgd:	0.74 ft/min.
Shortest Path Average Velocity:	
At 3.0 mgd:	0.44 ft/min.
At 1.5 mgd:	0.22 ft/min.
At 2.0 mgd:	0.29 ft/min.
At 1.0 mgd:	0.15 ft/min.

3. Normal Operation

Through experience with various drive speeds and chemical feed rates, a near optimum speed should be selected for the drive. Once the preferred RPM has been found, the flocculator motor will be set to run at that speed during daily operations. Speeds may need to be adjusted during the day if flow through a basin is changed, if characteristics of raw water change or if chemical feed rates are modified. The speed may need to be increased if the floc size grows too large or if significant settlement of flocs within the tank occurs.

Control of the flocculators is as follows:

Flocculators 1 and 2 receive power from MCC-A(9) and B(9), respectively. These flocculators may be operated in the Hand or Remote mode as selected on a Hand-Off remote selector switch located at the motor starter. In the Hand position, the plant operator starts and stops each flocculator using a push button station located at the flocculator. When operating in this position, the flocculator will run continuously until power is discontinued. In the Remote position, the flocculators are independently operated using On-Off switches (HS-3-1 and HS-3-2) located at the Main Control Panel. The flocculators will operate in the Remote position at the motor starter by selecting the On position at the Main Control Panel. Running indication is provided at the Main Control Panel by green pilot lights, and at the motor starter by red pilot lights.

F. Filters

1. Description (See Appendix A, B, F and G, Exhibits A-1, B-1, F-2 and G-1)

The suspended solids or flocs grown in the flocculation tanks must be removed. In direct filtration plants, these are removed in granular bed filters such as the gravity dual media filters in the Charlevoix Plant. Removal of the flocs occurs primarily within the filter bed and is called depth filtration. The mechanisms of removal are a simple process of straining and a more complex process of absorption in which particles are transported near surfaces of the media granules and attached through electrostatic interactions, chemical bridging or specific absorption. The latter removal process is more dependent on physical characteristics of the water, the filter media and the coagulants applied than the former.

During a filter run, the degree of dominance of one mechanism may change relative to the other. Sediments build up and are carried deeper and deeper into the filter bed. Eventually, either higher filter velocities carry solids beyond the bed or headloss due to the clogged filter media becomes so great that the run must be terminated and the filter bed must be washed.

Choice of media is important to capture solids, to extend run times and to retain the structure of granules after backwashing. A sand too fine resists passage of water while a sand too coarse permits passage of solids. An effective size of 0.45 to 0.55 and uniformity coefficient of up to 1.65 is

appropriate for the sand filter. Anthracite granules as a top media have been found to more than double the filter run time. Its effective size should range from 0.8 to 1.2 and its uniformity coefficient should not exceed 1.85.

The filter bed is where the primary function of the filtration plant occurs. Its layout and supporting systems, however, are critical to a continuous operation. The filter must be divided into cells, each of which must be periodically removed from service for cleaning. A description of the layout is as follows. Treated water from the flocculation tanks or pipe bypassing the tanks is channeled in an inlet flume under a walkway to the distribution box at the central juncture of four filter cells. Through control of valves in the distribution box, the water is allowed to flow by gravity into the operating filter cells.

It then passes through the dual filter media of 20-inch anthracite over 12-inches of sand and through diffuser nozzles in the underdrain top slab to a space under the filters called the underdrain. From the underdrain of each cell an effluent pipe carries the filtered water to a clear well from which it flows over a level control weir into a second well. The second well is the wet well for the backwash pumps and the source well for reservoir supply line.

During filter backwash, other components of the filter are activated. Under the central control console, the filter well inlet valve is closed, allowing the cell to drain down. (The remaining three cells remain in service during backwash of one cell.) Then the cell's backwash valve is opened and water from the clear well along with make-up water from the backwash pumps reverses direction in the cell's effluent pipe, returning water to the underdrain. This water and compressed air from air wash pipes in the underdrain space flows up through the diffuser nozzles and filter media. The upward flow of water "floats" the media, expanding it by up to 50 percent of its volume and washes out the trapped and absorbed matter. After approximately 10 minutes of violent scrubbing action, the air is turned off and the backwash water continues to drive trapped air from the filter and to segregate the filter media, thus preventing higher filter headloss due to an air-bound filter. The flush water is collected by the two backwash troughs over the filter bed and channeled through the backwash valve and down the single washwater drain.

2. Specifications

Manufacturer:	Tonka Equipment Company
Design Flow Rate:	3 mgd (4 cells) - 521 gpm/cell 2 mgd (3 cells) - 463 gpm/cell
Filtration Area:	546 sq.ft. (3 cells) - 182 sq.ft./cell
Maximum Airwash Rate:	546 scfm (3.0 cfm/sq.ft.)/cell
Maximum Backwash Rate:	2730 gpm (15.0 gpm/sq.ft.)/cell
Underdrain Design:	False bottom - 24" sq. and 12" x 24"; precast concrete slabs - 3" thick reinforced to withstand 1400 lbs/sq.ft load and withstand 600 lbs/sq.ft. uplift force, slabs have distributors on 8" centers.
Filter Media:	Bottom layer - 12" filter sand with an effective size of 0.45 - 0.55 mm and uniformity coefficient less than 1.65. Top layer - 20" anthracite with effective size of 0.8 - 1.2 mm and uniformity coefficient less than 1.85.
Filter Control:	Remote manual, semi-automatic and automatic modes via control console mounted on distributor box - 120 volt, 60 Hertz, 1 phase, 15 amp.
Filter Inlet Distribution Assembly:	8'-0" sq. x 2'-8" height 1/4" welded aluminum construction, structurally reinforced; design flow - 3 mgd.
Center Control Column:	5'-6" diameter x 14'-6" high constructed of Type 304 stainless steel with structural hydrostatic pressure encountered. Unit equipped with 4 S.S. overflow gullets and 4 16" backwash waste valves with stem extensions to work platform located above backwash discharge level.
Washwater Collection System:	Media separation washwater troughs of welded steel construction, structurally reinforced.
Outlet Weir:	2" x 6" redwood planks with holddown clamps
Airwash Piping:	Pipe - 6" ASTM A53 Schedule 40 galvanized with grooved ends. Flanges, fittings and couplings - malleable iron galvanized.

Control Valves

Type: Butterfly, pneumatic cylinder operated with limit switches

Manufacturer: DeZurik

Identification Number	Quantity	Size	Location
B-8-1, B-8-2, B-8-3 B-8-4	4	12"	Cell influent
B-6-1, B-6-2, B-6-3, B-6-4	4	16"	Backwash Effluent
B-7-1 B-7-2, B-7-3, B-7-4	4	18"	Isolation
IB-1-1, IB-1-2, IB-1-3, IB-1-4	4	6"	Airwash Influent

3. Normal Operation

Operations are controlled from the main control console located above the distribution box of the 4 filters. The backwash pumps and blowers are set at their locations to run automatically through interlocks with the controller. Their console switches are set either to Off or to Auto if they should run during automatic operating mode. The outlet weir and high filter headloss floats are adjusted to elevations that optimize filter cycle time and water quality. The drain down timer, airwash timer and backwash timer are set on the console to maximize filter cycle time. The main power switch on the console is On and one of three operating modes has been set for each filter cell. Normally, the operating mode would be semi-automatic, but automatic or manual might be selected to automate the entire process or to manually control each set of the filter cycle.

The operation would proceed as follows for each of the three modes.

a. Semi-Automatic

Rising water in a filter cell trips float switch and lights an alarm light when the terminal head is reached.

Alarm is silenced by manually operating a switch.

Backwash is initiated by manually operating the Semi-automatic Backwash Start switch and will continue automatically to completion with cell return to service as follows:

- **Cell inlet valve is closed, allowing cell to drain down to effluent weir level.**

- **After cell draindown timer has timed out, the cell backwash waste valve automatically opens, beginning the water backwash.**

- Cell airwash supply valve is opened and blower is started to begin a timed simultaneous air scour and water backwash which is controlled by an adjustable duration timer.

- After the airwash timer has timed out, the airwash supply valve is automatically closed, the blower is stopped, and the air purge water wash is initiated.

- After the water backwash timer has timed out, the backwash waste valve is closed and the cell inlet valve is opened, returning the filter cell to service.

b. Manual

Rising water in a filter cell trips float switch and lights an alarm light when the terminal head is reached.

Alarm is silenced by manually operating a silence button.

Cell inlet valve is closed by manually operating a switch allowing cell to drain to effluent weir level.

Cell backwash waste valve is opened by manually operating a switch allowing the cell to drain to the wash trough level and beginning the water backwash.

Cell airwash supply blower is started and valve opened by manually operating respective switches to airwash bed simultaneously with the water backwash.

The cell airwash supply valve is closed, the blower is stopped by manually operating respective switches continuing water backwash to purge accumulated air from the filter bed.

Cell is returned to service by manually closing cell backwash waste valve and manually opening cell inlet valve by operating respective switches.

c. Automatic

Terminal head in a filter cell is reached when rising water trips a float switch, which sounds an alarm, lights an alarm light, and closes the cell inlet valve, beginning the draindown to the effluent weir level.

As draindown begins, the alarm is silenced and the remaining cells on automatic are interlocked in the service position. Contacts for interlocking influent pumps are closed at this time.

Cell backwash waste valve automatically opens, beginning the water backwash.

The cell airwash supply blower is started and the airwash valve opened, beginning the simultaneous air scour and water backwash which is controlled by an adjustable duration timer.

At the end of the simultaneous air scour and water backwash, the air supply valve is closed, the blower is stopped and the air purge water wash is initiated.

When the water backwash timer times out, the backwash waste valve is closed, the cell inlet valve is opened, and all interlock contacts are opened, returning the filter cell to the service mode and allowing other filter cells to be backwashed as necessary.

NOTE: Automatic control has been provided as an operation mode, but use of the filters in this mode should not be done without concurrence from the Michigan Department of Public Health.

G. Submersible Backwash Pumps

1. Description (See Appendices A, F and G, Exhibits A-1, F-1, F-2 and G-1)

The filtered water from the operating filter cells flows by gravity from the clear well to the cell which is being backfilled. This flow is insufficient to scour the filter media, and additional water must be supplied by the backwash pumps.

2. Specifications

Design Backwash Unit Flow Rate:	15 gpm/sq.ft. filter area
Design Backwash Pump Run Time:	10-20 minutes
Required Filter Backwash Flow:	2730 gpm
Required Backwash Pump Discharge @ 2 mgd plant capacity:	1340 gpm
Required Backwash Pump Discharge @ 3 mgd plant capacity;	645 gpm
Backwash Pump Rate at Minimum Reservoir Level:	600 gpm
Backwash Pump Rate at Maximum Reservoir Level:	1000 gpm
Pump Manufacturer:	Hydromatic Pump Co. (Marley Pump Co.)
Pump Type:	Submersible Centrifugal Sewage
Model/Series:	SGL-300
Rated Capacity:	600 gpm @ 14-ft. TDH
Motor Data:	460V, 3 Ph, 60 Hz, 3 Hp, 870 rpm

3. Normal Operation

During normal operation, 3 mgd would be flowing through the plant. One backwash pump, controlled by the filter control console, would be set to come on automatically during a wash episode. Its run time would be determined by the console timer setting. If the plant is operating at 2 mgd capacity, both pumps must be set to run. The controls for the pumps are as follows:

Backwash Pumps 1 and 2 receive power from MCC-A(5) and B(5), respectively. These pumps may be operated in the Hand or Auto mode as selected on a Hand-Off-Auto selector switch located at the motor starter. In the Hand position, the operator starts and stops the pumps using a push-button station located at the pump. In the Hand or Auto mode, the pumps are interlocked with the backwash control console. Refer to the backwash control console O&M manual for a description of the interlock. Each pump is provided with an Elapsed Time Indicator and a Red Running Light, which are located at the motor starter.

H. Airwash System

1. Description (Exhibit A-1, F-1, F-2, G-1)

A combination air-water backwash of filters has been found to be far more effective in cleaning the media than water flush alone. Not only is the abrasion of media granules increased, but mudballs that form on the bed surface are eliminated. The air breaks up larger solids in the freeboard space above the bed, carrying the pieces to the trough.

The air system consists of two rotary positive displacement blowers with intake piping from a common exterior filter silencer. The discharge piping distributes air to a perforated pipe in the underdrain of each filter cell. The discharge piping has a silencer, isolation check and butterfly valves, and pneumatically operated control valves to each filter cell. Excessive discharge pressure can be expelled through a relief line with relief valve and exterior unloader silencer. The system has controls at the motor control center and the main control console of the filters.

2. Specifications

Design Capacity:	350 cfm - 550 cfm @ 4 psi 2 - 3 cfm/sq.ft. of filter
Blower Manufacturer:	Sutorbilt
Type:	F Series, vertical, rotary positive displacement
Model:	5 LVF
Motor:	15 Hp, 180 rpm, TEFC, 1.15 SF, 460V, 3 Ph, 60 Hz, Model 254TTFL5726

3. Normal Operation

One blower, controlled by the main filter control console, would be set to come on automatically during a wash episode. Its run time would be determined by the console timer setting.

Backwash Blowers 1 and 2 receive power from MCC-A(7) and B(7), respectively. The blowers may be operated in the Hand or Auto mode, as selected on a Hand-Off-Auto selector switch located at the motor starter. In the Hand position, the plant operator starts and stops the blowers using a push-button station located at the blowers. In the Hand or Auto mode, the blowers are interlocked with the Backwash Control Console (BCC). Refer to the BCC O&M Manual for description of the interlock. Each blower is provided with

an Elapsed Time Indicator and a Red Running Light, which are located at the motor starter.

L. High Service Pumps

1. Description (Exhibits A-1, B-1, F-3, G-1)

The high service pumps deliver water to the distribution system. By filling elevated tanks within the system, the pumps provide the water at pressures required by the users. The pumps are sized to provide maximum day demand plus fire flow with the largest pump out of service. For a large fire requiring 3500 gpm on maximum day, it has been assumed that approximately 1150 gpm would drain from elevated storage while one large pump and two smaller pumps are pumping. Greater storage of water for additional flow from elevated tanks will be required if a large pump is either not installed or down for service. Only three vertical turbine pumps with associated discharge piping, isolation butterfly valves, check valves and air relief valves on vent piping were installed initially. Space had been provided for future installation of a fourth pump.

2. Specifications

Pumps:				
Designation:	HS-1	HS-2	HS-3	HS-4 (future)
Manufacturer:	Aurora	Aurora	Aurora	—
Series:	1110	1110	1110	—
Model:	Verti-line	Verti-line	Verti-line	—
No. Stages:	3	4	4	—
Capacity:				
GPM	2000	1000	1000	—
Head	240	225	225	—
Motor:				
Manufacturer:	USEM	USEM	USEM	—
Horsepower:	150	75	75	—
RPM:	1770	1770	1770	—
Type:	TEFC	TEFC	TEFC	—
Voltage:	460	460	460	—
Phase:	3	3	3	—
Frequency:	60	60	60	—
Butterfly Valves:				
Designation:	B-10-1	B-10-2	B-10-3	B-10-4
Size (inch):	12	12	12	—
Manufacturer:	Allis Chalmers	Allis Chalmers	Allis-Chalmers	—
Model:	12-150B-F	12-150B-F	12-150B-F	—

Check Valves:

Designation:	**RC-2-1**	**RC-2-2**	**RC-2-3**	**RC-2-4**
Size (inch):	**12**	**12**	**12**	**—**
Manufacturer:	**GA Ind.**	**GA Ind.**	**GA Ind.**	**—**
Model:	**FIG 280D**	**FIG 280D**	**FIG 280D**	**—**

Relief Valves:

Manufacturer:	**Multiplex Mfg. Co., Crispin**
Model:	**2" deep well air vent**

3. Normal Operation

The high service pumps will normally operate automatically 24 hours each day. The starting and stopping of the pumps will be controlled by sensors of water elevation at the elevated tank and ground storage reservoir. Although the pump on/off elevations were set at time of plant start-up, these elevations may be raised or lowered to suit seasonal operations. For example, during winter, a period of lowest water demand, the pump on/off elevations may be spread further to allow greater movement of stored water and thereby, prevent freezing and aging of water within the elevated tank. Alternately, pumps may be turned off for a safe duration to allow greater fluctuation of water levels. The pump order, i.e., lead, lag 1, lag 2, and lag 3, may be changed if any pump is used much more than another. One of the smaller pumps should be kept at the lead position (mode 1), however, since it has higher efficiencies at the lesser flows. A detailed explanation of the pump controls is as follows.

- Pumps 1, 2 and 3 receive power from MCC-C(1), D(1) and C(3), respectively. These pumps operate in the On or Auto mode as selected on an On-Off-Auto selector switch located at the motor starter. When operating in the On position, these pumps will operate continuously until power is discontinued. The Auto mode is used with pump selector switches HS-8-1, HS-8-2, HS-8-3 and HS-8-4 (future pump), located at the main control panel. Using these switches, the pumps may be set to On-Off-Mode 1, Mode 2, Mode 3 and Mode 4. The pumps should be set in each operating position, and selection (mode of operation) for each pump should rotate periodically to equalize pump usage/wear. When operating in the On position, as selected at the main control panel, the pump(s) will run continuously until the level in the North or South reservoir drops below elevation 585.25. When this occurs, the pumps will stop and North

Reservoir Low (LAL 5-2) and/or South Reservoir Low (LAL 5-1) alarms, located at the MCP, will be activated. If the low level in the reservoirs has been achieved, the pumps will not restart until the water level in the reservoir tank is replenished and reaches an elevation of 587. A float in the north reservoir (LSM-5-5) and/or in the south reservoir (LSM-5-2) will signal for pump restart once the elevation is attained. When power is restored after an outage, the pumps will automatically restart after time has elapsed on a 0-15 second timer set at 3 seconds. A second timer has been provided to guard the pumps against momentary (6 seconds or less) loss of power.

When placed in the Auto position using the selector switch at the motor starter, the pumps operating in Mode 1, 2, 3 or 4 (as selected on the switch located at the main control panel), will not run if one of the following 3 conditions occurs:

- The water level in the north or south reservoir is below Reservoir Low elevation 585.25.
- The water level in the elevated tank reaches a high level elevation 776.5 at which point Elevated Tank High (LAH-8) alarm, located at the MCP, will be activated.
- There is a zero signal in telemetry (LS-8-7) due to a signal failure between the tank and the transmitter. If this happens, an Elevated Tank Zero Signal Shutdown (UA-8-2) alarm will be activated at the MCP. If there is a loss of signal between the transmitter and the receiver, a Telephone Line Loss of Carrier alarm will be activated at the MCP.

When the level in the elevated tank lowers to elevation 748.0, an Elevated Tank Low (LAL-8) alarm will be activated at the MCP. The following are the water elevations in the elevated tank which signal the pumps in the reservoir to begin and end operations:

A pump in mode	Starts the pump at water elevation in elevated tank	Stops pumping at water elevation
1 (LS-8-2)	773	776
2 (LS-8-3)	772	775
3 (LS-8-4)	767	770
4 (LS-8-5)	761	764

All pumps are protected from overheating by a motor thermoswitch which detects high motor temperature. When this occurs, after time has elapsed on an 0-10 second timer (set at 2 sec.), Hot Motor Winding light is activated at the motor starter, High Service Pump Failure alarm (UA-6) located at the main control panel is activated and the motor shuts off, which locks the pump out. The plant operator shall determine which of the pumps has failed. The pump cannot be restarted until the motor has cooled sufficiently and the thermal reset button has been pushed. A Test Thermal push button has been provided for periodic testing of the thermoswitch.

If power to the pumps has been interrupted, the motors cannot be restarted until time has elapsed on a 0-5 minute timer. These timers for the pumps should be set to prevent simultaneous start-up of the pumps after a power failure.

At the present time, three high service pumps are available for use in these modes. Control logic has also been provided for a future (fourth) high service pump.

An elapsed time indicator and Red Running Light located at the motor starter have been provided to indicate pump operation. Should any of these pumps fail, High Service Pump Failure alarm UA-6 will be activated at the MCP.

J. Filtered Water Reservoir

1. Description (See Exhibit B-1)

The 1.0 million gallon filtered water reservoir has approximate dimensions of 80-ft. x 120-ft. x 16-ft. side water depth. The reservoir has provisions for chlorinated water to flow into one end of the tank and be withdrawn from the opposite end with the high service pumps. The reservoir bottom is at elevation 585 (USLS Datum), which is higher than the maximum recorded level of Lake Michigan (584.81). The reservoir is divided in half to permit maintenance.

Filtered water storage has been sized in conjunction with the 0.3 mg elevated storage tank to meet the demands for maximum day and peak hour flow equalization, to provide adequate detention time to satisfy chlorine contact requirements and to provide storage to meet fire flow requirements.

2. Specifications

Storage Volumes:

Plant Size (mgd):	3
Max. Day Equalization (mg):	0.63
Chlorine Detention Time (mg):	0.24
Fire Storage (mg):	0.63
Total Storage (mg):	1.5
Storage at WTP (mg):	1.0

3. Normal Operation

During normal operation, both sections of the reservoir will have equal amounts of water whose combined total gives sufficient reserve for normal user and fire flow demands.

With an average of 1 mgd water usage in Charlevoix, the reservoir will steadily fill during plant operations. After eight hours of plant operation, the reservoir should be sufficiently full for the day, providing the day had been started with a reserve for fire demand. During dry summer months the reservoir will fill more slowly and the plant will need to operate for more than 8 hours.

The reservoir will ebb to its lowest amount in the morning before the plant starts its daily operation. If a major fire occurred before plant start-up on maximum day, over 630,000 gallons of stored water may be needed. Furthermore, if only 0.15 mg came from the elevated tank, then half of the water in the ground storage reservoir would be required. This is the extreme case and maintaining a half mg reserve may not always be desired. During low season, less water might be stored to ensure freshness of the water. Filling of the reservoir may have daily variations as well as seasonal variations. During some days of the week, the reservoir may be filled to capacity so as to permit fewer hours of plant operation on the following day.

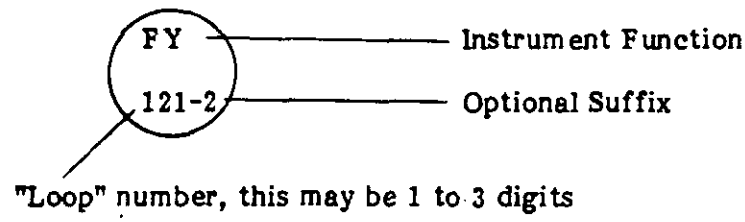
K. Instrumentation

1. Description (Exhibits G-1 and G-2)

The process instrumentation system's prime objective is to control the treatment process automatically as directed by the plant operator. This includes the automatic sensing of all necessary operating parameters and the control of all required final elements to maintain the process.

The secondary objective, but as important as the primary objective, is information gathering. It is a regulated requirement and it is desirable to record data on all plant process variables. All flow variables should also be continuously integrated with respect to time in order to obtain total flow data. A means must be provided for the interpretation of process data and to take into account analytical data from the laboratory to alter the commands to the control system for improving the quality of treatment.

Because of the size and complexity of the plant it is desirable to have a method of identifying the various instruments, valves, pumps and control components by a unique tag. So that the notation is readily understandable we will use Instrument Society of America (ISA) standard notation. A typical tag (balloon) would be as follows:



Instrument Function. This is a two or more character code (see the ISA abbreviation table). For example FY is flow computing relay.

Loop No. The trailing digits are the arbitrary loop identification numbers and are assigned as necessary. In this case, we have Loop No. 121.

Suffix. A numerical suffix may be optionally applied if there is more than one similarly designated device in a loop. In the example, the presence of the "-2" indicates the use of several "FY's" in Loop 121.

Pertinent characteristics are stated on the flow diagram. Dashed balloons indicate future, proposed items. All primary elements state the span, offset

and size as applicable. Electrical connections are either 4-20 mA or control a-c as determined from their context. Pneumatic lines are either direct pressure or 3-15 psi as determined from their context.

The Instrumentation Society of America (ISA) has prepared the following abbreviations table to describe the functions of instrumentation equipment. These abbreviations appear in this Operation and Maintenance Manual and in the Contract Drawings. Examples of how to use the table are as follows:

Example 1: TR

"T" as a first letter means "Temperature" or "Turbidity"

"R" as a succeeding letter means "Record" or "Print"

Experience indicates the infrequent usage of "Print", therefore, it can be ruled out. Therefore, TR could mean either:

Temperature Recorder

Turbidity Recorder

Example 2: FIT

"F" as a first letter means "Flow Rate"

"I" as a succeeding letter means "Indicate"

"T" as a succeeding letter means "Transmit" or "Transform"

Again, experience would indicate that "Transform" is inappropriate. Therefore, FIT would mean:

Flow Rate Transmitter

Note that this notation system generally applies to the process instrumentation flow diagrams. The control logic schematics would appear to use conflicting symbols for the following:

"CR" can mean "Control Relay"

"TR" can mean "Timing Relay"

"TDR" can mean "Timing Delay Relay"

"TS" can mean "Time Switch", note that in a flow diagram that a "Time Switch" is a "KS"

"L" when used by itself always means "Light" in both contexts.

Table III-1

ISA Abbreviation Table

Letter	First Letter	Succeeding Letter	Letter	First Letter	Succeeding Letter
A	Analysis	Alarm	O	Overload	Orifice
B	Burner, Flame	Batch	P	Pressure, Vacuum	Point
C	Conductivity	Control (feedback type)	Q	Quantity	Totalize, Integrate
D	Density, Specific Gravity	—	R	Radioactivity	Record, Print
			S	Speed, Frequency	Switch
E	Voltage	Primary Element		Solenoid	
F	Flow Rate	Ratio	T	Temperature	Transmit,
G	Gauging	Glass		Turbidity	Transform
H	Hand, Manual	High	U	Multivariable	Multifunction
I	Current	Indicate	V	Vibration,	Valve, Damper,
J	Power	Scan		Viscosity	Louver
K	Time, Time Schedule	Control (no feedback)	W	Weight, Force	—
			X	—	—
L	Level	Low, Light	Y	—	Relay,
M	Moisture,	Middle			Compute
N	—	—	Z	Position	Drive, Actuate

To be able to effectively operate any plant, an operator must be able to understand how to use the control system. Basically, the control system is made up of building blocks wired together to perform a control objective. To understand how the system achieves its overall control objective, each building block must be understood.

Throughout the following discussion references will be made to front of control panel selector switches and control devices. The operator is expected to adjust any of these devices to control the system. There are many more devices inside the control panels which have adjustment switches. None of these devices require the operator to make an adjustment to control the

system. Only experienced technicians should be allowed access to the inside of the control panels.

The use of selector switches and their function are well understood. However, analog controllers of various types are not. These devices are used to control level, flow, pump speed, chemical feeding, and position. The types involved are called manual loading stations, proportional only controllers, proportion plus reset controllers, and ratio stations. The Charlevoix Water Treatment Plant contains only ratio stations.

Ratio stations are identified on the instrumentation one-lines by the initials FFK. They are used for ratioing one signal (the output) to another signal (the input) in chemical feed applications.

On the face of the ratio station there is a thumbwheel to set the ratio and an output indicator. The ratio station output signal can vary from 0.3 to 3.0 times the input signal. Some ratio stations will have the 0.3 to 3.0 scale printed on the thumbwheel adjustment but usually it is a scale based on dosage rates in milligrams per liter (mg/l). An example use of a ratio station is as follows:

Assume a process flow of 3000 gallons per minute (gpm) corresponds to a full scale 20 mA input signal to a ratio station. A chlorinator has a 100 pounds per day (ppd) output at full speed (i.e., 100 ppd at 20 mA and 0 ppd at 4 mA). If the ratio station were set to 1.0, the chlorinator would feed 100 ppd when 3000 gpm process flow occurred and 50 ppd when there was 1500 gpm of process flow. Note that for both process flows the chemical dosage is the same. Therefore, the ratio station scale is usually printed in dosage units (mg/l) instead of the multiplier number. To double the above dosage, the ratio setpoint has to be changed to 2.0. Now for a 1500 gpm process flow the chemical feed pump will feed 100 ppd. Up to process flows of 1500 gpm the dosage is constant. For process flows above 1500 gpm, the dosage will diminish since the chlorinator is already at maximum output.

Other analog devices located on the face of the main control panel include recorders (identified by the initials LR, TR and FR, which record level,

turbidity, and flow respectively), totalizers, annunciators, and selector switches. Recorders are used to make a printed copy of the instantaneous values of the measured parameter, that is, level, turbidity and flow. Instantaneous values are recorded in ink on a monthly basis on a strip chart. Consult the manufacturer's operation and maintenance manual for methods of adding ink and changing charts.

Totalizers are used to indicate the total gallons of process flow that have passed through a flowmeter. Totalizers are similar in appearance to an automobile odometer and are functionally equivalent to totalizing the number of miles the automobile has traveled.

Annunciators are used to signal a plant alarm condition by sounding an audible alarm and lighting-up an engraved window with a flashing light. Annunciators are segmented with a number of engraved windows, each for a different alarm condition. Once an alarm condition has occurred, the operator must depress an Acknowledge push button on the face of the MCP to silence the audible alarm. The engraved window light will then remain steady on if the alarm condition persists. The light will go out when the alarm condition has been corrected. The operator may test all of the annunciator lights by depressing an annunciator Test push button on the face of the MCP.

A summary of all of the alarms at the plant and their probable cause follows:

Window	Nomenclature	Comp. Ident.	Probable Cause
1-1	Raw water wet well low	LAL-1	Raw water level is below EL 567.5, pump failed to stop.
1-2	Chlorine residual high/low	AAHL-3	Abnormally high or low chlorine is detected at analyzer.
1-3	Telephone line loss of carrier	UA-8-1	Loss of signal between the transmitter and the receiver due to defective telephone line or transmitter or receiver.
1-4	Elevated tank high	LAH-8	Water level in tank exceeds EL 776.5. See High Service Pumps for discussion of this condition.

(continued)

Window	Nomenclature	Comp. Ident.	Probable Cause
1-5	Elevated tank low	LAL-8	Water level in tank is below EL 748.0. See High Service Pumps for discussion of this condition.
1-6	Elevated tank zero signal shutdown	UA-8-2	Signal failure between tank and transmitter.
2-1	South Reservoir low	LAL-5-1	Water level in reservoir is below EL 585.25. See High Service Pumps for discussion of this condition.
2-2	North Reservoir low	LAL-5-2	Water level in reservoir is below EL 585.25. See High Service Pumps for discussion of this condition.
2-3	Reservoir High	LAH-5	Water level in either filter water reservoir exceeds EL 601.0. To Reset depress Reservoir High Level button (HS-5) at MCP.
2-4	High Service Pump Failure	UA-6	One of the High Service Pumps has failed.
2-5	Plant air pressure low	PAL-15	Air compressor failure or air leak
2-6	Filter Building sump high	LAH-15	Broken water pipe or defective sump pump
3-1	Ammoniator Failure Alarm	PA-12	This alarm will be activated by either of two conditions: 1) a break (leak) in the ammoniator line, or 2) low level of ammonia in the ammonia cylinder.
3-2	Chlorinator Failure Alarm	PA-13	This alarm will be activated by either of two conditions: 1) a break (leak) in the chlorinator line, or 2) low level of chlorine in the chlorine cylinder. Se chlorine feed system for discussion of these conditions.
3-3	Ammonia gas alarm	UA-12	Abnormally high concentration of ammonia gas is detected.
3-4	Chlorine Gas Alarm	UA-13	Abnormally high concentration of chlorine gas detected in Chlorine Room.
3-5	Chemical Sump high	LAH-16	Rupture in chemical storage tanks
3-6	Filter problem	UA-4	See manufacturer's manual for cause.

In addition to the annunciator, a dialer has been included to supplement the alarm system. The water treatment plant will not be manned 24-hours per day; therefore, it is necessary to provide alarm status information to appropriate personnel located remote from the plant. The dialer has the capability of calling personnel via the telephone line and reporting a general plant alarm. Various telephone numbers may be programmed into the dialer. For specific programming and operation of the dialer, consult the manufacturer's operation manual.

In operation, the alarm system functions as follows. If, for example, a high water level alarm were to occur, the appropriate annunciator window would begin flashing and an audible alarm would sound. If the alarm were to go unacknowledged for several minutes (as determined by an adjustable timer within the control panel), the dialer would be activated and begin dialing out. Once the person on-call has picked up the receiver, the dialer will state that an alarm has occurred at the plant. When plant personnel arrive at the plant, they will be able to identify the exact cause of the alarm by looking at the annunciator and finding a window with a flashing light.

Finally, on the face of the MCP are various selector switches and pilot lights. The purpose of these devices is fully explained in the detailed write-up of each process description.

L. Washwater Lagoon

1. Description

Waste backwash water is disposed of in an infiltration bed. The infiltration bed is sized for backwashing each filter on a daily basis for using an infiltration rate of 6-inches/hour maximum. Reported infiltration rates for sandy soil range betwen 6 and 20-inches/hour.

2. Specifications

Based on an infiltration rate of 6-inches/hour, a backwash rate of 15 gpm/sq.ft. of filter area, and a backwash time of 15 minutes per filter, the two infiltration bed sizes are 30-ft. x 90-ft. x 6-ft. The lagoon is divided into two 15-ft. sections to permit maintenance. Isolation of the lagoon is accomplished by closing Valves B-15-2 and B-15-3.

3. Normal Operation

Normally, valves B-15-1, 2 and 3 would be open, allowing washwater to freely drain to both lagoons. The lagoon will overflow before the water elevation is high enough to influence the filter wash trough. Sludge accumulations should be removed when the infiltration rate becomes too slow to keep up with the incoming washwater. Gates and stop planks have been provided at the west end of the lagoons to permit vehicular access during sludge removal. If sludge is removed after plant operating hours, both lagoons can be worked on. However, during plant operations, one lagoon must remain in service. The other lagoon can be isolated by closure of valve B-15-2 or B-15-3.

It will be periodically necessary to clean or repair the flocculation tanks. The water and any accumulated solids in the tanks can also be drained to the lagoons. Exterior valves A-3-1 and A-3-2 permit or prevent drainage from these tanks.

M. Laboratory

1. Description

The Charlevoix Water Filtration Plant is furnished with a laboratory located in the Filter Building.

The laboratory testing results are used to monitor water quality, to monitor system performance and to explore possible effects of potential process modifications.

2. Specifications

The major pieces of equipment located in the laboratory are as follows:

Electronic Balance

Manufacturer:	Ohaus
Model:	E160R

Nephelameter

Manufacturer:	Fisher
Model:	DRT-100

Amperometric Titrator

Manufacturer:	Wallace and Tiernan
Model:	A-790

Fluoride Specific Ion Electrodes
Manufacturer: **Orion**
Model: **940900**

Laboratory Oven
Manufacturer: Blue M
Model: OV-12A

Refrigerator
Manufacturer: Marvel
Model: 61RF

Microscope
Manufacturer: Burrel
Model: 561B-L

Incubator
Manufacturer: Burrel
Model: 200

Sterilizer
Manufacturer: Napco
Model: 704-9000D

pH/Specific Ion Meter
Manufacturer: Corning
Model: M-150

Thermal Printer
Manufacturer: Corning
Model: 478439

Spectronic Spectrophotometer
Manufacturer: Bausch & Lomb
Model: DV

Vacuum Pump
Manufacturer: Precision
Model: DD-100

Water Purification System
Manufacturer: Barnstead
Model: D3798

Balplan Microscope
Manufacturer: Bausch & Lomb
Model: CRTLCIH

N. Chlorine Feed System

1. Description (Exhibits A-1, C-4, F-2 and G-2)

Chlorine can be fed into the raw or finished water at several locations. Its purpose is disinfection and prevention of organic growth. One location is within the intake line at a point 200 feet from the intake screens. This was installed during the first construction phase so as to provide a means of early disinfection in the previous water supply system. Since further reliability of this line was not ensured, a second chlorine solution injector in the raw water piping was installed between the low service pump discharge header and mixers. The filtered water is also chlorinated at two locations. One location is at the inlet to the pipe supplying the reservoir.

This chlorine keeps the water fresh while it is held in the reservoir. A second chlorine solution injector is in the discharge header of the high service pump where water is exiting the filtration facility and entering the distribution system.

The main components of the chlorine system are in a sealed chlorine feed room. Chlorine tanks, scale, chlorinator, gas injectors, and chlorine detector are in the chlorine room. The cylinders hold the supply of chlorine under high pressure. Three out of six cylinders on one side of the scale supply gas simultaneously. When this is exhausted, the supply is automatically switched over to the remaining three cylinders. The dual side scale measures the chlorine remaining on each side. A vacuum regulator check unit reduces the exiting gas supply pressure from that within the cylinders to one below atmospheric (room) pressure.

From the vacuum regulator check unit, the chlorine gas under a controlled vacuum passes through a relief valve to a rotometer in the control unit, causing a float to indicate rate of flow. A differential regulating valve in the control unit throttles the gas to the gas injector by means of a variable orifice. The orifice size is varied by an electric positioner operating in response to external signals. From the control unit, the gas flows to a gas injector which is designed to produce a vacuum to draw the chlorine from the chlorinator and mix the gas with plant water flowing through the injector. The resultant solution flows to the point of application. Except for the high

service pump discharge application point, the chlorine solution has sufficient pressure to be injected into the raw or filtered water. A booster pump raises the solution pressures needed for injection at the high service pump discharge. Control of the solution flow is through motorized and nonmotorized ball valves. When solution flow is stopped, chlorine gas injection, controlled by the chlorinator, is also stopped. The solution flow rate does not determine the amount of chlorine injection at the point of application. The chlorine feed rate will vary only in response to the chlorinator control setting and metered plant flow.

Chlorine gas is hazardous and should be handled only by trained, qualified personnel. Safety features are built into the chlorine feed system. The gas is reduced to a very low pressure. Alarms are sounded when hi-low vacuum switches sense pressures too high or too low. A standby pressure relief valve discharges high pressure gas to a line vented outside the building. Vacuum relief valves in the control units admit room air to relieve excessive vacuum. A chlorine gas detector detects the presence of gas within the room.

2. Specifications

Chlorinators (3)

Manufacturer:	Wallace & Tiernan
Model:	V-500
Capacity:	3 to 500 pounds per day (ppd)
Tube Range:	10 to 100 ppd
Plant Water Pressure:	60-90 psi
Solution Injection Pressure:	18 psi, maximum
Accuracy:	+ 4% of indicated reading
Spare Tube Capacity:	30 ppd

Booster Pump (1)

Manufacturer:	Webtrol
Model:	FM Series F15B2014-1
Capacity:	15 gpm @ 72 psi
Motor	
Model:	10FDT020-M3PH
Type:	TEFC
Horsepower:	2.0
Electrics:	3 Ph, 460V, 60 Hz
RPM:	3450

3. Normal Operation

The chlorinators will normally be operated automatically. The chlorinators will be manually set to feed the required amount of chlorine per volume of water passing the injection points. The chlorine demand will have been determined by public health standards, accumulated plant experience and examination of water samples for bacteria and residual chlorine. The chlorine feed rates will be paced according to the flow sensed in flowmeters. More specific operation and control are as follows:

Chlorinators 1 and 3 chlorinate the raw water and filtered water at the reservoir inlet. These chlorinators receive a pacing signal from ratio stations FFK-13 and FFK-14, respectively, which are located at the main control panel. Chlorination is paced at these ratio stations and is mixed with the water at a rate (0-100 ppd) proportional to the water flow from the Low Service Pumps as measured on flowmeter FE/FIT-2. The flow of water into the chlorinators is regulated by a motorized valve. The valve may be operated in a Hand or Auto mode as selected on a Hand-Off-Auto selector switch located at the valve. In the Hand position, the motorized valves may be opened or closed using Open-Closed push buttons located at the valve (HS-13 operates the valve to Chlorinator 1 and HS-14 operates the valve to Chlorinator 3). Positioning of the valve will continue, provided the Open or Close push button remains depressed. (Limit switches provide for maximum open and maximum closed positioning of the valves.) Once contact with the push button is discontinued, the valve will remain in that position until a push button is depressed again. Therefore, when operating in the Hand position, for a fully open or fully closed valve, the plant operator must depress the desired push button until its limit switch is effected.

In the Auto position, this valve fully opens and fully closes when any of the Low Service Pumps are operating. In this mode, the limit switches also provide for maximum open and maximum closed positioning of the valve.

Pressure switches PS-13-1 (for Chlorinator 1) and PS-13-3 (for Chlorinator 3) detect high vacuum (low pressure) and low vacuum (high pressure) conditions in Chlorinators 1 and 3, respectively. A high vacuum (low pressure) condition indicates a break in the chlorination line, producing a chlorine leak. A low

vacuum (high pressure) condition indicates a low level of chlorine in the chlorine cylinder. When either of these conditions occurs, a Chlorinator Failure Alarm (PA-13) will be activated at the main control panel. It is the responsibility of the plant operator to identify the problem causing the alarm. On-Off selector switches (HS-13-1 and HS-13-3, respectively) are provided for turning off the alarm system and the power to the chlorinators when they are not in use.

Chlorinator 3 chlorinates water from the High Service Pumps. When HS-7, located at the main control panel, is set to Auto and the High Service Pumps are producing water flow, Chlorinator 3 will chorinate the water as it is fed to the high service pump discharge header. Chlorination is paced at ratio station FFK-7, and is added at a rate (0-100 ppd), proportional to the water flow from the High Service Pumps as measured on flowmeter FE/FIT-7. Pressure switch PS-13-2 detects high vacuum (low pressure) and low vacuum (high pressure) conditions in Chlorinator 2. A high vacuum (low pressure) condition indicates a break in the chlorination line, producing a chlorine leak. A low vacuum (high pressure) condition indicates a low level of chlorine in the chlorine cylinder. When either of these conditions occurs, a Chlorine Failure Alarm (PA-13), will be activated at the main control panel. It is the responsibility of the plant operator to identify the problem causing the alarm. On-Off selector switch (HS-13-2) is provided for turning off the alarm system and the power to the chlorinator when it is not in use.

Chlorine Booster Pump 1 may be operated in Hand or Auto mode as selected on a Hand-Off-Auto selector switch located at the motor control center. In the Hand position, the plant operator starts and stops the pump using a push-button station located at the pump. In the Auto position, the pump will run when High Service Pumps 1, 2 or 3 are operating and Chlorine Mode Selector Switch HS-7, located at the MCP, is set on Auto.

O. Ammonia Feed System

1. Description (Exhibits C-1, G-2)

Anhydrous ammonia is injected into the raw water in the low service pump discharge piping to prevent formation of trihalomethanes (TTHM). TTHMs are chlorinated organics resulting from chlorination of the water which may be carcinogenic. The ammonia also can eliminate tastes and prolong chlorine action. The ammonia feed system works like the chlorine feed system. Subsection N, Chlorine Feed System, should be read for a description of the system and the Ammonia Schematics in Exhibit C-1 should be reviewed. Briefly, the system consists of ammonia cylinders, scale, automatic switchvoer vacuum regulator check unit, standby pressure relief valve, ammoniator, gas injector, and solution diffuser. An ammonia gas detector with alarm is a safety feature of this system.

2. Specifications

Ammoniator (1)

Manufacturer:	Wallace and Tiernan
Model:	V-500 ppd
Capacity:	3-500 ppd
Tube Range:	5-45 ppd
Plant Water Pressure:	60-90 psi
Solution Injection Pressure:	18 psi
Accuracy:	+4% of indicated reading
Spare Tube Capacity:	15 ppd

Gas Detector (1)

Manufacturer:	Honeywell
Model:	UVH-10A2
Range:	0-50 ppm

3. Normal Operation

The ammoniator will normally be operated semi-automatically. Valves in the plant water plumbing must be manually opened and closed to activate the system. The ammonia rate (0-45 ppd), manually set on the controller, will automatically be paced according to the flow sensed in the low service flowmeter, FE/FIT-2. The ammoniator receives its pacing signal from ratio station FFK-12.

P. Alum/Ferric Chloride Feed System

1. Description (Exhibits C-3 and G-2)

Either alum or ferric chloride solution can be fed into the raw water with this

system. Alum or ferric chloride solution is used to coagulate solids in the raw water. The resultant flocs are captured by the granular filter. The major components of the system are a 6300 gallon corrosion-resistant tank with liquid level sensor, access manhole, fill pipes, overflow pipe and drain pipe, two diaphragm metering pumps, diluton apparatus and diffuser for injecting chemical into raw water pipe. Exhibit C-3 in the Appendix shows a schematic of the system. The chemical solution is unloaded from tanker truck into the tank chemical fill line. If the delivered chemical solution requires dilution, metered water is added to the tank through a plant water fill line until the required dilution is obtained. A bubbler level indicator system senses the liquid level and, thereby, the volume of chemical available. Plant air is set up to purge the bubbler and mix the tank contents. The tank can be drained to the sump in the Chemical Room. A double diaphragm metering pump pumps an adjustable rate of flow from the tank to the injector in the raw water line. The rate per volume of raw water can be set on the pump. The stroke of the pump can also be varied according to meter raw water flow. A means of diluting the pumped chemical is available. Plant water whose flow is measured by a rotameter can be added into the discharge line of the metering pump.

2. Specifications

Storage Tank	
Manufacturer:	Warner Fiberglass Products, Inc.
Model:	C-CFV-10-6302
Capacity:	6302 gallons
Material:	Polylite 33-402 Polyester Resin
Diaphragm Metering Pump	
Manufacturer:	Wallace and Tiernan
Model:	44-213
Capacity:	0-20.8 gph
Motor Data:	Hp, 1725 rpm
Electrics:	150V, 60 Hz, 1 Ph
Rotameter	
Manufacturer;	Wallace and Tiernan
Model:	Varea-Meter
Tube Number:	WT-1/2-40-G-10
Float Number:	1/2-G-6VI-13
Nominal Capacity:	2 gpm

3. Normal Operation

The alum or ferric chloride feed system will normally operate automatically. The

metering pumps will be manually adjusted to feed the desired amount of chemical per volume of raw water as determined by raw water turbidity and plant experience. The pumps will alternately feed chemical solution to the mechanical or static mixer. The feed amount is paced at ratio station FFK-11, proportional to the Low Service Pump discharge as metered by flowmeter FE/FIT-2.

Q. Polymer Feed System

1. Description (Exhibits C-2 and G-2)

With this system, anionic polymer can be fed into the raw water as a coagulant aid and filter bed conditioner. The system's major elements are a scale, polymer feed eductor, plant water totalizing meter, manual loading station, mixing tank with propeller type mixer, diaphgram metering pump, rotameter and diffuser. Exhibit C-2 of Appendix C shows the polymer feed schematic. The polymer is weighted on the scale and loaded manually into the eductor. A meter volume of plant water, controlled manually by a valve, is run through the eductor, mixing with the polymer before filling the mixing tank. A mixer agitates the mixture until the polymer dissolves.

The diaphragm metering pump pumps an adjustable rate of polymer solution flow from the tank to the diffuser in the raw water piping. Enroute to the diffuser is a plant water connection with rotameter, providing a means of diluting the solution.

2. Specifications

Scale (1):

Manufacturer:	Reliance Electric/Toledo Scale
Model:	2300 Weight-plate
Capacity:	30 lbs. to 1500 lbs.

Eductor-Polymer Dispenser (2)

Manufacturer:	Nalco Chemical Co.
Model:	Type III, 3/4-inch

Tank (2)

Manufacturer:	Raven
Model:	Mix Tanks - M1C7645
Capacity:	350 gallons

Mixer (2)

Manufacturer:	EMI
Model:	FRG-4
Motor:	3/4 Hp, 400 rpm

Electrics:	**3 Phase, 60 Hz/**
Loading Station (2)	
Manufacturer:	**Essex Engineering Corp.**
Model:	**2415**
Impedence:	**4-20 mA DC**
Diaphragm Metering Pumps (2)	
Manufacturer:	**Wallace and Tiernan**
Model:	**44-213**
Capacity:	**0 to 20.8 gph**
Motor:	Hp, 1725 rpm
Electrics:	115V, 60 Hz, 1 phase
Rotameters (1)	
Manufacturer:	Wallace & Tiernan
Model:	Varea-meter
Tube Number:	WT-1/2-40-G-10
Float Number:	1/2-G-GVI-13
Nominal Capacity:	2 gpm

3. Normal Operation

The operation of the polymer feed system is primarily automatic. Making a batch of polymer solution, however, is only semi-automatic. The polymer must be manually weighed and loaded into the eductor. A valve must be opened to add water and the mixer must be switched on to agitate the polymer mixture. The metering pump must be manually adjusted to feed the desired amount of polymer per volume of raw water. The pumps will alternately feed polymer solution to the low service pump discharge piping. The feed amount is paced at ratio station FF-10, proportional to the raw water flow as measured by flowmeter FE/FIT-2.

R. Fluoride Feed System

1. Description (See Exhibits C-5 and G-2)

Fluoride (fluosilicic acid) is added to the water to provide protection to users from dental decay. Excessive amounts, however, cause deterioration and early loss of permanent teeth. One ppm fluoride residual in the finished water has been considered an appropriate amount. The system's major elements are a scale with wall-mounted inductor, a 55-gallon drum containing fluosilicic acid, diaphragm metering pumps, injector, and plumbing containing pressure relief valve, backpressure valve, antisiphon valve, sampling tap and pressure

gauges. Exhibit C-5 in Appendix C is the fluoride feed schematic showing functional relationships between the major components. The fluosilicic acid sits on the scale during normal operation. The metering pump draws acid through suction piping and forces it through discharge piping to the injector. The pump stroke length and frequency can be readily changed by dials so as to adjust pumping rate. The pressure relief valve relieves high discharge pressures, the backpressure valve prevents raw water from entering the system, and the antisiphon valve prevents fluosilicic acid from entering the raw water during plant shutdown.

2. Specifications

Scale:	1
Manufacturer:	Reliance Electric/Toledo Scale
Model Number:	2185 Portable w/8140 Indicator
Capacity:	1200 lbs
Metering Pumps:	2
Manufacturer:	Wallace & Tiernan
Model Number:	Series 45 010 Chempulse
Capacity:	10 gph
Range:	250:1

3. Normal Operation

The operation of the fluoride system is automatic. The 55-gallon drum must be set on the scale with the suction tube placed in it. The metering pump must be adjusted for a correct feed rate before automatic operation begins.

The fluoride system operates automatically in the On position as selected on an On-Off selector switch located at the pumps. A flow switch is activated when Low Service Pump 1 and/or Low Service Pump 2 are producing flow. Fluoride is introduced into the water by selecting Fluoride Metering Pump 1 or 2 on a selector switch (HS-15) located at the pumps. Use of these pumps should be manually alternated to prevent premature wear. The amount of fluoride is paced at ratio station FFK-15 at a rate (0-10 gpd) proportional to the water flow from the low service pumps as measured by flowmeter FE/FIT-2.

S. Plumbing Systems

1. Description (See Exhibit D-4)

a. Potable Water

A new potable water line runs off the high service pump header to the Mechanical Room and is connected to an aboveground meter and backflow preventer.

From the backflow prevention station, the potable water runs to all buildings on the plant site requiring potable water. Potable water is used for plumbing fixtures, laboratory fixtures and a source of tempered water for safety showers and eyewashes, and a source for domestic hot water.

b. Service Water

Service water is obtained from the new potable water meter station. A backflow preventer at the tie point of the service water line to the potable water line isolates the service water system from the potable water system.

Service water lines run to all plant locations requiring service water. Service water is used for liquid alum dilution, polymer mixing, fire protection in boiler rooms, boiler make-up water, pump seals, and hose bibbs.

2. Specifications

Backflow Preventer

Manufacturer:	Hersey "Beeco"
Model:	Aergap, FRP-II
Type:	Reduced Pressure

T. High Pressure Air System

1. Description (See Exhibit D-3)

The high pressure air system consists of two air-cooled reciprocating air compressors, water-cooled aftercooler, moisture separator, air receiver, air dryer, filters and pressure regulator. From the above equipment, the high pressure air lines carry the compressed air to the buildings, etc., requiring high pressure air. Compressed air is used primarily for valve operators, level indicators, chemical mixing, air tools and automatic temperature controls.

The air compressors, air receiver, air dryer, and other accessories are located in the Mechanical Room.

2. Specifications

Reciprocating Air Compressor	2
Manufacturer:	Quincy
Model:	F-340
Capacity:	24 scfm @ 150 psig (each)
Discharge Pressure:	150 psig
Motor Data:	7-1/2 Hp (each)
Air Receiver	
Manufacturer:	Brunner
Capacity:	120 gallons
Mounting:	Horizontal
Air Dryer	
Manufacturer:	Pioneer
Model:	R55A/W (refrigerant)
Capacity:	55 scfm

3. Normal Operation

Air compressors will be controlled by pressure switches. A drop in air pressure at the receiver will activate the compressor. A further drop in pressure will activate the second compressor. Normally, only one compressor will be operating at a time with the other compressor as a standby unit.

The duplex air compressors may be operated in either a constant run, or automatic mode as selected by constant run-off-start auto selector switches on the compressor control panel mounted near the compressor. When a compressor is in the constant run position, the compressor runs continuously. This feature is provided to allow the motor to remain running continuously while loading solenoid determines whether air is compressed or not. In the start-auto position, the compressor responds to a low pressure switch.

Normally one compressor is run continuously and one is standby in the start-auto mode. If the continuously running compressor cannot satisfy the plant air requirements, the receiver pressure will drop. The resulting low pressure will cause the second compressor to start. If the pressure were to continue to drop, a low pressure alarm would be activated, signalling a compressor failure or broken air line.

Under normal operating conditions, one compressor is used at a time. The lead compressor changes automatically by means of an alternator. This feature is provided to even out equipment wear.

Each of the permanent air systems is piped such that the prefilter, air dryers, afterfilters and/or pressure-reducing valves may be bypassed if necessary.

All of the pneumatic valves are capable of being operated manually, should their air supply become interrupted.

U. Heating, Ventilating and Air Conditioning

1. Description (See Exhibits D-1, E-1, F-2 and F-3)

a. Design Temperatures:

Latitude:	45° - 14'
Exterior Temperature:	-16°F Winter (97½%)
	87°F Db Summer (2½%)
	73°F Wb Summer (2½%)
Heating Degree Days:	Approximately 8500
Cooling Hours Over 80°F:	301
Interior Temperature:	72°F
	(see specific room requirements)

b. HVAC Process Requirements

1) Fuel

Natural gas is used for the fuel requirements. Natural gas is the most economical fuel source for the water filtration plant.

2) Heating

Heating is provided with a central hydronic system with primary circulation pumps. This system provides the greatest flexibility for heating the various corrosive environments in the plant.

c. Individual Area Requirements

1) Chemical Room/Liquid Alum Storage Area

Design Temperature:	60°F
Heating:	Heat is provided by hot water unit heaters.
Ventilation:	Outside air intake damper is interlocked with an exhaust fan to provide ventilation rate of six air changes per hour on an intermittent basis.

All heating and ventilating equipment is corrosion-resistant.

2) Electrical Room

Design Temperature:	60°F
Heating:	A hot water unit heater provides heating for the Electrical Room.
Ventilation:	A wall intake louver with a motor-operated damper and an exhaust fan controlled by a room thermostat provides ventilation for the Electrical Room.

Exhaust fans have sufficient capacity to dissipate the heat from the electrical equipment with a room temperature rise of 20°F maximum above the outside ambient temperature.

3) Mechanical Room (Boilers, Air Compressors)

Design Temperature:	60°F
Heating:	A hot water unit heater is used for heating the Mechanical Room.
Ventilation:	An intake louver is used for the intake of combustion air.

4) **Office Area**

Design Temperatures:

Winter:	$72^{o}F$
Summer:	$78^{o}F$

Heating: Heating is provided by the hydronic heating coil located in the air handling unit serving the area. Additional heating in each zone is provided by fin-tube radiation or variable air volume box reheat coils. Cabinet unit heaters are used at entrances.

Ventilation: Air is supplied by the supply fan of the air handling unit. The exhaust fan will exhaust the air from the space.

Air Conditioning: A direct expansion cooling coil is located in the air handling unit serving the Lab/ Office Area. The direct expansion coil is piped to a remote air-cooled condensing unit.

5) Laboratory/Locker Room Area

Design Temperatures:

Winter:	$70^{o}F$
Summer:	$78^{o}F$

Heating: Heating is by the hydronic heating coil in the HVAC unit. Additional heating is done by fin-tube radiation or by reheat coils on VAV boxes.

Ventilation: The same HVAC unit supplying the office area also suplies air to the laboratory area. The exhaust fan exhausts air from the laboratory fume hood to the outside. HVAC unit also supplies air to the locker rooms at the rate of two CFM/ft^2. This

air is exhausted from the toilet area adjacent to the locker room to the outside.

Air Conditioning: The same direct expansion coil and the same condensing unit serving the office area will also serve the Laboratory Area.

6) Garage

Design Temperature: 60°F

Heating: A hot water unit heater provides heat for the garage.

Ventilation: An outside air inlet damper and exhaust fan is used for ventilating the area at a rate of 1.5 cfm per square foot.

7) Filter Room

Design Temperature: 70°F

Heating: A hot water coil in the heating and ventilating unit is used for heating the Filter Building.

Ventilation: Ventilation is provided by a heating and ventilating unit. Ventilation rate is six air changes per hour. A roof hood with a relief damper relieves room air to the outside when a large quantity of outside air is drawn in by the heating and ventilating unit.

8) Chlorine Room and Ammonia Feed Room

Design Temperature: 70°F

Heating: A hot water unit heater is used to provide for the Chlorine and Ammonia Rooms.

Ventilation: A motor-operated inlet damper and an exhaust fan ventilates the room when occupied. The exhaust fan is activated either by a rise in room temperature, a

door switch, a manual push button switch, or a gas leak detector. The ventilation rate is 60 air changes/hour. Air is drawn from a point approximately 1-ft. -0-inch above the floor in the Chlorine Room.

9) Pump Room

Design Temperature:	70°F
Heating:	A hot water unit heater is used for heating the Pump Room.
Ventilation:	An outside air inlet damper and an exhaust fan will provide 12 air changes an hour on an intermittent basis, minimum. The ventilation rate shall also limit the temperature rise resulting from heat given off from motors to 18°F above outside ambient.

2. Specifications (Major HVAC Equipment)

Heating and Ventilating Unit (HV-1)

Manufacturer:	Bohn
Model:	06 HCS LF
Capacity (air flow):	2165 cfm
Fan Motor Size:	1-1/2 Hp
Total Heating Capacity:	161.9 MBH

Heating, Ventilating and Air Conditioning Unit (HVAC-1)

Manufacturer:	Bohn
Model:	06 VCS LF
Capacity (air flow):	2300 cfm
Fan Motor Size:	3 Hp
Total Cooling Capacity:	94.9 MBH
Total Heating Capacity:	160.7 MBH

Hot Water Heating Boiler

Manufacturer:	Bryan Steam Corp.
Model:	CL-120
Capacity:	960 MBH output
Burner:	Atmospheric natural gas with high/low fire.

Condensing Unit (CU-1)

Manufacturer:	Century
Model:	RC-84
Total Cooling Capacity:	94.0 MBH
Number of Compressors:	2 (1 @ 4½ Hp, 1 @ 3½ HP)

Number of Condenser Fans: 1 (½ Hp)

3. Normal Operation (Control Sequence)

a. Heat and Vent Unit (HV-1)

1) Day Cycle

The fan runs continuously on the day cycle. The mixed air controller, through a minimum position switch, will modulate the outside and return air dampers to maintain the mixed air setting. The minimum position switch will hold the outside air damper open at minimum position.

A controller with a sensor in the outside air will open the hot water control valve when the outdoor temperature drops below its setting.

A room thermostat will modulate the face and bypass damper to maintain the room temperature setting.

2) Night Cycle

The seven-day time clock will deactivate the heat and vent unit during the night setting. When the space temperature drops below the setting of the night thermostat, the supply fan will be activated. The outside air damper will be closed and the return air damper will be open. The face damper will be open and the water flow through the coil will be full flow. The fan will remain running until the night thermostat setting is satisfied.

Whenever the temperature settings of the firestat or the freezestat are exceeded, the fan will stop and the outside air damper will close. The firestat and the freezestat have manual reset requirements.

The day-night-auto switch can be used to override the time clock setting.

b. HVAC Unit (HVAC-1 (CU-1)

1) Day Cycle

The supply air fan runs continuously on the day cycle. During the heating season, the room thermostat modulates the heating coil valve and the face and bypass damper to maintain the space temperature setting. The heating coil will be moved to full open position when the outside air temperature drops below a set temperature. Outside air damper will be at minimum position.

During the cooling season, the heating coil control valve will be closed and the face and bypass damper will allow full air flow through the heating coil. The room thermostat will cycle the two stages of refrigeration on the condensing unit to maintain the room temperature setting. The outside air damper will be at minimum position.

2) Night Cycle

The seven-day time clock will deactivate the HVAC unit during the night setting. When the space temperature drops below the night temperature setting, the supply fan will be activated. The heating coil will heat the return air and the outside air damper will be closed. When the setting of the night thermostat has been satisfied, the supply fan will shut off.

The day-night-auto switch can be used to override the time clock setting. When the temperature settings of the freezestats and the firestats are exceeded, the supply air fan will stop and the outside air damper will close. Both of these devices require manual reset.

During the times of the year when outside air can be used for cooling, the room thermostat will modulate the return air and outside air dampers to maintain the room temperature setting.

c. Hydronic System Control

An outdoor air reset controller will reset the hot water heating supply temperature inversely, as the outdoor temperature varies, by modulating

a 3-way control valve on the hydronic system. The hydronic pump will deactivate when the outdoor temperature exceeds a set temperature. The boiler will be prevented from firing when the outside temperature exceeds a set temperature.

d. Variable Air Volume Boxes

During the cooling season, the room thermostat will modulate the damper to the open position with a rise in room temperature.

During the heating season, the reversing relay and a higher of two pressures relay will modulate the damper to the open position with drop in room temperature. The heating coil control valve will also modulate to the open position when there is full air flow to the room and the room temperature continues to drop.

e. Unit Heaters

A room thermostat will activate the unit heater supply fan with a drop in space temperature.

f. Cabinet Heaters (force flow units)

A room thermostat will activate the cabinet heater supply fan with a drop in space temperature.

g. Exhaust Fans and Inlet Dampers

A rise in space temperature above the thermostat setting will activate the supply fan and open the inlet damper.

h. Combustion Air Dampers

The combustion air dampers will open when the boiler firing control sequence is activated. The boiler will not be capable of firing until the combustion air dampers are fully open.

i. Chlorine and Ammonia Rooms Exhaust

The room thermostat will activate the supply fan and open the inlet damper when the space temperature exceeds the thermostat setting. A push-button switch located outside of the door can be used to activate

the exhaust fan. A switch mounted on the door will also activate the fan when the door is opened. Leak detectors will activate an alarm when a gas leak is detected.

IV. WATER FILTRATION PLANT OPERATING PROCEDURES UNDER NORMAL AND ABNORMAL CONDITIONS

A. Initial Start-up

1. General

Initial start-up of the plant includes the check out and start up of all treatment systems. However, some of the systems started up at this time will not be used on a daily basis during normal operation.

2. Preparation for Start-up

Prior to initial start-up of the plant, all systems should be inspected to insure that approved system components have been installed. The equipment should be checked for completeness of installation. Equipment should be checked for proper mounting and tightness of bolts and fasteners. All wiring connections must be made. Lubricant levels must be checked. Painting of piping or process equipment must be completed. Pressure tests of pipework must be completed. Some equipment must be calibrated.

Qualified manufacturer representatives are required to check, test and adjust many of the plant systems. Vertical turbine pumps, mixers, flocculators, filters, low pressure air blowers, all chemical feed systems, all major instrumentation and laboratory equipment require start-up by experienced manufacturer representatives. This representative will calibrate equipment requiring calibration and supervise required performance testing. In addition, staff training will be provided by the constructing contractor for operating each of the following major equipment systems: vertical turbine pumps, mixers, flocculators, filters, instrumentation, all chemical systems, and laboratory equipment. The contractor must schedule the manufacturer's representatives to check out and start up individual systems so as not to require operation of equipment which has not yet been started up by a qualified manufacturer's representative. Start-up of some systems such as filters and instrumentation may require the presence of factory representatives of several systems.

Any and all water discharged into the City's water distribution system must comply with the Safe Drinking Water Act. The City's existing potable water must be used to clean, flush and fill the process tanks and piping for initial

checkout and testing when required by the manufacturer's representatives. Equipment should not be run dry.

A suggested sequence for initial start-up follows, but is not intended to be all inclusive.

- Thoroughly clean all tanks and piping.
- Disinfect/sterilize all components starting at the flocculation tanks and continuing through the process to the high service discharge piping.
- Perform pressure and leakage tests.
- Insure that all plant components have been individually checked out and started up by the manufacturer's representatives.
- Insure that Owner and MDPH are given advance notice of intended start-up.
- Provide Owner training of operation and maintenance.
- Develop initial chemical feed rates with Owner.
- Follow the manufacturer's start-up procedures for each system component.
- The flocculators and filters should be filled from the City's existing potable water supply.
- Follow the start-up sequence provided under the Normal Start-up section of this manual.
- Water quality samples must be collected and analyzed prior to delivering water to the distribution system. Otherwise, do not activate the high service pumps until the finished water quality complies with the Safe Drinking Water Act.
- Failure of any system component or failure to meet water quality standards will require that the plant be shut down until the situation is corrected or the standby system placed into operation.
- It is expected that both the system components and alternate standby components will be started up and operated during the initial start-up period.

B. Normal Start-up

1. General

Under normal operating conditions, the plant will be operated at a 3 mgd

treatment rate and will be operated from 8 to 16 hours a day, depending on water demand within the system. Because of the on/off operation, the treatment systems in the plant must be turned off when the plant is not treating water (nighttime) and turned on when the plant is started up.

Systems that must be turned on/off include low service pumps, rapid mix units, flocculation tanks, sand filters, and chemical feed systems. The start-up of the systems should be done in an orderly way, such that the low service pumps are the last system turned on.

2. Flocculators

Turn the flocculators on with the on-off switches located at the main control panel. The Hand-Off-Remote switches located at the motor starter must be in the Remote position for the On-Off switch of the main control panel to turn the flocculators on.

3. Rapid Mixer

Turn the rapid mixer on with the on-off switch located at the main control panel. The Hand-Off-Remote switch located at the motor starter must be in the Remote position for the on-off switch at the main control panel to turn the mixer on.

4. Sand Filters

Sand filter operation is controlled at the console located at the filters. The filter is not turned on/off with the rest of the plant. Start-up of this system consists of checking to ensure that valves are open or closed as required and that backwash systems are set to operate on the operator's command.

- Check to see that filter mode selector is in the Semi-automatic position.
- Check to insure that cell inlet and outlet valves are open.
- Check to insure that cell washwater drain valves are closed.
- Check to insure that backwash pumps are in the Auto mode.
- Check to insure that the backwash blowers are in the Auto mode.

5. Chemical Feed Systems

Under normal conditions, the chemical systems which will be required are the

chlorine, alum, fluoride and polymer systems. The following start-up instructions are made on the basis that chemical feed rates have already been set.

a. Chlorine System

Power to either Chlorinator 1 or 2 must be turned on as well as power to the motorized water valve. The Hand-Off-Auto selector switch for the valve should be in the Auto position.

Depending on water quality, water usage and chlorine demand within the system, post-chlorination at the high service pumps may be required. Post-chlorination is obtained by turning Chlorinator 3 to the Auto position. Power to the booster pump must also be turned on by switching the selector to the Auto position. Operation of the post-chlorination system may be required when the rest of the plant is turned off, thus the starting and stopping sequence would not be necessary.

b. Alum System

Start the alum system up by turning on power to the metering pumps. The alum pump selector switches should be turned to the Auto position.

c. Polymer System

Start the polymer system up by turning on power to the metering pumps. The polymer metering pump selector switches should be turned to the Auto position.

d. Fluoride System

Start the fluoride system up by turning on power to the metering pumps. The fluoride metering pump selector switches should be turned to the Auto position.

e. Low Service Pumps

Turn on two of the low service pumps using the on-off switches located at the main control panel. The Hand-Off-Remote switches located at the motor starters must be in the Remote position for the on-off switch at the main control panel to turn the pumps on.

After the pumps are turned on, read the plant influent flowmeter. Discharge valves on the low service pumps should be throttled as needed to adjust the raw water flow rate.

C. Normal Short-term Shutdown

1. General

Normal short-term shutdown will generally occur during the nighttime periods when filtered water storage has adequate capacity to meet water demand.

Shutdown of the treatment processes should be in reverse order of the start up sequence. The low service pumps, rapid mixer, flocculator, chemical feed systems and sand filters should be shutdown by turning Hand-Off-Auto switches to the Off position and On-Off switches to the Off position.

D. Complete Shutdown

1. General

Complete shutdown of portions of the system may become necessary for maintenance or when the system is not required to provide quality finished water.

One of the flocculators may be taken out of service. In which case, the tank should be drained and kept free of debris until needed. Disinfection may prove to be necessary prior to restarting.

The rapid mixers and chemical standby equipment can be shut down and restarted in accordance with the manufacturer's recommendations as needed.

It is not expected that the entire plant will require long-term shutdown beyond the normal short-term limits.

E. Normal Limits of Operation

The plant has been designed with sufficient capacity to provide the community's demand for water by operating less than 24 hours per day. The plant should be operated at its rated capacity of 3.0 mgd until the one million gallon ground storage reservoir and the 300,000 gallon elevated storage tank are filled. When these reservoirs are full, the plant can be shut down. The high service pumping

units will continue to provide water to the distribution system based on the water level in the elevated storage tank. Operating personnel are not required to pump water from the reservoir to the distribution system.

Individual plant system alarms will notify personnel of any malfunction.

F. Emergencies and Operational Response

1. General

This section discusses a few major emergencies that may occur during plant operation. It is assumed that preventive and corrective maintenance will be performed to prevent simultaneous failure of systems or failure of both the primary and backup equipment. Sufficient water can be stored within the reservoir to allow time for minor repairs. It is expected that plant operations would be extended as needed to provide enough water to meet the City's demand. It is also expected that records of equipment performance would be kept and readily available so that manual settings can be made should automatic operation fail.

2. Power Failure

The main electrical power supply to the plant may be interrupted during storms or due to accidental disruption to the distribution system. The plant has two separate power supplies which will require manual switchover upon power disruption. The manual transfer switch will be thrown by plant personnel during normal operating hours or by specific notice by the plant's alarm system when personnel are not at the plant. The electrical systems will reset and automatically return to operation when power is returned.

3. Instrumentation Failure

Instruments which sense and/or control vital equipment may malfunction, distrupting automatic operation. Equipment may come on or go off at inappropriate times, and feed rates may become incorrect. When this occurs, systems controlled by the malfunctining instrument must be operated manually. For example, chemical feed systems paced by malfunctioning meter equipment must be turned to manual and given a feed rate based on pumped flow rates. Also, if the filter controller fails, the filter backwash must be sequenced manually. If the repair of the malfunctioning instrument

requires a specialist, the plant operator should call the equipment supplier immediately.

4. Trihalomethanes

Trihalomethanes (THMs) may be discovered in the filtered water. Should this happen, the ammonia system must be activated to control formation of THMs.

5. Reduced Plant Flow

Although reduced capacity can be compensated for by extending hours of operation, this abnormality should be eliminated. Valves should be checked to ensure that they are fully open. Individual pump discharge heads and flow rates should be checked against initial performance records to ensure that pump impeller wear is not the cause of reduced flow. The low service pump wet well water level should be checked during pump operation. High headloss within the plant intake structures may cause reduced flow, especially during periods of low lake levels. The infiltration bed may become clogged with silt or organic matter.

If excessive loss is confirmed in the intake system, the infiltration bed should be backwashed. An intake backwash line was installed as an aid in cleaning the bed. The high service pumps can discharge water to the intake line. Follow the Pipework Flow Diagram for valve operation. The high service pumps must be throttled. At maximum backflush rates the discharge pressure should be 65 psi. Pumpage rates must be determined through experience. The operator should start at low pump rates and increase rates during successive cleaning attempts until an effective cleaning rate is reached. If this backflushing operation is unable to clean the bed, the blind flange on the emergency intake riser may be removed, allowing lake water to bypass the clogged bed. Raw water quality will then change and chemical feed rates may require adjustment.

G. Troubleshooting Guide

A troubleshooting guide for major plant processes is contained in Table IV-1, Charlevoix WTP Troubleshooting Guide. Troubleshooting guides for specific pieces of equipment may be found in the manufacturer's operation and maintenance literature. The operator should check the individual operating and maintenance manuals for specific troubleshooting guidance as soon as problems occur. If the manuals do not address the problem sufficiently to allow repair, the manufacturer should be contacted by phone for immediate response.

The operators may also consult with other water plants to solicit advice on how to handle the problem. The constructing contractor, engineer and/or MDPH may be able to assist with a solution.

A current copy of the organizational chart for the Michigan Department of Public Health is enclosed for your reference.

H. Calibration

Calibration of all equipment will be done initially by the manufacturers' representative during the start-up period. Instructions will be provided to the plant operators during start-up which will qualify them to recalibrate equipment that does not need specialized tools or technicians to accomplish.

I. Schematic Diagram

Schematic diagrams have been provided in the Appendices of this manual. Additional diagrams can be found in the equipment suppliers' shop drawing submittals and operation and maintenance manuals which accompany this manual.

Table IV-1
Charlevoix WTP Troubleshooting Guide

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
1. Low Service Pumps at reduced capacity	1a. Suction or discharge valve not fully open.	1a. Suction and discharge valves	1a. Open valves
	1b. Worn or broken impeller.	1b. Impeller	1b. Replace or repair impeller.
	1c. Sand infiltration bed clogged.	1c. Sand bed surface	1c. Rake bed or backflush infiltration bed.
	1d. Low lake elevation.	1d. Lake level	1d. Change impellers and motor.
	1e. Flowmeter malfunction.	1e. Flowmeter	1e. Adjust or repair flowmeter.
2. Frequent back-washing of filter	2a. Higher raw water turbidity.	2a. Raw water turbity	2a. Fill thin filtration bed areas with sand.
	2b. Incorrect chemical feed rate.	2b. Pump feed rate, line valves, injectors	2b. Change feed rate, open valves or clean injectors.
	2c. Malfunctioning mixer.	2c. Mixer blades and motor	2c. Replace or repair damaged parts.
	2d. Incorrect floculator propeller speed.	2d. Propeller speed	2d. Change propeller speed.
	2e. Clogged filter media.	2e. Biological or chemical growth on media	2e. Change chemical feed rates to stop growth and/or replace media.
	2f. Backwash system malfunction.	2f. Blower capacity, air piping valves, backwash pumps and backwash valves	2f. Replace air filters, repair blowers, repair backwash pumps, open and/or repair valves.
	2g. Malfunctioning auto filter controller.	2g. Controller and float sensors	2g. Repair or replace malfunctioning controller components.

Table IV-1 (continued)

Indicators/Observations	Probable Cause	Check or Monitor	Solutions
3. High turbidity in clear well	3a. Poorly developed floc. 3b. Uneven backwash. 3c. Insufficient media.	3a. Chemical feed rates, mixer, and floculator propeller speed 3b. Water and media surface patterns during and after backwash; also check controller 3c. Media depths	3a. Change chemical feed rates, restore mixer or adjust propeller speed. 3b. Unclog air diffusers, open air or backwash piping valves, repair malfunctioning controller. 3c. Add sand or charcoal media. Reduce backwash rates.
4. Low water in reservoir	4a. Insufficient plant water production for current demand. 4b. Anomalous system demand. 4c. Malfunctioning level sensor.	4a. Plant production rates and system demand 4b. Distribution leak or unusual customer usage 4c. Actual visible water level	4a. Increase plant production rate and/or plant operating hours. 4b. Fix leak; restrict customer usage. 4c. Repair level sensor.
5. Chlorine residual outside recommended safe limits	5. Incorrect chlorine feed rate.	5. Chlorine feed system	5. Replace chlorine supply tank, adjust chlorine pump rate, reposition chlorine piping valves.
6. Sludge beds not draining	6. Plugged sand beds.	6. Sludge depth and bed media	6. Remove sludge and clean or replace upper layer of bed media.
7. Loss of automatic chemical pacing	7a. Raw water flowmeter failure. 7b. Instrumentation malfunction or failure.	7a. Check flowmeter 7b. Check instrumentation	7a. Repair or replace flowmeter. 7b. Repair or replace instrumentation. 7c. Operate plant in manual mode until system is restored.

Michigan Department of Public Health
Bureau of Environmental and Occupational Health
Public Water Supply Program

The Division of Water Supply is comprised of three sections: Public Water Supplies, Public Swimming Pools, and Ground Water Quality Control. This listing is of the staff of the Public Water Supply Program only.

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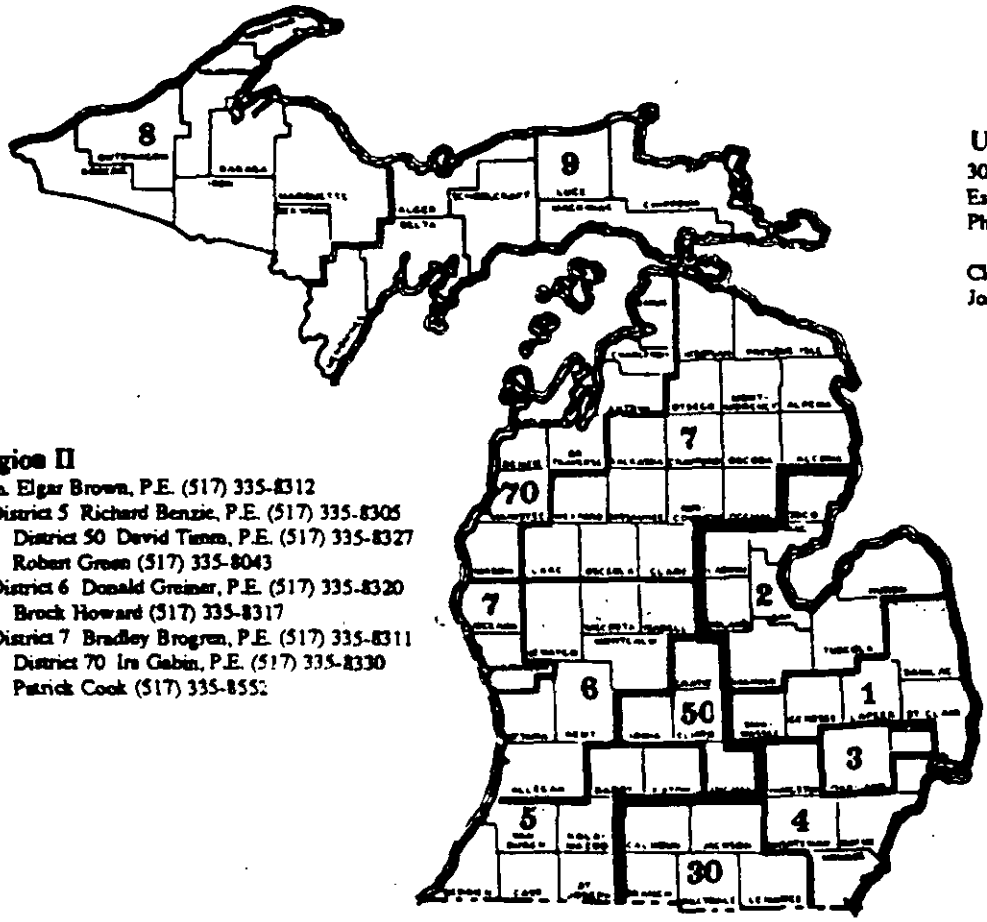

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V. PREVENTIVE MAINTENANCE PROCEDURES

A. General

Maintenance programs should be carried out with the objective to prevent emergencies, unscheduled shutdowns, or process bypassing. Plans conforming to construction records, shop drawings, and manufacturer's service manuals have been made available for ready reference. Familiarity with the location, basic operation, and maintenance of each equipment item is a responsibility each employee should assume.

All maintenance requires considerable skill, which can only be acquired through experience, study and practice. Free exchange of specific situations encountered by others is a useful tool to speed repairs and avoid future problems. Records describing specific problems and the solution exercised can further assist mechanics under similar situations encountered in the future. Periodic training sessions conducted by the plant staff, manufacturer's representatives and other consultants are also a useful tool in acquiring experience and confidence to complete repairs or design of new systems.

Proper operation and preventive maintenance of the plant equipment within the guidelines established by each manufacturer will immeasurably extend the equipment's life expectancy. This point cannot be stressed enough and should receive top priority. Sufficient tools, spare parts, materials, lubrication supplies and manpower must also be available to perform routine maintenance and equipment repairs. Selection of lubrication supplies can best be performed following a survey of all equipment by a local supplier. This survey is normally performed at no charge to the customer and permits bulk purchase from one source.

Regular housekeeping of the buildings and grounds should be scheduled. Housekeeping includes sweeping, mopping, and waxing of interior floors; maintaining cleanliness in the laboratory, toilet and shower rooms; snow and ice removal from walks, roads and exterior plant equipment and mowing of grass areas. Plant personnel, other City employees or contractual services may be used to perform these housekeeping requirements. The number of available plant personnel and budget limitations will dictate the final means of accomplishing the housekeeping requirements. Most large plants perform this on an in-house basis. Job descriptions for plant personnel should include this as a work requirement.

Any maintenance program should observe the following general outline:

1. Keep a clean, neat and orderly facility.
2. Establish a systematic plan for execution of daily operation.
3. Establish a routine inspection and lubrication schedule.
4. Keep data and records for each equipment item with emphasis on unusual incidents and faulty operating conditions.
5. Observe safety precautions.
7. Utilize manufacturer's service personnel where appropriate.
8. Establish an adequate operational budget.
9. Return tools to their proper storage area after use.

Total responsibility for the operation and maintenance of the water filtration plant rests with the Owner. In most cases, the Owner consists of a commission, council, board or agency comprised of a number of individuals with no singular responsibility. Therefore, it is imperative that the responsibility of operation and maintenance of the plant be passed from the Owner to the Plant Superintendent by specific direction or job description.

Maintenance programs should be carried out in a manner which prevents emergencies or unscheduled shutdowns. Periodic checks should be made by the Owner to insure that proper operation and maintenance practices are being adhered to at the plant. It is suggested that a numbered file system based on the Engineer's specification book numbering system be established. These files will include all approved shop drawings, manufacturer's installation, operation and maintenance manuals, parts lists, lubrication charts, maintenance records and past construction changes. Files for the existing plant should be collected and filed with the new material. Files for removed or replaced equipment should be destroyed.

To organize and streamline the corrective maintenance work, a maintenance management system should be used.

A maintenance management system for the City of Charlevoix Water Filtration Plant would consist of the following 4 components which are described in the following sections of this Chapter:

- Preventive Maintenance Jobs: Schedule
- Preventive Maintenance Jobs: Descriptions

- **Corrective Maintenance Jobs: Work Order Form**
- **Corrective Maintenance Jobs: Log Sheet**

This system will:

- **Give the Superintendent instant preventive maintenance work schedules for all equipment for each week of the year.**

- Assign the preventive maintenance jobs to the maintenance personnel quickly, fairly and efficiently.

- Allow the Superintendent to monitor the preventive maintenance work done, and not done, on the equipment every week.

- Efficiently assign corrective maintenance jobs to the plant personnel.

- Point out to the Superintendent which equipment is performing well and which is not (in terms of corrective maintenance). This will help the Superintendent when decisions are made in the future on what type of equipment to purchase.

- Lengthen the service life of the plant equipment.

- Avoid periods of time when the maintenance personnel have too little or too much to do. The work schedule will be distributed evenly throughout the year.

- Give the Superintendent a method to calculate how many hours per year are needed to maintain the plant equipment. From that, the number of personnel required can also be calculated.

B. Preventive Maintenance Jobs: Schedule

1. What Is It?

   The following schedule presents the timetable for performing the daily (D), weekly (W), monthly (M), quarterly (Q), semi-annual (S), and annual (A), preventive maintenance jobs for the equipment. There are two pages for each week, or a total of 104 pages.

2. How Do You Use It?

First, the space next to "WEEK OF" should be filled in. For example, if the schedule for 1987 is beginning on Monday, January 5, 1987, then that date would apply for week number one. January 12, 1987 would be filled in for week number two and January 19, 1987 for week number three and so forth. The 1987 schedule would therefore end with week number fifty-two starting on Monday, December 28, 1987.

Next, the various tasks should be assigned to the various maintenance personnel by writing the proper initials in the "Assigned To" column.

Then, as the jobs are performed, the maintenance personnel would acknowledge this by writing the proper initials and dates under the "Completion Date and Initials" column.

If there are any problems in performing the jobs, or if a corrective maintenance work order is required, then the last column, "Comments," is used for that purpose.

Once all the jobs for the week have been completed, the schedule sheet can be checked off in the upper right hand corner. The two sheets then become the the permanent record of preventive maintenance at the plant for that week.

Charlevoix

EQUIPMENT	PAGE	PERIOD
Butterfly Valves	1	Q
Industrial Butterfly Valve	2	Q
Check Valves	3	Q
Gate Valves	4	Q
Stop Plates	5	S
Vert Turbine Pump Low Service	6	DWS
Vert Turbine Pump High Service	7	DWS
Backwash Water Pump Submersible	8	SA
Chlorinator Chlorine Room	9	DMA
Ammoniator Ammonia Room	10	DMA
Liquid Polymer Metering Pump	11	WA
Alum Metering Pump Chemical Storage	12	WA
Backwash Air Supply Filter Bldg Pump Ro	13	WMSA
Flocculator Filter Bldg / Room	14	WSA
Mech In Line Mixer Filter Bldg	15	DWMS
Sump Pump Pump Room	16	WSA
Sump Pump Chemical Storage	17	DMA
Heat & Ventilat UnitFilter Room	18	A
HVAC Unit Filter Bldg	19	A
Air Cooled Cond UnitFilter Bldg Roof	20	QS
Air Compressors Mechanical Room	21	WMQSA
Automatic Damper	22	A
Exhaust Fans Roof	23	SA
Hot Water Heating Boiler - Mech Room	24	QS
Hot Water Unit Heaters	25	A
Electrical EquipmentThroughout Plant	26	A
Instrumentation Throughout Plant	27	A

Charlevoix
Preventive Maintenance Jobs

Week No.: 1 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1				X				
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 1

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 2 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2				X				
Check Valves	3								
Gate Valves	4								
Stop Plates	5					X			
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 2 Week of: _____

Equipment	Page No.*	D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 3 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3				X				
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8						X		
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 3 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 4 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4				X				
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X			X			
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 4 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 5 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20				X				
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler n Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 5

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 6

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X			X			
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X					X		
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X	X				
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 6 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 7

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24				X				
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 7

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 8

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8					X			
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number

** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 8

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 9 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X					X		
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 9 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 10

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X			X			
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 10 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 11 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 11 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 12 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X				X		
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X			X			
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page numbe
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 12

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 13 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annua_ or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 13 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 14

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1				X				
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X			X			
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 14 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 15 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2				X				
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X				X		
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annua or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 15 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 16 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3				X				
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X			X			
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annua_ or annual job

Week No.: 16 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 17 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4				X				
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 17 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 18 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X				X		
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20				X	X			
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annua. or annual job

Week No.: 18

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 19 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X		X				
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annua. or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 19 **Week of:** _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 20 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X			X			
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24				X				
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 20 **Week of:** _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 21 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X				X		
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 21 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 22 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23					X			
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 22

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 23

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job.

Charlevoix
Preventive Maintenance Jobs

Week No.: 23

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 24

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X				X		
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24					X			
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 24

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26						-		
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 25 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1	-							
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 25 **Week of:** _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 26 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 26 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 27 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1				X				
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X					X		
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 27 **Week of:** _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 28 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2				X				
Check Valves	3								
Gate Valves	4								
Stop Plates	5					X			
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 28 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 29 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3				X				
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 29 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26							-	
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 30 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1				-				
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4				X				
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X			X			
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18						X		
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 30

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 31

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20				X				
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 31 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 32 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X			X			
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X		X				
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annua or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 32 **Week of:** _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 33

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19						X		
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24				X				
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 33 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 34 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8					X			
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 34

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 35

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 35

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 36

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X			X			
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X				X		
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 36

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 37

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 37

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 38

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X			X			
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 38 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 39

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22						X		
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number

** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 39

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 40

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1				X				
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X		X			
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 40

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 41

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2				X				
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 41

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 42

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3				X				
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X			X			
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23						X		
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 42

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 43

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4				X				
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 43

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 44

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20				X	X			
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number

** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 44 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 45

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X		X				
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25						X		

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 45 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 46

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X		X			
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24				X				
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 46

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 47 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 47

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 48

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23					X			
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 48

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26						X		
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Week No.: 49

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X		X					
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X		X					
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 49

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 50

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X		X					
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X	X					
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24					X			
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 50 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 51

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X	X					
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X						
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number

** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 51 Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27						X		

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 52

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Butterfly Valves	1								
Industrial Butterfly Valve	2								
Check Valves	3								
Gate Valves	4								
Stop Plates	5								
Vert Turbine Pump Low Service	6	X	X						
Vert Turbine Pump High Service	7	X	X						
Backwash Water Pump Submersible	8								
Chlorinator Chlorine Room	9	X							
Ammoniator Ammonia Room	10	X							
Liquid Polymer Metering Pump	11		X						
Alum Metering Pump Chemical Storage	12		X						
Backwash Air Supply Filter Bldg Pump Rm	13		X						
Flocculator Filter Bldg / Room	14		X						
Mech In Line Mixer Filter Bldg	15	X	X	X					
Sump Pump Pump Room	16		X						
Sump Pump Chemical Storage	17	X							
Heat & Ventilat Unit Filter Room	18								
HVAC Unit Filter Bldg	19								
Air Cooled Cond Unit Filter Bldg Roof	20								
Air Compressors Mechanical Room	21		X						
Automatic Damper	22								
Exhaust Fans Roof	23								
Hot Water Heating Boiler - Mech Room	24								
Hot Water Unit Heaters	25								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

Charlevoix
Preventive Maintenance Jobs

Week No.: 52

Week of: _____

Equipment	Page No.*	** D	W	M	Q	S	A	Completion Date and Initials	Comments (Work Orders, etc.)
Electrical Equipment Throughout Plant	26								
Instrumentation Throughout Plant	27								

* - Page number refers to the Preventive Maintenance Job list page number.
** - D,W,M,Q,S,A indicates a Daily, Weekly, Monthly, Quarterly, Semi-annual or annual job

C. Preventive Maintenance Jobs: Descriptions

1. What Are They?

This section contains preventive maintenance job descriptions for the plant equipment. These tell you, at a glance, what jobs need to be performed daily, weekly, monthly, quarterly, semi-annually and annually (D, W, M, Q, S, A).

The job descriptions are, of necessity, brief. If the person doing the work needs more information, then he or she should get the O&M Manual on the equipment (which is on file in the Office Building).

In addition to the job descriptions, the sheets give the name and telephone number of the equipment sales representative. The sales representatives usually have a strong interest in keeping the equipment trouble-free. Therefore, do not hesitate to call them for help if there are any maintenance problems with the equipment.

The operator may wish to assign each piece of equipment a unique number and expand the number of sheets so as to have a separate sheet for individual equipment pieces within a group. For example, three sheets may be used for Low Service Pumps rather than one.

2. Where Are They?

These preventive maintenance job description sheets are kept on file by the Plant Superintendent. In addition, each sheet pertaining to each piece of equipment is kept in a protective clear plastic holder at the equipment location.

3. How Do You Use Them?

Once the maintenance personnel are given their weekly assignment of preventive maintenance jobs based on the annual schedule, they can go to the equipment to which they have been assigned and read the job description sheet. This will tell them what work has to be done. The job schedule sheet will say, for example, "Do monthly maintenance on the chlorinators." The job description sheet will say, "Monthly maintenance is to: clean all class rotameters."

4. What Are Other Considerations?

The list does not include minor items that can be found in most buildings and require normal inspection and maintenance.

The maintenance procedures for electrical equipment are not detailed. The maintenance personnel should become familiar with all the manufacturer's operation and maintenance materials furnished with the electrical equipment. In addition, it is recommended strongly that NFPA Handbook No. 70B, Recommended Practice for Electrical Equipment Maintenance, be obtained and followed. The booklet is available at nominal cost from:

National Fire Protection Association
470 Atlantic Avenue, Boston, Massachusetts 02210

The handbook also has many example data forms that can be used for maintenance recordkeeping.

Instrumentation components and systems are covered by a Maintenance Service Contract during the period immediately after construction. As these agreements terminate, it is strongly recommended that they either be extended with the original manufacturer at a negotiated price or that new agreements be obtained with other instrument maintenance firms. Most suppliers of instrumentation systems offer such services and will normally include all items, even those of some other manufacturer.

Other items in the preventive maintenance job descriptions may require specialized assistance.

Equipment manufacturers and suppliers are now providing various inspection, maintenance, calibration and repair services under yearly maintenance and service agreements. For the small plant with limited repair and maintenance personnel, this may be the best solution, although the dollar amount can be high for the first few years of a new plant. If the water treatment system requires similar services, it could be possible to include all equipment under one agreement.

PREVENTIVE MAINTENANCE JOBS

Equipment: Butterfly Valves

Location(s): see below

Number of Units: 40 MP&S Spec. Section: 19

Manufacturer: DeZurik & Allis Chalmers

Sales Represent. Name: Tonka Equipment Co.

Address: 5115 Industrial St., Maple Plains, Minnesota 55359

Phone: (612) 479-3125

Model: Serial Number:

Capacity: Horsepower:

Miscellaneous: Div. 15D

Lubricants Required:

Quarterly: Exercise and inspect all butterfly valves.

Mark	Location	Service	Size (inches)	Quantity
B-2-1 thru B-2-3	Filter Bldg., Pump Room	RW	12	3
B-3-1 thru B-3-6	Filter Bldg., Pump Room	RW	12	6
B-4-1 & B-4-2	Filter Bldg., Pump Room	RW	10	2
B-5-1 & B-5-2	Filter Bldg., Pump Room	RW	16	2
B-6-1 thru B-6-4	Filter Bldg., Filter Room	WWD	16	4
B-7-1 thru B-7-4	Filter Bldg., Filter Room	FW	18	4
B-8-1 thru B-8-4	Filter Bldg., Filter Inlet	RW	12	4
B-9-1 & B-9-2	Filtered Water Reservoir	FW	24	2
B-10-1 thru B-10-3	High Service Pump Station	FW	12	3
B-11-1 thru B-11-3	High Service Pump Station	FW	16	3
B-12-1	High Service Pump Station	FW	12	1
B-13-1 & B-13-2	Ground Buried	FW	16	2
B-14-1	Ground Buried	FW	4	1
B-15-1 thru B-15-3	Ground Buried	WWD	18	3

PREVENTIVE MAINTENANCE JOBS

Equipment:	Industrial Butterfly Valves
Location(s):	see below
Number of Units:	10 **MP&S Spec. Section:** 19
Manufacturer:	DeZurik
Sales Represent. Name:	Tonka Equipment Co.
Address:	5115 Industrial St., Maple Plains, Minnesota 55359
Phone:	(612) 479-3125
Model:	**Serial Number:**
Capacity:	**Horsepower:**
Miscellaneous:	Div. 15D
Lubricants Required:	

Quarterly: Exercise and inspect all industrial butterfly valves.

Mark	Location	Service	Size (inches)	Quantity
IB-1-1 thru IB-1-4	Filter Building	Air	6	4
IB-2-1 thru IB-2-4	Filter Building	Air	6	4
IB-3-1 & IB-3-2	Filter Building	Air	4	2

PREVENTIVE MAINTENANCE JOBS

Equipment: Check Valves

Location(s): see below

Number of Units: 10 MP&S Spec. Section: 19

Manufacturer: G.A. Industries

Sales Represent. Name:

Address: 290-D Marshall Rd., Mars, PA 16046

Phone: (412) 776-1020

Model: Serial Number:

Capacity: Horsepower:

Miscellaneous: Div. 15D

Lubricants Required:

Quarterly: Exercise and inspect all check valves.

Mark	Location	Service	Size (inches)	Quantity
RC-1-1 thru RC-1-3	Filter Building	RW	12	3
RC-2-1 thru RC-2-3	High Service Pump Station	FW	12	3
C-3-1 & C-3-2	Filter Building	SPD	6	2
DC-1-1 & DC-1-2	Filter Building	Air	6	2

PREVENTIVE MAINTENANCE JOBS

Equipment: Gate Valves

Location(s): see below

Number of Units: 5 **MP&S Spec. Section:** 19

Manufacturer:

Sales Represent. Name:

Address:

Phone:

Model: **Serial Number:**

Capacity: **Horsepower:**

Miscellaneous:

Lubricants Required:

Quarterly: Exercise and inspect all gate valves.

Mark	Location	Service	Size (inches)	Quantity
A-1-1 & A-1-2	Filter Building	SPD	4	2
A-3-1	Ground Buried	FW	6	1
A-3-1 & A-3-2	Ground Buried	Drain	6	2

PREVENTIVE MAINTENANCE JOBS

Equipment: Stop Plates

Location(s): see below

Number of Units: 2 MP&S Spec. Section: 19

Manufacturer: Warminster Fiberglass

Sales Represent. Name:

Address: P.O. Box 188 Southampton, PA 18966

Phone: (215) 674-6900

Model: Serial Number:

Capacity: Horsepower:

Miscellaneous: Div. 15D

Lubricants Required:

Quarterly: Exercise and inspect all stop plates.

Mark	Location	Service	Size (inches)	Quantity
SP-1-1 & SP-1-2	Filter Bldg., Floc Tanks	RW	18" x 2'-6"	2

PREVENTIVE MAINTENANCE JOBS

Equipment:	Vertical Turbine Pump - Low Service
Location(s):	Filter Bldg. - Pump Room
Number of Units:	3 — **MP&S Spec. Section:** 23
Manufacturer:	Aurora Pump
Sales Represent. Name:	Kerr Machinery Corp.
Address:	P.O. Box 37160, Oak Park, MI 48237
Phone:	(313) 543-3880
Model:	1110 Series — **Serial Number:**
Capacity:	1400 gpm @ — **Horsepower:** 20 Hp MS Electric
Miscellaneous:	Mark LS 1, 2 and 3
	Div. 11A
Lubricants Required:	

Daily:	Check and adjust packing. Replace after addition of one extra ring.
Weekly:	Grease top pump bushing using an NLGI #2 lithium grease.
Semiannually:	Purge and regrease the motor bearings using an NLGI #2 lithium grease.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Vertical Turbine Pump - High Service		
Location(s):	High Service Pump Station		
Number of Units:	3	MP&S Spec. Section:	23
Manufacturer:	Aurora Pump		
Sales Represent. Name:	Kerr Machinery Corp.		
Address:	P.O. Box 37160, Oak Park, MI 48237		
Phone:	(313) 543-3880		
Model:	1110 Series	Serial Number:	
Capacity:	2000 gpm (1)	Horsepower:	150 Hp (HS-1)
	1000 gpm (2)		75 Hp (HS-2 & 3)
Miscellaneous:	Mark HS 1, 2 and 3		
Lubricants Required:			

Daily:	Check and adjust packing. Replace after addition of one extra ring.
Weekly:	Grease top pump bushing using an NLGI #2 lithium grease.
Semiannually:	Purge and regrease the motor bearings using an NLGI #2 lithium grease.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Backwash Water Pump - Submersible
Location(s):	Filter Building - Filter Room
Number of Units:	2 **MP&S Spec. Section:** 23
Manufacturer:	Hydromatic (Marley)
Sales Represent. Name:	Kerr Machinery Corp.
Address:	P.O. Box 37160, Oak Park, MI 48237
Phone:	(313) 543-3880
Model:	SGL-300 **Serial Number:**
Capacity:	600 gpm **Horsepower:** 3 Hp
Miscellaneous:	Mark BW-1 & 2, Div. II C
Lubricants Required:	

Semiannually: If hydrorail system is used, lift to check for corrosion and wear. Lubricate rail.

Annually:

1. Check oil in motor, lubricate if needed.
2. If seal failure unit is not used, drain oil from seal chamber and check for water.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Sump Pump		
Location(s):	Pump Room		
Number of Units:	2	MP&S Spec. Section:	24
Manufacturer:	Auora Pump		
Sales Represent. Name:	Kerr Machinery Corp.		
Address:	P.O. Box 37160, Oak Park, MI 48237		
Phone:	(313) 543-3880		
Model:	642	Serial Number:	
Capacity:	100 gpm	Horsepower:	
Miscellaneous:	Div. 15F		
Lubricants Required:			

Weekly:

1. Lubricate the lower head bearing. Use gear fittings in sump plate. Use EP-2 grease.
2. Check for any unusual noise - could indicate lower bearing failure.

Semiannually: Check regreasable ball bearings for lubrication; regrease if necessary. Use lithium, lithium soda, or calcium base grase. Do not mix different brands of grease, avoid overlubrication to prevent bearing failure.

Annually: Check motors and lubricate if necessary, following motor manufacturer's recommendations.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Sump Pump		
Location(s):	Chemical Storage		
Number of Units:	1	**MP&S Spec. Section:**	24
Manufacturer:	Vanton Pump		
Sales Represent. Name:	Detroit Pump & Mfg. Co.		
Address:	18943 John R, Detroit, MI 48203		
Phone:	(313) 893-4242		
Model:	SGN-200	**Serial Number:**	
Capacity:	30 gpm	**Horsepower:**	1½ Hp
Miscellaneous:	Div. 15H		
Lubricants Required:			

Daily: Lubricate pump and guide bearings.

Monthly:

1. Check impeller clearance. Adjust as necessary.
2. Lubricate ball bearings. Do not overgrease. Use Mobilux #2 or equal.

Annually:

1. Clean ball bearings. Use SAE #10 or lighter.
2. Test ball bearings for quiet operation.
3. Lubricate drive assembly.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Backwash Air Supply - Low Pressure Air Blower
Location(s):	Filter Building Pump Room
Number of Units:	2 MP&S Spec. Section: 30
Manufacturer:	Universal Blower Pac
Sales Represent. Name:	
Address:	P.O. Box 435, Westfield, IN 46074
Phone:	(317) 773-7256
Model:	5LVF Serial Number:
Capacity:	550 cfm Horsepower: 15 Hp
Miscellaneous:	
Lubricants Required:	

Weekly:

1. Check unit and piping for foreign matter.
2. Check level and drive alignment.
3. Check unit for proper lubrication.
4. Turn unit over by hand to check for binding.
5. Jog to check rotation.
6. Operate for fifteen minutes with no load and inspect for any hot spots or any problems.
7. Apply load and check unit regularly.
8. Add oil as required to maintain proper level. Use SAE 20 oil.
9. Add oil in valve in top of blower after each use. Use 90 gear oil.

Monthly: Grease pump bearings with EP-2 grease.

Semiannually:

1. Check the oil. Use SAE 20 oil.
2. Lubricate gear couplings.
3. Lubricate blower motor.
4. Check fiberglass element in intake filter-silencers. Change when visually dirty.

Annually:

1. Check timing gears and gear end bearings.
2. Check impellers through intake and discharge ports.
3. Check for proper impeller clearance.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Chlorinator		
Location(s):	Chlorine Room		
Number of Units:	2	**MP&S Spec. Section:**	31
Manufacturer:	Wallace & Tiernan		
Sales Represent. Name:			
Address:	29200 Vassar Ave., Livonia, MI 48152		
Phone:	(313) 478-1890		
Model:	V-500	Serial Number:	
Capacity:	500 lb/day	Horsepower:	
Miscellaneous:	Div. IIB		
Lubricants Required:			

Daily:

1. Check chlorine connections for leaks.
2. Observe all gauges to see if chlorinators are functioning properly.

Monthly: Clean all glass rotameters.

Annually:

1. Inspect V-notch plug and valve seats for impurity build-up. Clean if necessary using soap and water.
2. Lubricate electric plug positioner motor bearings with 2 or 3 drops of SAE 10 nondetergent oil.
3. Replace gaskets and O-rings.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Ammoniator		
Location(s):	Ammonia Room		
Number of Units:	1	MP&S Spec. Section:	31
Manufacturer:	Wallace & Tiernan		
Sales Represent. Name:			
Address:	29200 Vassar Ave., Livonia, MI 48152		
Phone:	(313) 478-1890		
Model:	V-500	Serial Number:	
Capacity:	500 lb/day	Horsepower:	
Miscellaneous:	Div. IIB		
Lubricants Required:			

Daily:

1. Check connections for leaks.
2. Observe all gauges to see if ammoniators are functioning properly.

Monthly: Clean all glass rotameters.

Annually:

1. Inspect V-notch plug and valve seats for inpurity build-up. Clean if necessary using soap and water.
2. Lubricate electric plug positioner motor bearings with 2 or 3 drops of SAE 10 nondetergent oil.
3. Replace gaskets and O-rings.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Liquid Polymer Metering Pump		
Location(s):	Chemical Room		
Number of Units:	2	**MP&S Spec. Section:**	37
Manufacturer:	Wallace & Tiernan		
Sales Represent. Name:			
Address:	29200 Vassar Ave., Livonia, MI 48152		
Phone:	(313) 478-1890		
Model:	44-2Y3	**Serial Number:**	
Capacity:	22 gph	**Horsepower:**	
Miscellaneous:	Div. IIB		
Lubricants Required:			

Weekly:

1. Inspect piping for leaks.
2. Maintain oil level at the line on the oil dipstick. Use Gulf Multi-purpose Gear Lubricant EP-90 with antifoam agent. DO NOT OVERFILL. Check oil only when pump is NOT running.
3. Check belt tension.

Annually: Clean and lubricate drive assembly as necessary.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Alum Metering Pump
Location(s):	Chemical Storage
Number of Units:	2 MP&S Spec. Section: 37
Manufacturer:	Wallace & Tiernan
Sales Represent. Name:	
Address:	29200 Vassar Ave., Livonia, MI 48152
Phone:	(313) 478-1890
Model:	44-213 Serial Number:
Capacity:	20 gph Horsepower:
Miscellaneous:	Div. IIB
Lubricants Required:	

Weekly:

1. Inspect piping for leaks.
2. Maintain oil level at the line on the oil dipstick. Use Gulf Multi-purpose Gear Lubricant EP-90 with antifoam agent. DO NOT OVERFILL. Check oil only when pump is NOT running.
3. Check belt tension.

Annually: Clean and lubricate drive assembly as necessary.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Flocculator
Location(s):	Filter Building - Filter Room
Number of Units:	2 **MP&S Spec. Section:**
Manufacturer:	
Sales Represent. Name:	Tonka Equipment Co.
Address:	5115 Industrial St., Maple Plains, Minnesota 55359
Phone:	(612) 479-3125
Model:	**Serial Number:**
Capacity:	2 mp **Horsepower:**
Miscellaneous:	Div. 11D
	Eurodrive Varimot Variable Speed Mixer 3 Hp
Lubricants Required:	

Weekly: Grease gear reducer bearings.

Semiannually: Change oil in speed-trol and gear reducer.

Annually:
1. Inspect belt of speed-trol
2. Drain and inspect tanks

PREVENTIVE MAINTENANCE JOBS

Equipment:	Mechanical In-line Mixer
Location(s):	Filter Building
Number of Units:	1 MP&S Spec. Section: 33
Manufacturer:	
Sales Represent. Name:	Tonka Equipment Co.
Address:	5115 Industrial St., Maple Plains, Minnesota 55359
Phone:	(612) 479-3125
Model:	Serial Number:
Capacity:	Horsepower: 3/4 Hp
Miscellaneous:	Div. 11D
Lubricants Required:	

Daily:	Routine visual inspection for oil leaks or unusual noises.
Weekly:	Check oil level, add if necessary.
Monthly:	Add grease at all bearings, couplings and seals (if applicable).
Semiannually:	Grease motor.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Heating and Ventilating Unit		
Location(s):	Filter Room		
Number of Units:	1	MP&S Spec. Section:	44
Manufacturer:	Bohn		
Sales Represent. Name:	Rogind Parker Curtis, Inc.		
Address:	1549 Richmond St., Grand Rapids, MI 49504		
Phone:	(616) 453-7748		
Model:	06 HCS LF	Serial Number:	
Capacity:	2165 cfm	Horsepower:	1-1/2 Hp
Miscellaneous:	Div. 15I		
Lubricants Required:			

Annually:

1. Check filters and inlet screen and clean as necessary.
2. Check heating surface for dirt build-up on finned area, and clean with air, or with a detergent solution (rinse well after cleaning).
3. Assure that the fan blades have no dirt build-up. This can unbalance the fan and cause bearing problems with the motor.
4. Check drive belt for wear and replace as necessary. Check pulley alignment if belt wear seems excessive.
5. Check all fittings, traps, valves, etc., for tightness and proper operation.
6. Check all other components for malfunction.
7. Lubricate motor and fan shaft as required.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Heating, Ventilating & Air Conditioning Unit		
Location(s):	Filter Room		
Number of Units:	1	MP&S Spec. Section:	44
Manufacturer:	Bohn		
Sales Represent. Name:	Rogind Parker Curtis, Inc.		
Address:	1549 Richmond St., Grand Rapids, MI 49504		
Phone:	(616) 453-7748		
Model:	06 HCS LF	Serial Number:	
Capacity:	2300 cfm	Horsepower:	3 Hp
Miscellaneous:	Div. 15I		
Lubricants Required:			

Annually:

1. Check filters and inlet screen and clean as necessary.
2. Check heating surface for dirt build-up on finned area, and clean with air, or with a detergent solution (rinse well after cleaning).
3. Assure that the fan blades have no dirt build-up. This can unbalance the fan and cause bearing problems with the motor.
4. Check drive belt for wear and replace as necessary. Check pulley alignment if belt wear seems excessive.
5. Check all fittings, traps, valves, etc., for tightness and proper operation.
6. Check all other components for malfunction.
7. Lubricate motor and fan shaft as required.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Air-cooled Condensing Unit
Location(s):	Filter Building Roof
Number of Units:	1 — **MP&S Spec. Section:** 44
Manufacturer:	Century
Sales Represent. Name:	Heat Controller, Inc.
Address:	Jackson, MI 49203
Phone:	
Model:	RC-85 — **Serial Number:**
Capacity:	**Horsepower:**
Miscellaneous:	Div. 15I
Lubricants Required:	

Quarterly:

1. Inspect air filter. Replace as necessary.
2. Inspect condensate drain lines.
3. Check thermostat calibration and anticipator setting.
4. Check pulley alignment
5. Check wiring condition
6. Check refrigerant piping
7. Check insulation within blower compartment
8. Check crankcase heater

Semiannually:

1. Lubricate motors. (SAE 20 non-detergent oil is recommended.)
2. Inspect belts. Replace or align as necessary.
3. Inspect heating and cooling coils. Clean as necessary.
4. Inspect evaporator blower wheels. Clean as required.
5. Inspect all valves. Lubricate as required.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Air Compressors		
Location(s):	Mechanical Room		
Number of Units:	2	MP&S Spec. Section:	44
Manufacturer:	Quincy-Colt, Ind.		
Sales Represent. Name:	Air Supply, Dick Gates		
Address:	Rockford, MI		
Phone:			
Model:	QR-25 F340	Serial Number:	
Capacity:		Horsepower:	10
Miscellaneous:	Div. 15J		
Lubricants Required:			

Weekly:	Check level of oil in compressors, add as required.
Bi-weekly:	Run compressors through complete cycle, check controls in auto and hand operation.
Monthly:	1. Check operaton of safety valves.
	2. Change V-belt tension.
Quarterly:	1. Change oil in compressors.
	2. Remove and clean air strainers in alkali-free hydrocarbon solvent
Semiannually:	1. Remove caps and clean inlet and discharge valves and overload check valve.
	2. Remove crankcase cover, clean oil strainers and interior crankcase.
Annually:	Clean all surfaces and retouch paint as required.

PREVENTIVE MAINTENANCE JOBS

Equipment: Automatic Damper
Location(s): See below
Number of Units: 9 **MP&S Spec. Section:** 44
Manufacturer: Honeywell
Sales Represent. Name: Swaney Sales
Address:
Phone:
Model: **Serial Number:**
Capacity: **Horsepower:**
Miscellaneous: Div. 15K
Lubricants Required:

Annually: Check damper operation, clean and lubricate damper linkage.

Mark	Qty	Location	Capacity cpm	Nominal Size (inch)	Description	Volts/ Phase
AD-1	1	Chlorine Feed	1225	24 x 24	Intake	Pneumatic
AD-2	1	Pump Room	4536	48 x 44	Intake	Pneumatic
AD-3	1	Electical	1185	40 x 24	Intake	Pneumatic
AD-4	2	Mech. Rm/Boiler Req's.		48 x 28	Intake/Exh.	Pneumatic
AD-5	1	Ammonia Feed	1125	24 x 24	Intake	Pneumatic
AD-6	1	Garage	1074	36 x 16	Intake	Pneumatic
AD-7	1	Chemical Feed	804	32 x 16	Intake	Pneumatic
AD-8	1	High Svc. Upper Rm.	3600	36 x 48	Intake	Pneumatic

PREVENTIVE MAINTENANCE JOBS

Equipment: Exhaust Fans - Roof
Location(s): See below
Number of Units: 12 MP&S Spec. Section: 44
Manufacturer: Loren Cook
Sales Represent. Name: Marshall & Wells
Address: P.O. Box 8838, Grand Rapids, MI 49508
Phone: (616) 459-0189
Model: Serial Number:
Capacity: Horsepower:
Miscellaneous: Div. 15K
Lubricants Required:

Semiannually: Inspect the drive belts.

Annually: Oil the motor bearings with 3-5 drops of SAE 10 weight oil.

Mark	Location	cpm	s.p.	Motor HP	Volts/Phase
RF-1	Chlorine Feed	1125	1/2	1/6	115 / 1
RF-2	Pump Room	4536	3/8	3/4	460 / 3
RF-3	Electrical	1185	3/8	1/6	115 / 1
RF-4			1/2		
RF-5	Ammonia Feed	125	1/2		115 / 1
RF-6	Garage	1074	3/8	1/6	115 / 1
RF-7	Chemical Feed	804	3/8	1/6	115 / 1
RF-8	High SCR Upper	1800	3/8	1/4	115 / 1
RF-9	High SCR Upper	1800	3/8	1/4	115 / 1
RF-10	Laboratory	770	3/8	1/6	115 / 1
RF-11	Toilet & Custodial	298	3/8	1/6	115 / 1
RV-1	Filter Room				

PREVENTIVE MAINTENANCE JOBS

Equipment:	Hot Water Heating Boiler - Gas-fired
Location(s):	Mechanical Room
Number of Units:	1 **MP&S Spec. Section:** 44
Manufacturer:	Bryan Steam Corp.
Sales Represent. Name:	
Address:	P.O. Box 27, Peru, IN 46970
Phone:	(317) 473-6651
Model:	CL-120 Serial Number:
Capacity:	MBH 960 Output Horsepower:
Miscellaneous:	Div. 15L
Lubricants Required:	

Quarterly:	1.	Check burner operation and all controls for automatic operation.
	2.	Check the water treatment procedure.
	3.	Remove any carbon or soot from the heating surfaces of the boiler.
Semiannually:	1.	Inspect the boilers, burners and all controls.
	2.	Lubricate burners.
	3.	Remove and clean or replace the oil burner nozzles.
	4.	Check pilot burner for proper operation.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Hot Water Unit Heaters		
Location(s):	See below		
Number of Units:	11	MP&S Spec. Section:	44
Manufacturer:	Dunham-Bush		
Sales Represent. Name:	Wilson-Brinker Assoc.		
Address:	2918 Portage St., Kalamazoo, MI 49001		
Phone:	(616) 343-2567		
Model:		Serial Number:	
Capacity:		Horsepower:	
Miscellaneous:	Div. 15L		
Lubricants Required:			

Annually: Add 1/2 teaspoon of SAE 10 oil to motor bearings for normal operating times. (If unit operates 24 hours/day, add 1 teaspoon).

Note: Some heater motor bearings are sealed for life.

Mark	Location	CPM	MBH/GPM	HP/RPM	Volts/Phase
UH-1	Chlorine Feed	1214	45.3 / 4.67	1/8 / 1150	115 / 1
UH-2	Pump Room	214	45.3 / 4.67	1/8 / 1550	115 / 1
UH-3	Pump Room	1214	45.3 / 4.67	1/8 / 1550	115 / 1
UH-4	Electrical	1214	45.3 / 4.67	1/8 / 1550	115 / 1
UH-5	Ammonia Feed	1214	45.3 / 4.67	1/8 / 1550	115 / 1
UH-6	Garage	1100	32.1 / 3.30	1/8 / 1550	115 / 1
UH-7	Garage	1100	32.1 / 3.30	1/8 / 1550	115 / 1
UH-8	Chemical Feed	591	15.0 / 1.55	1/20 / 1550	115 / 1
UH-9	Mechanical	1100	32.1 / 3.30	1/8 / 1550	115 / 1
UH-10	High SVC Pump	1208	46.3 / 4.77	1/8 / 850	115 / 1
UH-11	High SVC Pump	1208	46.3 / 4.77	1/8 / 850	115 / 1

PREVENTIVE MAINTENANCE JOBS

Equipment:	Electrical Equipment
Location(s):	Throughout Plant
Number of Units:	MP&S Spec. Section: 45
Manufacturer:	Square D
Sales Represent. Name:	Square D Co.
Address:	32500 Concord Drive, Madison Hgts., MI 48071
Phone:	(313) 547-1600
Model:	Serial Number:
Capacity:	Horsepower:
Miscellaneous:	Div. 16B
Lubricants Required:	

NOTE: Recommend that this work be performed by outside contract.

Annual Service: Maintenance of the high voltage switchgear, low voltage unit substations, transfer switches, and motor control centers must be performed annually. This maintenance shall be performed by qualified personnel who have been trained and are familiar in the operation of the equipment involved.

The maintenance shall include but not be limited to the following work and shall be coordinated with the Owner so that plant operation is not disrupted. High voltage switchgear, low voltage unit substations or motor control centers shall not be dismantled in any way to perform any of the following maintenance. Extreme care shall be taken to prevent accidents.

1. Test the liquid in all liquid-filled transformers and oil-filled circuit breakers. Test for acid and breakdown voltages of the liquid.
2. Vacuum the interior of all cubicles including wire ways and remove foreign materials.
3. Wipe clean with lint-free cloth all insulators, bushings, bus supports, and terminations.
4. Tighten all conductor connections and bus bar connections.
5. Check all porcelain insulators for cracks.
6. Measure and record ground mat resistance.
7. Check air switches for corrosion and lubricate.
8. Clean all relay contacts and auxiliary contacts on starter contactors.

(continued)

PREVENTIVE MAINTENANCE JOBS

Equipment:	Electrical Equipment (continued)
Location(s):	Throughout Plant
Number of Units:	MP&S Spec. Section: 45
Manufacturer:	Square D
Sales Represent. Name:	Square D Co.
Address:	32500 Concord Drive, Madison Hgts., MI 48071
Phone:	(313) 547-1600
Model:	Serial Number:
Capacity:	Horsepower:
Miscellaneous:	Div. 16B
Lubricants Required:	

9. Check the trip settings, calibrations, and timing of all relays and protective devices.

10. Megger all bus work and feeder lines from the switchgear to the motor control centers. Record the results.

11. Megger all high voltage motors. Record the results.

12. Megger all 480 volt motors 50 Hp and larger. Record the results.

13. Provide a written report to the Owner that includes all the test data taken and any other observations or recommendations.

PREVENTIVE MAINTENANCE JOBS

Equipment:	Instrumentation
Location(s):	Throughout Plant
Number of Units:	MP&S Spec. Section: 46
Manufacturer:	Various
Sales Represent. Name:	Concourse Controls, Inc.
Address:	32440 Industrial Dr., Madison Hgts., MI 48071
Phone:	
Model:	Serial Number:
Capacity:	Horsepower:
Miscellaneous:	Div. 13A
Lubricants Required:	

Catalogs contain instructions for the following listed instrumentation items:

Quantity	Description
1	Mapco Model 9000 10" sonic flowmeter
1	Mapco Model 9000 12" sonic flowmeter
8	Anchor Scientific #P40-NO-SS float switches
2	Bellofram #50-241-960-067 filter/regulation
2	Conant #BR5TSL selector valve
1	Bristol #2408-10B-512-111-110 pressure transmitter
2	Bristol #2408-10B-412-111-110 pressure transmitter
3	HF Instruments #DRT-200B turbidity analyzer
1	Bristol #2711-30A-222-104-110-00N PQR-100 3 pen recorder
5	Bristol #2711-10A-200-104-110-00N PQR-100 1 Pen recorder
2	Adtech #LIT-56 linear intergrator
2	IVO #F523.030 6 digit elector-mech. totalizer
7	Bristol #2754-20A-111-000 ratio station
7	Adtech #DCA-18 voltage alarm module
6	Adtech #SCT-02 isolated signal convertor
1	Adtech #SCT-02 ISO signal converter (custom calibrated)
as req'd	Imperial Eastman tube fittings and tubing
as req'd	Whitey 2 and 3-way bulb valves

(continued)

PREVENTIVE MAINTENANCE JOBS

Equipment:	Instrumentation (continued)
Location(s):	Throughout Plant
Number of Units:	MP&S Spec. Section: 46
Manufacturer:	Various
Sales Represent. Name:	Concourse Controls, Inc.
Address:	32440 Industrial Dr., Madison Hgts., MI 48071
Phone:	
Model:	Serial Number:
Capacity:	Horsepower:
Miscellaneous:	Div. 13A
Lubricants Required:	

Catalogs contain instructions for the following listed instrumentation items:

Quantity	Description
3	ASCO #8211A15, 1/2" NPT N.C. solenoid valve
2	Square D #J9200-10 lightning arrestors
2	Bristol #8792-20A surge protectors
2	Bristol #8741 4 unit card rack
2	Bristol #8731-20B-110 power supply
1	Bristol #8771-31B-110-100-107-510 telemetry xmtr.
1	Bristol #8772-31B-111-001-075-000 telemetry rec'r.
1	RACO #CB-4 chatterbox dialer
1	Ronan #X85 instrument calibrator
1	GE #9T58B2812 1kVA 480/120V transformer
1	GE #9T92A5 variable transformer
as req'd	AB #1492-F1 300V terminals
as req'd	AB 800MR Series oiltight control units
4	Electro-switch PR-10 series Cam selector switches
24	Square D #KU-13/M1P14 3PDT Relay W/#NR-82 socket
1	ATC #305E-006-1-0-S Sync. timer
14	ATC #328A-200-Q-10-XX solid-state annunciator
1	Ronan #(4)(6) A11-2000 annunciator
3	Square D #SBO-1 size 0 contactor w/#SB-7 N.C. power pole
1	Condor #D24-4.8 24VDC power supply

D. Corrective Maintenance Jobs: Work Order Form

1. What Is It?

The work order form is used whenever corrective (as opposed to preventive) maintenance needs to be assigned. Its use is triggered by two things:

a. If, during the course of performing preventive maintenance work, a problem is found which cannot be corrected by preventive maintenance.

b. If a piece of equipment breaks down and cannot be repaired by any preventive maintenance procedure.

2. Where Is It?

The work order forms are stored by the Superintendent. An initial supply of 20 forms is provided. The superintendent can order more forms from McNamee, Porter and Seeley as needed.

3. How Do I Use It?

Fill in the spaces next to "Work Order No.", "Date," "Location," "Requested By," "Priority," "Equipment Name," and "Number." Check off the type of work: Inspect, Repair, Service, Overhaul, Paint, Other. Write in a description of the work. Write in an estimate of time and money (for materials) to do the work. The maintenance superintendent then signs the order, rips off the top (half-size) sheet, and gives it to the person assigned to do the work.

After the work is completed, the lower part of the form (Corrective Maintenance Work Record) is completed and is signed and dated by the person who did the work and the person accepting the work (this should be the maintenance supervisor).

4. What Do I Do With the Copies?

The top part (white copy) can be discarded. The yellow copy and pink copies should go into two files. The first file should be a notebook containing all completed corrective maintenance work orders in chronological order.

The second file should be on file on each piece of equipment. A new set of folders should be set up for this.

In this way, the superintendent can look through the corrective maintenance file for each piece of equipment and quickly see which equipment has performed poorly. This will aid in future decisions on which type of replacement equipment to buy.

CORRECTIVE MAINTENANCE WORK ORDER

Work Order No. _____ **Date** _____

Location **Requested By:** **Priority**

Equipment Name **Number** ___ **Inspected** ___ ___ **Service**

___ **Repair** ___ **Overhaul** ___ **Paint**

_____ **Work Description**

_____

_____

_____

_____

_____ **Work Performed/Comments**

_____

Job Estimate

Labor _____ hours

Material $ _____

_____
Maintenance Supervisor

CORRECTIVE MAINTENANCE WORK RECORD

Personnel Assigned	Hours	Date	Work Done	Parts and Materials
Total				

Work Completed By: _____ **Date:** _____

Work Accepted By: _____ **Date:** _____

E. Corrective Maintenance Jobs: Log Sheet

1. What Is It?

   The Corrective Maintenance Job Log Sheet is a form which allows the Superintendent to keep track of the Corrective Maintenance Work Orders. It lets him know when they've been assigned, to whom, and when they've been completed.

2. Where Are They?

   An initial supply of 5 sheets has been provided. They are stored by the Superintendent in the office.

3. How Do I Use It?

   As each work order is prepared, it should be logged in on this sheet under "Job and Work Order Date."

   The person assigned to do the work should be identified to the column "Assigned To:" Then, as each work order is completed, the columns entitled, "Completion Date and Initials" and "Comments" should be completed.

4. Where Does The Log Sheet Go?

   A good place would at the beginning of the notebook containing all completed work orders.

CORRECTIVE MAINTENANCE LOG SHEET

LOG SHEET NO.: _____

TIME PERIOD: FROM _____ TO _____

Job and Work Order Date	Assigned To:	Completion Date and Initials	Comments

Page:

VI. LOGS, RECORDS AND REPORTS

A. General

An important factor in any efficient water treatment system is the keeping of accurate records and reports. It is only by making a clear and concise report of what has happened and what has been accomplished that the experiences will be of assistance in meeting future operation situations. Operating cost records are essential if meaningful budgets are to be prepared. Accurate records permit plant operating personnel and management to maintain better control of their facility.

When records are accurately kept, they provide an essential basis for the design of future changes or expansions of the treatment plant. In the event of legal questions in connection with water treatment plant operations, accurate and complete records would be urgently required as evidence of actual occurrences at any given time or any particular period of time. Thus, records and their proper maintenance are an integral part of good water treatment plant management. However, only those records should be kept which are known to be useful. At most plants, limitations of personnel, money and facilities restrict the amount of record keeping that can be done before a part of the operating program is sacrificed.

B. Daily Report

A plant daily operating log should be maintained. The log should be bound in a notebook to prevent destruction or alteration and considered part of the permanent official record of the plant. Suggested information to be included in the daily log is:

1. Routine operational duties
2. Unusual conditions (operations and maintenance)
3. Accidents to personnel
4. Sickness or absence of personnel
5. Complaints (water taste, etc.)
6. Plant visitors
7. Inspections (copy of inspector's report should be obtained, if possible)
8. Safety talks or programs
9. Special operator schooling programs

C. Monthly Operating Report

The Michigan Department of Public Health requires all Municipal Water Filtration Plants to submit a monthly operating report. Copies of the standard report forms are included in this section.

The report must be signed by a certified operator and/or the Plant Superintendent. The telephone number of the person to contact concerning the report should be indicated. The monthly operating report should be prepared in duplicate with one copy retained at the plant and the original mailed to:

Michigan Department of Public Health
Charlevoix County Annex
District #3
Charlevoix, Michigan

D. Annual Report

The Plant Superintendent should prepare an annual report for the plant. This may be under the direction and supervision of the Director of Water Resources. The report should be prepared at the end of the calendar or fiscal year.

The annual report is generally divided into two parts, a Management Data Section, and an Operating Data Section.

The annual report should include the following information:

1. Under the Management Data:
   a. Total capital cost
   b. Total capital cost depreciated
   c. Replacement cost
   d. Replacement cost depreciated
2. Under Operating Data, provide the unit operating cost per million gallons for the year using the following costs:
   a. All cost exclusive of debt service
   b. All cost including debt service
3. Provide graphs showing at least ten years of records (if available) for:
   a. Average daily flow for each month
   b. Average daily flow for each year.
   c. Projected curve for the next five years

d. **Total unit cost ($/mg) for each year.**

E. Operating Cost Record

The Plant Superintendent should maintain detailed records of all operating costs. The major categories of operating costs are:

1. **Salaries, wages and benefits**
2. **Utilities - includes electricity, fuel oil, propane, water, telephone and gasoline**
3. **Chemicals - includes alum, polymer, fluoride, ammonia, and chlorine.**
4. **Maintenance - includes maintenance contracts, spare parts, service calls, special tools, cleaning equipment and related supplies.**
5. **Miscellaneous - includes lab chemicals, cleaning supplies, first aid supplies, stamps, publications, etc.**
6. **Insurance**

Costs should include information on unit costs, total costs and amounts or quantities used. Any cost accounting system should be compatible with the parent governmental body accounting system.

F. Personnel Records

Records that reflect such things as training individuals have received and employee turnover rate are valuable to treatment plant management. These records are used to determine salaries, seniority and possible promotion of personnel at the filtration plant.

G. Emergency Operating Report

During any emergency plant operation, supplemental records should be maintained and used as special reports. These should include, as a minimum, the following items:

1. Overtime of operating personnel
2. Additional chemicals used
3. Cost of special rental equipment
4. Cost of repairs to plant equipment
5. Extra testing and laboratory reports

At the end of an emergency operation, a final report should be made. A review of the entire operation should be held. Lessons learned should be incorporated into the plant's emergency operating plans.

H. Equipment Records

Equipment records and a plan for their optimal use are described in Chapter V. For each major equipment item there is a preventive maintenance sheet containing equipment data and maintenance instructions as needed. A schedule presents a timetable for performing periodic equipment maintenance. Corrective maintenance work order sheets and log sheets with explanations for their use are also in Chapter V.

VII. SAFETY

A. Emergency Telephone List

Sheriff:	Charlevoix County Sheriff 1000 Grant St. Charlevoix MI	547-4461
Police:	City Police Department 210 State St. Charlevoix, MI	547-3255
State Police:	1200 Route M-119 Petoskey, MI	347-8101
Fire Dept.:	City Fire Dept. 210 State Street Charlevoix, MI	547-3266
Hospital:	Charlevoix Area Hospital Lake Shore Drive Charlevoix, MI	547-4024
Ambulance:	City Fire Dept. 210 State Street Charlevoix, MI	547-3266
Chemical Spills	CHEMTREC	1-800-424-9300
Michigan Dept. of Public Health	Charlevoix County Annex District No. 3 Charlevoix, MI	547-6523
	U.S. Coast Guard Charlevoix, MI	547-4447

The above numbers are correct as of December 1986. This information should be checked and updated at least semi-annually and posted near telephones and on bulletin boards for quick reference by all personnel in case of an emergency.

B. Safety Program

The filtration plant should have its own safety program. Its program should be coordinated with any City programs to combine any common lectures or topics of discussion wherever possible.

An introductory course in first aid from the American Red Cross should be taken by all employees. Periodically, an update or refresher course in first aid should be given to all plant personnel. All personnel should at least learn how to take care of serious bleeding, asphyxiation and shock. Make sure that the phone numbers of the police department, fire department and hospitals are posted in a conspicuous place near the telephones and on bulletin boards as mentioned previously.

It is of the utmost importance that any injury, however slight, be reported to the Plant Superintendent immediately. This is the only procedure which gives full personal and legal protection to the employees as well as the employer.

A sample Accident Report From prepared by OSHA is provided at the end of this Chapter for possible use (Figure VII-1).

C. Sewers and Structures

When entering sewers, wet wells and related structures, safety procedures should be practiced at all times. Items to watch for are proper entrance and adequate protection while inside. In the case of this filtration plant and circulation system, some manholes are of sufficient diameter to allow physical entrance thereto. Extreme caution should be exercised when entrance is necessary.

Entrance to an underground structure or sewer line should be preceded by checking for gases with the use of oxygen deficiency testing equipment. If gas is present, a number of actions should be taken, such as removing adjacent manhole covers, providing fresh air supply by using an air compressor and hoses or a special blower unit and wearing a protective mask. A life line should be attached to the person entering the structure and two persons should always be present outside. Rubber boots, rubber gloves and protective clothing should be worn. If a light source is necessary, it should be a non-sparking type to avoid possible explosion of gases. If work requires a prolonged stay inside the structure, frequent rest periods

and/or changes of personnel should be practiced. Washing of hands and/or showers are advised as soon as employees finish work.

Safety equipment necessary for such inspection of work includes the following: rubber boots, rubber gloves, hard hats, life belts, life lines, non-explosive light source, testing equipment, protective masks, fresh air source and ladders.

When manhole covers or surface mounted doors are removed or opened, barricades should be placed around openings. Replace covers or close doors once work is completed.

The above instructions are for a complete system. For temporary excavation, open trenches and tunnels, appropriate safety regulations should be followed. Consult IOSHA and City safety regulations.

The table on the following page lists common dangerous gases encountered in sewers and at water filtration plants. It is recommended that this be reproduced and placed on all bulletin boards throughout the plant.

Common Dangerous Gases

Name of Gas	Chemical Formulae	Specific Gravity of Vapor Density** (Air = 1)	Explosive Range (% by volume in air) Lower Limit	Upper Limit	Common Properties (Percentages below are percent in air by volume)	Physiological Effects (Percentages below are percent in air by volume)	Most Common Sources in Sewers	Simplest and Cheapest Safe Method of Testing†
Oxygen	O_2	1.11	Not flammable		Colorless, odorless, tasteless, nonpoisonous gas. Supports combustion.	Normal air contains 20.93% of O_2. Man tolerates down to 12%. Below 5 to 7% likely to be fatal.	Oxygen depletion from poor ventilation and absorption or chemical consumption of available O_2.	Oxygen deficiency indicator.
Gasoline Vapor	C_5H_{22} to C_9H_{30}	3.0 to 4.0	1.3	7.0	Colorless, odor noticeable in 0.03%. Flammable. Explosive.	Anesthetic effects when inhaled. 2.49% rapidly fatal. 1.1% to 2.2% dangerous for even short exposure.	Leaking storage tanks, discharges from garages, and commercial or home dry-cleaning operations.	1. Combustible gas indicator. 2. Oxygen deficiency indicator for concentrations over 0.3%.
Carbon Monoxide	CO	0.97	12.5	74.2	Colorless, odorless, non-irritating, tasteless. Flammable. Explosive.	Hemoglobin of blood has strong affinity for gas causing oxygen starvation. 0.2 to 0.25% causes unconsciousness in 30 minutes.	Manufactured fuel gas.	CO ampoules.
Hydrogen	H_2	0.07	4.0	74.2	Colorless, odorless, tasteless, nonpoisonous, flammable. Explosive. Propagates flame rapidly; very dangerous.	Acts mechanically to deprive tissues of oxygen. Does not support life. A simple asphyxiant.	Manufactured fuel gas.	Combustible gas indicator.
Methane	CH_4	0.55	5.0	15.0	Colorless, odorless, nonpoisonous. Flammable. Explosive.	See hydrogen.	Natural gas, marsh gas, mfg. fuel gas, sewer gas.	1. Combustible gas indicator. 2. Oxygen deficiency indicator.
Hydrogen Sulfide	H_2S	1.19	4.3	46.0	Rotten egg odor in small concentrations but sense of smell rapidly impaired. Odor not evident at high concentrations. Colorless. Flammable. Explosive. Poisonous.	Death in few minutes at 0.2%. Paralyzes respiratory center.	Petroleum fumes, from blasting. Sewer gas.	1. H_2S ampoules. 2. 5% by wt. lead acetate solution.
Carbon Dioxide	CO_2	1.53	Not flammable		Colorless, odorless, nonflammable. Not generally present in dangerous amounts unless there is already a deficiency of oxygen.	10% cannot be endured for more than a few minutes. Acts on nerves of respiration.	Issues from carbonaceous strata. Sewer gas.	Oxygen deficiency indicator.
Nitrogen	N_2	0.97	Not flammable		Colorless, tasteless, odorless. Nonflammable. Nonpoisonous. Principal constituent of air (about 79%).	See hydrogen.	Issues from some rock strata. Sewer gas.	Oxygen deficiency indicator.
Ethane	C_2H_6	1.05	3.1	15.0	Colorless, tasteless, odorless, nonpoisonous. Flammable. Explosive.	See hydrogen.	Natural gas.	Combustible gas indicator.
Chlorine	Cl_2	2.3	Not flammable Not explosive		Greenish yellow gas, or amber color liquid under pressure. Highly irritating and penetrating odor. Highly corrosive in presence of moisture.	Respiratory irritant, irritating to eyes and mucous membranes. 30 ppm causes coughing. 40-60 ppm dangerous in 30 minutes. 1000 ppm apt to be fatal in few breaths.	Leaking pipe connections. Overdosage.	Odor, strong ammonia on swab gives off white fumes.

*From Water and Sewage Works – Van Kleeck – August 1933.
**Gases with a specific gravity less than 1.0 are lighter than air; those more than 1.0 heavier than air.
†The first method given is the preferable testing procedure.

D. Electrical Hazards

The electrical system at the treatment plant includes a wide variety of equipment. Many systems utilize voltage at high levels that may prove to be dangerous or hazardous when maintenance is attempted by other than qualified personnel.

Any equipment system labelled "High Voltage" should be maintained only by qualified electricians. Normal maintenance and fuse replacement may be done on Low Voltage equipment. All operating controls of the equipment are designed to be used by any of the plant operating personnel without special knowledge of the electrical system. However, it should not normally be necessary for the main switchgear assembly to be operated during normal plant maintenance procedures.

Fractional horsepower motors, in general, are 115 volt, single-phase, 2-wire motors. Larger units are 230 or 460 volt, 3-phase, 3-wire. In working around electrical equipment, make sure conditions are dry. Rubbers and rubber gloves should be worn. Care must be taken in using water around electrical equipment. Rubber mats in front of switchboards and panels are desirable, especially in pumping stations.

When removing fuses for checking or replacement, use a fuse puller.

When working on any electrical equipment, make sure the power is off and that the proper disconnect switches are locked in the off position and tagged so that the power cannot accidentally be turned on by another person. Also, use the proper device for opening any high voltage disconnect switches, such as insulated poles with hooks designed for this purpose. These are called "hot sticks".

To prevent accidents and electrical problems, make sure that the proper fuses and overload relays as recommended by the manufacturer are used in all equipment. Always replace with the same type and size as originally installed.

Never attempt to physically remove a person who is in direct contact with live electrical wires. Use long wooden poles or ropes to dislodge the person from the wires. Also, attempt to locate the power source and shut it off immediately.

Make sure that all portable electrical equipment is properly grounded and that electrical extension cords are in good condition.

All electrical equipment used by maintenance personnel in hazardous locations should be explosion proof.

E. **Mechanical Equipment Hazards**

Make sure that all guards are in place on rotating and reciprocating parts. If removed for any reason, they should be replaced once lubrication, maintenance, inspection or repair work is finished.

Cleanliness and good housekeeping must be strictly adhered to around any equipment with moving parts to prevent falls which might throw a person against the moving parts.

Use the proper tools for the job. The wrong size or type of wrench or other tool may lead to serious injury. Make sure that all tools are returned to proper locations, so that they will be available for the next repair work.

When greasing or servicing any piece of equipment, it may be necessary to stop the unit to reach certain grease points. Make sure that safety disconnects are used.

When cleaning equipment or parts, do not use gasoline or other highly volatile cleaners. Use mineral spirits or the manufacturer's recommended cleaners with a low flash point.

Carry out a strong preventative maintenance program on all equipment to reduce the need for major repairs or maintenance and thus reduce exposure to hazards.

Wear proper protective clothing. Avoid loose fitting clothing and especially loose ties which may be caught in moving parts.

When using a chisel, punch or power grinder, always wear goggles or safety glasses. Safety shoes must be worn.

F. Explosion and Fire Hazards

Smoking, dropping lighted matches or burning tobacco or using open flames in and around sewers, natural gas piping, and carbon slurry tanks, may result in explosions or fires. Certain areas should be designated as no smoking areas and signed properly. Only electrical equipment approved for hazardous locations should be used in such areas.

It is recommended that at least one unannounced fire drill be conducted annually at the plant.

G. Health Hazards

The health hazards in a water filtration plant include the following: physical injuries, much the same as in any industry or home; bodily infections; noxious or toxic gases and oxygen deficiency.

1. Physical Injuries

The most common of all physical injuries are those resulting from falls or lifting. By using common sense and reasonable care, these injuries can be kept to a minimum.

- Use the proper tools and equipment to perform all work and learn how to lift with the legs rather than using the back.
- Good housekeeping and the immediate cleaning up of any oil, sludge or other spills will greatly reduce falls due to slips or stumbles over debris or objects strewn about on the floor.
- Guard rails have been provided around open tanks and openings in slabs. They should be continually inspected and maintained in good repair.
- Gates and safety chains should be kept closed.

2. Bodily Infections

Any cuts or breaks in the skin should be treated with 2% iodine solution, and any deeper cuts or punctures should be treated by a physician. A first aid kit should be available, but only minor injuries should be treated at the site. The best defense against infection is the practice of good personal hygiene and prompt medical attention for any injury that breaks the skin.

3. Noxious Gases and Vapors - Oxygen Deficiency

These dangers have been discussed under "Explosions and Fire Hazards", but in addition they can cause asphyxiation and poisoning. Artificial respiration should be started immediately on anyone suffering from oxygen deficiency.

- A gas such as nitrogen may be inert and non-explosive, but by displacing oxygen, its presence can result in asphyxiation.
- Carbon monoxide, combining with the hemoglobin in the blood, can result in chemical asphyxiation.
- Chlorine gas is an irritant which can cause injuries to the air passages, the lungs or both and also can cause oxygen deficiency by displacing oxygen from the atmosphere. If a person is affected by chlorine, the first step is to safely remove the victim to open air away from all fumes and then call a physician. If the person is unconscious or not breathing, use artificial respiration. Wash off any splash or liquid chlorine on the skin to reduce irritation and acid burns.

H. Chlorine and Ammonia

The Plant Superintendent should have available the following pamphlets:

Chlorine Manual
The Chlorine Institute
70 West 40th
New York, N.Y. 10018
Price: $5.00 (1986)
Phone: (212) 819-1677

MOP 4 - Chlorination of Wastewater
Water Pollution Control Federation - WPCF
2626 Pennsylvania Avenue, N.W.
Washington, D.C. 20037
Price: $12.00 (1986)
Phone: (202) 337-2500

Safety Requirements for the Storage and
Handling of Anhydrous Ammonia
American National Standards Institute, Inc.
1430 Broadway
New York, New York 10018

1. Chlorine

Chlorine is not explosive or flammable. It reacts chemically with many substances. Chlorine gas has a characteristic odor and greenish-yellow color and is about two and one-half times as heavy as air. Thus, if it escapes from a container or system, it will seek the lowest level in the building or area in which the leak occurs. Liquid chlorine is clear, amber in color and is about one and one-half times as heavy as water.

Chlorine gas is a respiratory irritant. In sufficient concentration the gas irritates the mucous membranes, the respiratory system and the skin. In extreme cases, the difficulty of breathing may increase to the point where death can occur from suffocation.

Liquid chlorine in contact with skin or eyes will cause burns.

Every precaution must be taken to keep chlorine equipment free from moisture. Piping, valves, and containers must be closed when not in use to keep atmospheric moisture out of the system. Never use water on a chlorine leak because resulting corrosive conditions always make the leak worse. When a chlorine leak occurs, authorized, trained personnel equipped with suitable gas masks should investigate and take action. Whenever possible, no person should work alone on a chlorine leak.

In case of fires, chlorine containers should be removed from the fire zone immediately. If no chlorine is escaping, water should be applied to cool containers that cannot be moved.

To find a chlorine leak, tie a cloth to the end of a stick, soak the cloth with aqua ammonia and hold close to the suspected area. A white cloud will result if there is any chlorine leakage. Avoid contact of ammonia with brass. Commerical 26° Baume aqua ammonia should be used (household ammonia is not strong enough).

Two emergency kits have been furnished under this contract. They are designed to contain most leaks which may be encountered. Keep the kit in open view.

2. Ammonia

Ammonia should be handled only by properly trained personnel. In no case shall ammonia be used in conjunction with chemicals unless the possible reactions have first been adequately investigated. Under some circumstances, ammonia and ammonium compounds can form explosive products with other chemicals.

Ammonia gas irritates the skin and mucous membrane. At 50 ppm, its odor is detectable by most people. The maximum allowable concentration for an 8 hour working exposure is specified as 50 ppm by the American Conference of Government Industrial Hygienists. Because it serves as its own warning agent, no person will voluntarily remain in concentrations which are hazardous. At 5000 ppm, it is rapidly fatal. Since ammonia gas is lighter than air, adequate ventilation is the best means of preventing any accumulation.

If a leak occurs in an ammonia system, the personnel trained for and designated to act in such emergencies shall:

- See that persons not required to deal with an emergency are evacuated from the contaminated area.
- Put on a suitable gas mask
- Wear gauntlet type plastic or rubber gloves and wear plastic or rubber suits in heavily contaminated atmospheres.
- Shut off the appropriate valves.

3. Personal Protective Equipment

Suitable gas masks are provided at the plant. They should be located outside the probable location of any leak. They should be routinely inspected and maintained in good condition. They should be cleaned after each use and at regular intervals. Equipment used by more than one person should be sanitized after each use. Safety glasses or goggles, hard hats and safety shoes should be worn as dictated by the emergency work to be done.

I. Recommended List of Safety Equipment

1. First Aid Kit
2. Explosive Gas Meter
3. Oxygen Deficiency Indicator
4. Voltage Tester and Clamp-on Ammeter for Electrical Testing
5. Hot Stick
6. Vibration Analyzer
7. Carbon Monoxide Detector
8. Fire Extinguishers
9. Air Mask (chlorine)
10. Rubber Gloves, Boots and Aprons

11. **Safety Goggles and Face Masks**
12. **Safety Shoes**
13. **Hard Hats**
14. **Ladders**
15. **Safety Harness**
16. **Manila Rope (50-ft. x 3/4-inch minimum)**
17. **Portable Air Blower**

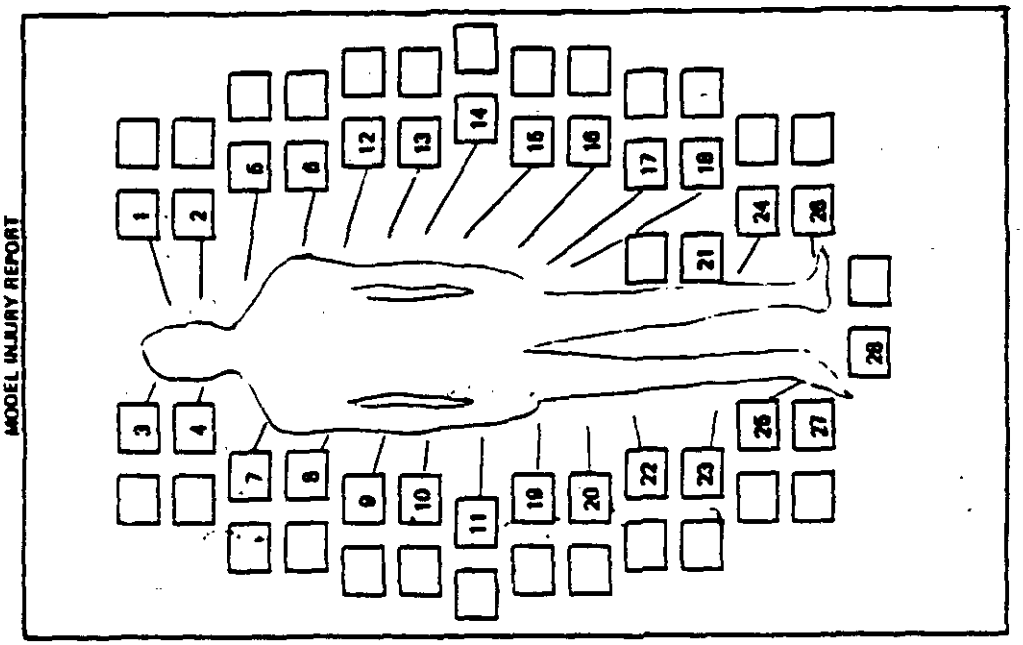
All the above items should be inventoried and tested periodically under the plant safety program established by the Superintendent. Some items are personally owned (such as safety shoes) and may be required for employment.

J. Sample Accident Report Form

1. Name
2. Department
3. Time
4. Date of accident.
5. Injured part of body
6. Occupation when injured
7. Years of experience in occupation
8. Last accident to this individual
9. List names and check numbers of witnesses
10. Exact location of accident
11. What job was being performed?
12. What happened?
13. Why did the accident happen?
14. What did some person, other than the injured, do, or fail to do, that contributed to the accident?
15. What conditions of the employee's environment (tools, equipment, machines, structures, materials, etc.) contributed to the accident?
16. What recommendations to you make?
17. What corrective action has been taken?
18. Foreman
19. Investigated by
20. Reviewed by

FIGURE VII-1

Accident Report Form



THE NEW OCCUPATIONAL SAFETY AND HEALTH ACT

NOTE: Using the code below, write the appropriate letter next to the number relating to injury in circled space around skeleton figure. This will give you an overall and precise picture of nature of injury.

Head	1	WOUNDS — Laceration	A
Face	2	Contusion	B
Eye	3	Infection	C
Teeth	4	Foreign body	D
Neck	5	Puncture	E
Collarbone	6	EYES — Foreign body	F
Shoulder	7	Burn corrosive	G
Arm	8	Burn heat	H
Elbow	9	Burn flash	I
Forearm	10	Wound	J
Wrist	11	Irritation	K
Chest	12	BURNS — Heat	L
Rib	13	Chemical	M
Back	14	Friction	N
Abdomen	15	SKIN — Dermatitis	O
Hand	16	Irritation-Rash	P
Finger	17	FRACTURE	Q
Thumb	18	STRAIN	R
Hip	19	SPRAIN	S
Ruptures	20	GASES — Nausea	T
Leg	21	Dizziness	U
Thigh	22	Irritation	V
Knee	23	PAINS	W
Shin	24	MISCELLANEOUS	X
Ankle	25		
Foot	26		
Instep	27		
Toe	28		

VIII. TOOLS, SPARE PARTS AND SUPPLIES

A. Recommended List of Tools

Item	Unit	Quan.
Hand Tools		
Axe	Ea.	1
Bolt Cutter	Ea.	1
Brushes		
Paint		
Natural Bristle, 1"	Ea.	1
Natural Bristle, 2"	Ea.	1
Natural Bristle, 4"	Ea.	1
Nylon Bristle, 1"	Ea.	1
Nylon Bristle, 2"	Ea.	1
Nylon Bristle, 4"	Ea.	1
Steel wire	Ea.	2
Bronze Wire	Ea.	1
Calipers		
Inside 4"	Ea.	1
Inside 6"	Ea.	1
Outside 4"	Ea.	1
Outside 6"	Ea.	1
Vernier	Ea.	1
Chain Puller		
5-foot reach	Ea.	1
15 foot reach	Ea.	1
Chisels		
Cold	Set	1
Wood	Set	1
Clamps		
"C"	Set	2
Spring	Ea.	2
Crimpers	Ea.	1
Drill	Ea.	1
Files		
8-inch long	Set	1
12-inch long	Set	1
Gear Pullers	Set	1
Grease Gun	Ea.	1

Item	Unit	Quan.
Hammers		
Claw	Ea.	1
Ball Pein	Ea.	1
Bricklayers	Ea.	1
Soft-faced	Ea.	4
Sledge	Ea.	1
Levels		
24"	Ea.	1
48"	Ea.	1
Micrometers	Set	1
Oil Can	Ea.	1
Pick	Ea.	1
Pipe Cutters		
HD 1/8" - 2"	Ea.	1
HD 2" - 4"	Ea.	1
Soil Pipe	Ea.	1
Pipe Reamers		
1/8" - 2"	Ea.	1
2" - 4"	Ea.	1
Pipe Threaders		
¼" - 1"	Ea.	1
1" - 2"	Ea.	1
2½" - 4"	Ea.	1
Pipe Taps	Set	1
Pipe Vise	Ea.	1
Pliers		
Slip-joint, 6"	Ea.	1
Slip-joint, 8"	Ea.	1
Linemans 8"	Ea.	1
Diagonal Cut, 4"	Ea.	1
Diagonal Cut, 6"	Ea.	1
Long-nose straight, 6"	Ea.	1
Long-nose straight, 8"	Ea.	1
Long-nose curved, 6"	Ea.	1
End cut, 6"	Ea.	1
End cut, 8"	Ea.	1

Item	Unit	Quan.
Pliers (continued)		
Adjustable		
Tongue & Groove 4"	Ea.	1
Tongue & Groove 6"	Ea.	1
Tongue & Groove 8"	Ea.	1
Tongue & Groove 10"	Ea.	1
Spring clamping 5"	Ea.	1
Spring clamping 7"	Ea.	1
Spring clamping 10"	Ea.	1
Punches	Set	1
Putty Knife	Ea.	6
Rakes		
Round bow	Ea.	1
Leaf	Ea.	1
Rule	Ea.	1
Saws		
Crosscut	Ea.	1
Rip	Ea.	1
Hack	Ea.	1
Keyhole	Ea.	1
Screwdrivers		
Standard Tip	Set	1
Phillips Tip	Set	1
Shovels - long handle		
Round Point	Ea.	1
Square Point	Ea.	1
Shovels - short handle		
Round Point	Ea.	1
Square Point	Ea.	1
Squares		
Carpenters	Ea.	1
Combination	Ea.	1
Surface Gauge	Ea.	1
Taps & Dies	Set	1
Tapes		
Long	Ea.	1
Locking - 16'	Ea.	1
Locking - 25'	Ea.	1

Item	Unit	Quan.
Test Indicator	Ea.	1
Thickness Gauges	Set	1
Tubing Kit	Kit	1
Vise	Ea.	1
Wrecking Bar	Ea.	1
Wrenches		
Hex key	Set	1
Chain	Ea.	1
Combination	Set	1
Adjustable	Set	1
Pipe	Set	1
Socket, 1/2 drive	Set	1
Socket, 3/8 drive	Set	1
Torque	Ea.	1
Electric Tools		
Drills		
3/8" capacity	Ea.	1
3/4" capacity	Ea.	1
Accessories		
Arbor Adaptors	Ea.	1
Twist Drills	Set	1
Reduced Shank Drills	Set	1
Masonry Drills	Set	1
Drill Press	Ea.	1
Grinders		
Disc Grinder	Ea.	1
Bench Grinder	Ea.	1
Saws		
Circular Saw	Ea.	1
Jig Saw	Ea.	1
Band Saw	Ea.	1
Radial Arm	Ea.	1

Item	Unit	Quan.
Air Tools		
Impact Hammer	Ea.	1
Air Wrench	Ea.	1
Paint Spraying Equipment	Set	1
Sandblaster	Set	1
Impact Wrench	Set	1
Drill	Set	1
Hose	Set	1
Blow Gun	Set	1
Tire Air Chuck	Ea.	1
Hydraulic Tools		
Jack Set	Set	1
Rams		
Short 4 ton	Ea.	1
Long 4 ton	Ea.	1
General Shop Equipment		
Brooms	Ea.	6
Cabinet, Flammable Storage	Ea.	2
Hand Truck	Ea.	1
Ladders		
Extension	Ea.	1
Step	Ea.	1
Padlocks	Set	1

Item	Unit	Quan.
Parts Cleaner	Ea.	1
Platform Truck	Ea.	1
Safety Equipment		
Respirators - Dust	Ea.	6
Respirators - Paint	Ea.	6
Goggles	Ea.	12
Aprons	Ea.	12
Gloves	Pr.	12
Rainsuits	Set	3
Boots	Set	3
Barricade Cones	Ea.	6
Barricade Sign	Ea.	2
Hard Hats	Ea.	6
Safety Harness	Ea.	2
Safety Rope w/hook	Ea	2
Portable Safety Railing Wagon	Ea.	2
Slings		
Chain	Ea.	1
Nylon	Ea.	1
Tool Boxes, Chests and Cabinets		
Tool Boxes	Ea.	5
Tool Chests	Ea.	5
Tool Cabinets	Ea.	5
Vacuum	Ea.	1
Wheelbarrow	Ea.	1
Workbenches	Ea.	5
Fastener Assortment	Ea.	1
Welding Equipment	Kit	1
Propane Torch Equipment	Kit	1
Soldering gun	Kit	1

B. Spare Parts

Spare parts should be limited to those items recommended by the manufacturer or as determined by the Plant Superintendent through experience. Excessive spare parts may lead to the following: parts never used, money invested in a needless parts inventory, inadequate storage facilities, and lost or damaged parts.

It is suggested that only filters, drive belts, chain links and other small parts as recommended be stocked until an experience factor can be built up for each item of equipment.

Certain equipment is initially furnished with a limited spare parts inventory. These should be cataloged and stored properly for immediate use as required.

1. Recommended Spare Parts by Manufacturer

   a. Chlorinator

Division:	11B
Manufacturer:	Wallace & Tiernan
Quantity:	2
Spare Parts:	Wallace and Tiernan has preventive maintenance kits that contain standard replacements for parts most susceptible to wear. Using these kits in a scheduled program for replacing worn parts can minimize the incidence of downtime. These kits can also facilitate minor emergency repairs.

   b. Ammoniator

Division:	11B
Manufacturer:	Wallace and Tiernan
Quantity:	1
Spare Parts:	Wallace and Tiernan preventive maintenance kits contain standard replacements for parts most susceptible to wear. Using these kits in a scheduled program for replacing worn parts can minimize the incidence of downtime and facilitate minor emergency repairs.

   c. Liquid Polymer Metering Pump

Division:	11B
Quantity:	2
Manufacturer:	Wallace and Tiernan
Spare Parts:	Wallace and Tiernan preventive maintenance kits contain standard replacements for parts most susceptible to wear. Using these kits in a scheduled program for replacing worn parts can minimize the incidence of downtime and facilitate minor emergency repairs.

d. Polymer Feed System

Division:	11B
Manufacturer:	Nalco
Quantity:	2
Spare Parts:	P4591 - Disperser complete P4592 - Eductor with flex tube P4593 - Funnel P4594 - Liquid polymer orifice plug

e. Alum Metering Pump

Division:	11B
Manufacturer:	Wallace and Tiernan
Quantity:	2
Spare Parts:	Wallace and Tiernan has preventive maintenance kits that contain standard replacements for parts most susceptible to wear. Using these kits in a scheduled program for replacing worn parts can minimize the incidence of downtime. These kits can also facilitate minor emergency repairs.

f. Fluoride Metering Pump

Division:	11B
Manufacturer:	Wallace and Tiernan
Quantity:	1
Spare Parts:	Wallace and Tiernan has preventive maintenance kits that contain standard replacements for parts most susceptible to wear. Using these kits in a scheduled program for replacing worn parts can minimize the incidence of downtime. These kits can also facilitate minor emergency repairs.

g. Low Service Pumps

Division:	11A
Manufacturer:	Aurora
Quantity:	3
Spare Parts:	1 thrust bearing for driver 1 radial bearing for driver 1 packing box bearing 1 set square packing 1 top column flange gasket 2 lineshaft bearings 1 intermediate bowl bearing 1 suction case bearing 1 packing box gasket

h. High Service Pumps

Division:	11A
Manufacturer:	Aurora
Quantity:	3
Spare Parts:	1 thrust bearing for driver
	1 radial bearing for driver
	1 packing box bearing
	1 set square packing
	1 top column flange gasket
	2 lineshaft bearings
	3 intermediate bowl bearings (HS-1)
	4 intermediate bowl bearings (HS-2 & 3)
	1 suction case bearing
	1 packing box gasket

i. Sump Pump

Division:	15H
Manufacturer:	Vanton
Quantity:	1
Spare Parts:	3 Rulon outer sleeve bearings
	1 complete shaft subassembly including impeller ready to install
	1 casing including outer sleeve bearing and locknut
	1 camlock ball bearing
	1 casing cover
	1 casing cover O-ring

C. Expendable Supplies

1. Recommended List of Basic Laboratory Reagents

Reagent	Quantity	J.T. Baker Catalog No.	Mallinckrodt Catalog No.	MCB Catalog No.
Acetic Acid, Glacial	6 x 2.5 l	9508-3	2504	AX0073
Acetone	4 x 4 l	9006-3	2440	AX0120
Ammonium Acetate, crystal	2 x 500 g	0596-1	3272	AX1220
Ammonium Chloride, granular	2 x 500 g	0660-1	3384	AX1270
Ammonium Hydroxide, 30%	1 x 2.5 l	9721-3	3256	AX1303
Ammonium Molybdate, crystal	1 x 500 g	0716-1	3420	AX1310
Ammonium meta-Vanadate, powder	1 x 125 g	0715-4	-	AX1435
Calcium Chloride, anhydrous 20 mesh	2 x 500 g	1311-1	4225	CX0175
Chloroform	1 x 4 l	9180-3	4440	CX1055
Cobalt Chloride, 6-hydrate, crys	1 x 125 g	1670-4	4532	CX1800
Dextrose, anhydrous, granular	2 x 500 g	1916-1	4912	DX0145
Drierite, indicating, 4 mesh	2 x 2.5 kg	L057-2	3367	DX2505
EDTA, disodium, dihydrate, crys	1 x 500 g	8993-1	4931	EX0539
Ethanol, denatured, 95%	1 x 4 l	9287-3	7018	EX0280
Ferric Chloride, 6-hydrate lump	1 x 500 g	1996-1	5029	FX0210
Ferrous Ammonium Sulfate, 6-H_2O	1 x 500 g	2054-1	5064	FX0245
Hydrochloric Acid, 36.5-38.0%	6 x 2.5 l	9535-3	2612	HX0603
Hydrogen Peroxide, 30%	1 x 500 ml	2186-1	5240	HX0635
Indicators,				
Bromcresol Green	1 x 10 g	C946-2	1793	BX1160
Bromphenol Blue	1 x 10 g	D293-2	1794	BX1415
Congo Red	1 x 25 g	F787-3	2329	CX1905
P-Dimethyl aminobenzalrhodanine*	1 x 10 g	J431-2	2754	DX1605
Eriochrome Black-T, sodium salt	1 x 25 g	L126-3	2419	EX0100
Eriochrome Blue-black R (calcon)	1 x 25 g	E278-3	-	CX0323
Methylene Blue	1 x 25 g	Q473-3	5891	MX0990

*also 5-p-Dimethylaminobenzylidene rhodanine

Reagent	Quantity	J.T. Baker Catalog No.	Mallinckrodt Catalog No.	MCB Catalog No.
Methyl Orange, sodium salt	1 x 30 g	2694-0	6246	MX1255
Methyl Red, sodium salt	1 x 10 g	R086-2	6250	MX1410
Phenolphthalein, powder	1 x 125 g	2870-4	2635	PX0525
Phenol Red	1 x 5 g	T254-1	2636	PX0530
Thymol Blue, sodium salt	1 x 5 g	V859-1	2726	TX0620
Isopropyl Alcohol	1 x 4 l	9084-3	3032	PX1835
Magnesium Sulfate, 7-hydrate, crys	1 x 500 g	2500-1	6066	MX0080
Manganese Sulfate, mono-hydrate	2 x 2.5 kg	2550-5	6192	MX0210
Methanol, absolute	1 x 4 l	9070-3	3016	MX0485
Nitric Acid, 69.0-71.0%	6 x 2.5 l	9601-3	2704	NX0409
Perchloric Acid, 69-72%	1 x 2.5 l	9652-3	2766	PX0396-A
pH Buffers				
pH 4	1 x 500 ml	5657-1	0029	BX1634
pH 7	1 x 500 ml	5656-1	0031	BX1635
pH 10	1 x 500 ml	5655-1	0032	BX1636
1,10-Phenanthroline, Monohydrate	1 x 10 g	T170-2	1919	PX0460
Phosphoric Acid, 85%	1 x 2.5 l	0260-3	2796	PX0995
Potassium Chloride, crys	2 x 500 g	3040-1	6858	PX1405
Potassium Hydroxide, pellets	1 x 2.5 kg	3140-5	6984	PX1480
Potassium Iodide, granular	2 x 500 g	3162-1	1123	PX1507
Potassium Permanganate, crys	1 x 500 g	3228-1	7068	PX1550
Potassium Persulfate, crys	2 x 500 g	3238-1	7076	PX1560
Potassium Phosphate, dibasic, pdr	2 x 500 g	3252-1	7092	PX1570
Potassium Phosphate, monobasic, cry	1 x 500 g	3246-1	7100	PX1565
Primary Standards,				
Potassium Biphthalate, crys	1 x 500 g	2958-1	6704	PX1476
Potassium Dichromate, crys	1 x 500 g	3093-1	6772	PX1445
Potassium Bi-Iodate	1 x 100 g	-	-	-
Sodium Carbonate, anhydrous	1 x 500 g	-	7528	SX0395
Salicylic Acid, crys	1 x 500 g	0300-1	2028	SX0060

Reagent	Quantity	J.T. Baker Catalog No.	Mallinckrodt Catalog No.	MCB Catalog No.
Silver Nitrate, crys	1 x 30 g	3426-0	2169	SX0205
Sodium Acetate, 3-hydrate, crys	1 x 500 g	3460-1	7364	SX0255
Sodium Arsenite	1 x 500 g	3487-1	7392	SX0295
Sodium Azide, practical	1 x 100 g	v015-5	1953	SX0300
Sodium Bicarbonate, anhydrous	1 x 500 g	3506-1	7412	SX0320
Sodium Chloride	1 x 500 g	3624-1	7581	SX0420
Sodium Hydroxide, pellets	1 x 2.5 kg	3722-5	7708	SX0590
Sodium Phosphate, dibasic, 7-hydr	1 x 500 g	3824-1	7914	SX0715
Sodium Sulfate, anhydrous, gran	2 x 500 g	3891-1	8024	SX0760
Sodium Sulfite, anhydrous	1 x 500 g	3922-1	8064	SX0785
Sodium Thiosulfate, 5-hydrate, crys	2 x 500 g	3946-1	8100	SX0815
Stannous Chloride, dihydrate, crys	1 x 500 g	3980-1	8176	SX0885
Starch, soluble, powder	1 x 2.5 kg	4006-5	8188	SX0930
Sulfuric Acid, 95-98%	6 x 2.5 l	9681-3	2876	SX1244

Plant Engineering Magazine's Exclusive Chart

Interchangeable Lubricants

By R. L. MARINELLO, Senior Editor

ALL plant practices dealing with lubrication—purchase, inventory, and application—have not always received management's full attention. The increase in lubricant prices during the past 7 years, along with the difficulty, at times, of obtaining the needed petroleum products, has caused many industries to look more closely at their methods of purchasing and applying such products. Every plant engineer is especially interested in finding ways to hold down expenditures for petroleum products.

There are three areas the plant engineer should examine closely to determine what savings might be possible. They are lubricant cost, consolidation, and conservation. The first item—cost of lubricants—is almost beyond the control of the plant engineer. There is only one way in which he can obtain a saving and that is in the purchase cost per gallon. It would be wise for the plant engineer to review his present purchasing practices and compare the savings that might be realized if he were to order certain petroleum products in larger quantities.

Industrial operations using 5000 gal a year of a particular lubricant, or 6000 gal a year of two or more lubricants, may find bulk purchasing economically beneficial. Buying lubricants by the drum costs more. The main increase in drum handling costs is from the deposit that all companies charge. And the charges, about $15 per drum, are rising.

The costs of delivering lubricants keep going up. However, bulk rates are lower than van-load shipments of drummed lubricants. It can really pay the plant engineer to evaluate the economics of bulk lubricant delivery. Before conducting an investigation to see if bulk storage is the right way to go, he should review present lubricant consumption with the supplier. This review is important because the supplier can provide basic information to help determine the savings per gallon in bulk purchasing. The company may be using smaller quantities of two or three oils or hydraulic fluids that, individually, do not have the potential for bulk purchasing. However, if a single oil will work in place of the two or three, consumption may be high enough to allow bulk purchasing.

The results of such a survey may indicate that the savings possible do not warrant a bulk system. However, conducting an evaluation will assure the plant engineer that he is buying and using lubricants in the most economical way. Because growth and rapid changes in the economy may alter decisions, it is recommended that the evaluation be kept on file and that it be reviewed periodically.

Consolidation of many lubricants into fewer types can be more productive and should be one of the first considerations of the plant engineer. He should study the types of lubricants the plant is purchasing and using on the various machines. He may be surprised to learn how many types of lubricants are specified, the number of departments specifying lubricants, and how they are being used.

Using the information from such a survey, he may find it possible to reduce the variety of lubricants and greases by 10 to 30 percent. Several additional benefits can be realized from such a reduction: stocking fewer lubricants simplifies purchasing, reduces the chance of employees using the wrong product on equipment, and makes it easier to train personnel; requisitioning can be restricted to specific personnel; and total lubricant inventory can be reduced.

Consolidating the company's stock of lubricants and greases and at the same time reducing the inventory of stocks can be accomplished with the help of PLANT ENGINEERING magazine's chart of interchangeable lubricants, which appears on the following pages. The first comprehensive listing appeared in the August 2, 1968, issue. Favorable reader response led to the decision to update the information periodically. This chart contains the latest information available.

Used properly, the chart can be a valuable reference. However, the data do not indicate the quality of individual lubricant designations. Nor is any attempt made to imply what lubricant performance can be expected under a particular set of operating conditions. Lubricant producers and suppliers stress that questions about the effectiveness of a recommended substitution should be answered by the equipment manufacturer's representative or oil company application engineers.

FILE 80010

Table I. Commonly Used Industrial Lubricant Viscosity Ratings

Plant Engineering Magazine's Designation*	ISO Viscosity Grade	AGMA† Grade No. (approx.)	SAE‡ Viscosity No. (approx.)	SAE GEAR Lubricant No. (approx.)	Viscosity, SUS at 210 F (approx.)
32	32	–	–	–	–
68	68	–	–	–	–
100	100	–	–	–	–
150	150	–	–	–	–
215	220	–	10W	70W	45
315	320	–	20	–	63
465	460	5	30	80W	82
700	680	6	40	–	98
1000	1000	7	50	90W	116
1500	1500	8	60	90	155
2150	2200	8A	70	–	205
3150	3300	9	–	140	255

*Numbers correspond to viscosity ratings (SUS at 100 F) listed on ASTM and ISO standards.

†American Gear Manufacturers Association.

‡Society of Automotive Engineers, Inc.

Outside of special situations, however, most of the products listed in the chart can be interchanged as indicated. And, in most cases, substantial cost savings can be realized by reducing stocks of duplicate oils and greases.

The chart can help in two ways. It can aid engineers in identifying equivalent lubricant brands and sources, and it can serve as a guide for consolidating present lubricant stocks. Lubricant experts say that any plant using more than 20 lubricants is a prime candidate for consolidation. Even in installations that use fewer than 20 lubricants, thought should be given to further consolidation.

In the past, the American Society of Lubrication Engineers (ASLE) and the American Society for Testing and Materials (ASTM) used a standard viscosity scale of Saybolt Universal Seconds (SUS) at 100 F. The current viscosity classification system is described in "Standard Recommended Practice for Viscosity Systems for Industrial Fluid Lubricants," ASTM D2422-75. It is based on International Standards Organization (ISO) viscosity grade numbers ("Industrial Liquid Lubricants—ISO Viscosity Classification," ISO Standard 3448) and is applicable to fluids ranging in kinematic viscosity from 2 to 1500 cSt at 40 C.

A portion of the standard states: "This system provides a suitable number of viscosity grades, a uniform reference temperature, a uniform viscosity tolerance, and a nomenclature system for identifying the viscosity characteristics of each grade.

"This system implies no evaluation of lubricant quality and applies to no property of a fluid other than its viscosity at the reference temperature. . . .

"For the sake of worldwide uniformity of nomenclature in identifying the viscosity characteristics of fluid lubricants the following wording shall be used to designate a particular viscosity grade: ISO viscosity grade—which may be abbreviated to: ISO VG. The wording would be followed by the normal viscosity at 40 C expressed in centistokes (millimeters squared per second) units of measurement."

Table II. Viscosity Conversion Chart

ISO Viscosity Grade	Kinematic Viscosity, Centistokes, at 40 C (104 F)	Saybolt Viscosity, SUS at 100 F (38 C) (approx.)
2	1.98-2.42	32
3	2.88-3.52	36
5	4.14-5.06	42
7	6.12-7.48	50
10	8.65-11.0	60
15	13.5-16.5	75
22	19.8-24.2	105
32	28.8-35.2	150
46	41.4-50.6	215
68	61.2-74.8	315
100	90.0-110	465
150	135-165	700
220	198-242	1000
320	288-352	1500
460	414-506	2150
680	612-748	3150
1000	900-1100	4650
1500	1350-1650	7000

Table I shows common lubricant viscosity ratings, including ISO viscosity grade numbers. Many manufacturers have changed or are changing their viscosity classifications. Table II lists the 18 ISO viscosity grades and equivalent kinematic viscosity (in cSt at 40 C) and Saybolt viscosity at 104 F (40 C).

Many lubricant companies recommend the purchase of a higher grade lubricant to satisfy the needs of specific machines as well as the use of this product on some machines calling for a lower grade product. And the switch to multipurpose lubricants and greases leads to lower costs and better performance. Modern multipur-

Text continued on p. 114

See next 12 pages for complete Interchangeability Chart

PLANT ENGINEERING'S CHART OF INTERCHANGEABLE LUBRICANTS

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Alnho (Far-Best Corp.)	Amalie Refining Co. (Div. of Witco Chemical Corp.)	American Industrial Research Corp.	American Industries Inc.	The American Lubricants Co. (Alubco)	American Lubricants, Inc. (Amlube)	Amoco Oil Co. (Standard Oil Co. of Indiana)
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Moly-Shield Hd 150	•	•	253 #10 R & O Hyd. Oil	Hyd. Oil, Light	150 Hyd. Oil (R & O)	American Ind. Oil #32
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Moly-Shield Hd 215	AMA Oil 200	•	253 #20 R & O Hyd. Oil	Hyd. Oil, Med.	200 Hyd. Oil (R & O)	American Ind. Oil #46
PE-315-A	68	Med.-Heavy Inhibited Hyd. & Gen. Purpose	284-346	Moly-Shield Hd 315	AMA Oil 300	•	253 #30 R & O Hyd. Oil	Hyd. Oil, Heavy	300 Hyd. Oil (R & O)	American Ind. Oil #68
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Moly-Shield Hd 700	Hus Dal SAE 40	•	253 #40 R & O Hyd. Oil	Hyd. Oil, XH Heavy	650 Hyd. Oil (R & O)	American Ind. Oil #150
PE-150-HP	32	High-Pressure (Anti-Wear) Hydraulic Oil	135-165	Moly-Shield Hd 150	•	•	256 #10 R & O Hyd. Oil	Moly Hyd. Oil, Light	150 AW Hyd. Oil	Rykon Oil #32 or Amoco AW 32
PE-215-HP	46	High-Pressure (Anti-Wear) Hydraulic Oil	194-236	Moly-Shield Hd 215	AMA Oil 200	•	256 #20 R & O Hyd. Oil	Moly Hyd. Oil, Med.	200 AW Hyd. Oil	Rykon Oil #46 or Amoco AW 46
PE-315-HP	68	High-Pressure (Anti-Wear) Hydraulic Oil	284-346	Moly-Shield Hd 315	AMA Oil 300	•	256 #30 R & O Hyd. Oil	Moly Hyd. Oil, Heavy	300 AW Hyd. Oil	Rykon Oil #68 or Amoco AW 68
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		•	•	•	•	•	•	Amoco FR Fluid PE
PE-FRH-2	—	Fire-Resistant Hyd. Fluid/Water-Glycol		•	•	•	•	•	•	Amoco FR Fluid WG
PE-FRH-3	—	Fire-Res. Hyd. Fluid/Water Oil Emulsion		•	•	•	254 FR Hyd. Fluid	FYR-Safe Hyd. Fluid	•	Amoco FR Fluid WO
PE-33-B	2	Very Light Spindle Oil (Over 8000 rpm)	30-35	•	•	•	•	•	•	Amoco Spindle Oil "A"
PE-60-B	10	Light Spindle Oil (3600-8000 rpm)	54-65	Moly-Shield BCO Light	•	Ranlube Spindle Oil Light	273 Spindle Oil #1	•	Light Spindle Oil	Amoco Spindle Oil "A"
PE-100-B	22	Spindle Oil (Up to 3600 rpm)	95-115	Moly-Shield BCO Medium	Hydraulic Oil R	•	273 Spindle Oil #2	Spindle Oil	Spindle Oil	Amoco Spindle Oil "C"
PE-150-C	32	Light Way Oil	135-165	Moly-Shield Way Oil 150	•	•	516 Way Lube #10	Moly Way Lube #20	•	Waytac Oil #32
PE-315-C	68	Medium Way Oil	284-346	Moly-Shield Way Oil 315	•	Ranlube #20	516 Way Lube #20	Moly Way Lube #40	Medium Way Lube	Waytac Oil #68
PE-1000-C	220	Heavy Way Oil	900-1100	Moly-Shield Way Oil 1000	•	Ranlube #90	516 Way Lube #50	Moly Way Lube #90	Heavy Way Lube	Waytac Oil #220
PE-700-D	150	Light Gear Oil	630-770	Moly-Shield Hd 700	AMA Oil 800	Ranlube #30	608 Ind. Gear Lubricant #40	Ultra Tec Gear Lube, SAE 80-90	Gear Oil Light	American Ind. Oil #150
PE-1000-D	220	Medium Gear Oil	900-1100	Moly-Shield Hd 1000	SMG 90	Ranlube #65	608 Ind. Gear Lubricant #90	Ultra-Tec Gear Lube, SAE 80-90	Gear Oil Med.	American Ind. Oil #220
PE-2150-D	460	Heavy Gear Oil	1935-2365	Moly-Shield Hd 2150	SMG 140	Ranlube #145	608 Ind. Gear Lubricant #140	Ultra Tec Gear Lube, SAE 140	Gear Oil Heavy	American Ind. Oil #460
PE-315-E	68	Light Extreme-Pressure Gear Oil	283-347	Moly-Shield 100 80	MPGL 80W-90	Ranlube #20	322, 325 Gear Oil #80	Moly Ultra Tec Gear Lube, SAE 80	EP 300 Gear Oil	Permagear or Amogear EP 68
PE-1500-E	320	Heavy Extreme-Pressure Gear Oil	1350-1650	Moly-Shield 100 8140	MPG 140	Ranlube #140	322, 325 Gear Oil #140	Moly Ultra Tec Gear Lube, SAE 90	EP 1500 Gear Oil	Permagear or Amogear EP 320
PE-1000-G	320	Open Type Gear Shield (Open Gears)		Moly-Shield 847 OG	•	Ranlube OGH	335 Open Gear Lube w/Moly 90	Bacon 60	Super Gear Shield	Amoco Compound 40X
PE-GPG-2	—	Gen. Purpose E.P. Lithium Base Grease	NLGI 2	Aqua-Shield 103	All Purpose with Moly	Ranlube #2	666 MP Bearing Grease	Improved Molyshield	#2 EP Lith Grease	Amolith Grease #2 EP
PE-MG-2	—	Molybdenum Disulfide E.P. Grease		Moly-Shield 102	All Purpose with Moly	Ranlube #2	557-A-33 Moly Grease	Hy-Moly	MoS_2 Grease	Rykon Premium Moly Grease #2

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Anderson Oil & Chemical Co. Inc.	Ashland Oil, Inc. Valvoline Oil Div.	Atlantic-Richfield Co.	BP Oil Inc.	Bown's Carbolene Co., Inc.	Bel-Ray Co., Inc.	Boron Oil Inc.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Winter Hyd. Oil 10	ETC (R & O) #15	Duro 32	Energol HLP 32	Tona-Film #150 TH	Bel-Ray AW Lube #0	Petrolube 32
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Winter Hyd. Oil 45	ETC (R & O) #20	Duro 46	Energol HLP 46	Tona-Film #200 LTH	Bel-Ray AW Lube #1	Petrolube 46
PE-315-A	68	Med.-Heavy Inhibited Hyd. & Gen. Purpose	284-346	Winter Hyd. Oil 60	ETC (R & O) #30	Duro 68	Energol HLP 68	Tona-Film #300 MTH	Bel-Ray AW Lube #2	Petrolube 68
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	•	ETC (R & O) #70	Duro 117 or 160	Energol HLP 150	Tona-Film #400 TH	Bel-Ray AW Lube #4	Petrolube 150
PE-150-HP	32	High-Pressure (Anti-Wear) Hydraulic Oil	135-165	Winter Hyd. Oil 40AW	AW Oil #15	Duro AW 32	Energol HLP 32	Tona-Film #150 TH	Raylene AW Hyd. Fluid #0	Petrotac 32 LC
PE-215-HP	46	High-Pressure (Anti-Wear) Hydraulic Oil	194-236	Winter Hyd. Oil 45AW	AW Oil #20	Duro AW 46	Energol HLP 46	Tona-Film #200 LTH	Raylene AW Hyd. Fluid #1	Petrotac 46 LC
PE-315-HP	68	High-Pressure (Anti-Wear) Hydraulic Oil	284-346	Winter Hyd. Oil 60AW	AW Oil #30	Duro AW 68	Energol HLP 68	Tona-Film #300 MTH	Raylene AW Hyd. Fluid #2	Petrotac 68
PE-FRH-1	—	Fire-Resistant Hyd. Fluid/Synthetic		•	•	•	•	•	Bel-Ray "No-Flame" Hyd. Fluid S	•
PE-FRH-2	—	Fire-Resistant Hyd. Fluid/Water-Glycol		•	•	•	•	•	Bel-Ray "No-Flame" Hyd. Fluid G	Petrotac Fire-Safe FR-WG
PE-FRH-3	—	Fire-Res. Hyd. Fluid/Water Oil Emulsion		•	•	Duro FR HD	•	•	Bel-Ray "No-Flame" Hyd. Fluid E	•
PE-33-B	2	Very Light Spindle Oil (Over 8000 rpm)	30-35	•	•	•	Energol HP 2	•	Raylene EP Spindle Oil Light	•
PE-60-B	10	Light Spindle Oil (3600-8000 rpm)	54-65	Winter Hi Speed Spindle Oil	•	Diamond 7	Energol HP 10	•	Raylene EP Spindle Oil Med.	•
PE-100-B	22	Spindle Oil (Up to 3600 rpm)	95-115	Winter Spindle Oil 4	ETC (R & O) #10	Diamond 20	Energol HP 22	Tona-Film #100 TH	Raylene EP Spindle Oil Heavy	Petrospeed 1000
PE-150-C	32	Light Way Oil	135-165	•	WayLube Oil W-15	Tackle 32	Energol HP 32 C	Tona-Film EP 150 ST	Raylene EP Lube #1	•
PE-315-C	68	Medium Way Oil	284-346	Winter Way Oil 8	WayLube W 30	Tackle 68	Energol HP 68 C	Tona-Film EP 300 ST	Raylene EP Lube #2	Petac 68
PE-1000-C	220	Heavy Way Oil	900-1100	•	WayLube W 100	Tackle 220	Energol HP 220 C	Tona-Film EP 1000 ST	Raylene EP Lube #5	Petac 220
PE-700-D	150	Light Gear Oil	630-770	Winter Gear Oil 60	ETC (R & O) #70	Duro 117 or 160	Energol HLP 150	Tona-Film #400 TH	Raylene EP Lube #3	Petrotac 150
PE-1000-D	220	Medium Gear Oil	900-1100	Winter Gear Oil 90	ETC (R & O) #100	Duro 220	Energol HLP 220	Tona-Film #500 TH	Raylene EP Lube #5	Petrotac 220
PE-2150-D	460	Heavy Gear Oil	1935-2365	Winter Gear Oil 140	ETC (R & O) #200	Duro 460	Energol HLP 460	Tona-Film #2500 TH	Raylene EP Lube #7	Petrotac 460
PE-315-E	68	Light Extreme-Pressure Gear Oil	283-347	•	EP Compound #30	Pennant NL 68	Gearep 80	Tona-Film EP 300 ST	Bel-Ray 100 Gear Oil #50	Petrotac 68
PE-1500-E	320	Heavy Extreme-Pressure Gear Oil	1350-1650	Hudson Gear Lube 4111	EP Compound #130	Pennant NL 480	Gearep 80W-140	Tona-Film EP 1400	Bel-Ray 100 Gear Oil #90	Geared 320
PE-1000-G	320	Open Type Gear Shield (Open Gears)		Hudson Metalcoat A 165	•	Jet Lubricant Tacky	Gearep OG	Tona-Film Moly Open Gear #0 & 00	Bel-Ray 4LO Open Gear Lube #1	Pecon Lube 1500
PE-GPG-2	—	Gen. Purpose E.P. Lithium Base Grease	NLGI 2	•	Val-Lith #2 EP	Litholine EP 2 or LEP 2	Bearing Gard—2	Tona-Film Lubricating Grease #2 EP	Termalene EP Grease #2	Multi-Service EP #2
PE-MG-2	—	Molybdenum Disulfide E.P. Grease		Hudson Moonah 2254	Special Moly EP	Arco EP Moly D Grease	Bearing Gard—2	Tona-Film Moly Compound #33	Molylube 126 EP Grease #2	Aluminum Molydisulfide EP #2

[illegible footnotes]

PLANT ENGINEERING'S CHART OF INTERCHANGEABLE LUBRICANTS

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Brooks Technology Co.	Cato Oil and Grease Co.	Champlin Petroleum Co.	Chevron U.S.A. Inc.	Cities Service Co.	Conoco Inc.	Dartmus Industrial Corp.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Vanstone 400	Pennex R & O Ind. Oil A 5	Hydral R & O 150	Chevron OC Turbine Oil 32	Citgo Pacemaker 32	Dectol R & O Oil 32	Dartmus Hyd. 100
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Vanstone 610	Pennex R & O Ind. Oil B	Hydral R & O 215	Chevron OC Turbine Oil 46	Citgo Pacemaker 46	Dectol R & O Oil 46	Dartmus Hyd. 100/200
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	Vanstone 620	Pennex R & O Ind. Oil C	Hydral R & O 315	Chevron OC Turbine Oil 68	Citgo Pacemaker 68	Dectol R & O Oil 68	Dartmus Hyd. 100/300
PE-700-A	100	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Vanstone 630	Pennex R & O Ind. Oil E 5	Hydral R & O 700	Chevron OC Turbine Oil 150	Citgo Pacemaker 150	Dectol R & O Oil 100	Dartmus 1000
PE-150-HP	32	High Pressure (Anti Wear) Hydraulic Oil	135-165	Vanstone 600	AW/AL Hyd. Oil 10	Hydral AW 150	Chevron EP Hyd. Oil 32	Citgo Pacemaker XD-32 or A/W Hyd. Oil 32	Super Hyd. Oil 32	Dartmus Hyd. 100
PE-215-HP	46	High Pressure (Anti Wear) Hydraulic Oil	194-236	Vanstone 610	AW/AL Hyd. Oil 15	Hydral AW 215	Chevron EP Hyd. Oil 46	Citgo Pacemaker XD-46 or A/W Hyd. Oil 46	Super Hyd. Oil 46	Dartmus Hyd. 100/200
PE-315-HP	68	High Pressure (Anti Wear) Hydraulic Oil	284-346	Vanstone 620	AW/AL Hyd. Oil 20	Hydral AW 315	Chevron EP Hyd. Oil 68	Citgo Pacemaker XD-68 or A/W Hyd. Oil 68	Super Hyd. Oil 68	Dartmus Hyd. 100/300
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		•	•	•	•	Citgo Pacemaker Synthetic FR Fluid[10]	•	Dartmus HF 15
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water Glycol		•	•	•	•	Citgo Glycol FR-40 XD	FC Fluid	Dartmus FR 150 G
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water-Oil Emulsion		Vanstone 650	•	•	Chevron FR Fluid D	Citgo Invert FR Fluid	FR Hyd. Fluid	Dartmus FR 100 E
PE-33-B	2	Very Light Spindle Oil (Over 6000 rpm)	33-35	•	Twin Disc Torque Converter Fluid	•	•	•	•	Dartmus SPO L
PE-60-B	10	Light Spindle Oil (3000-6000 rpm)	54-65	•	Pennex R & O Ind. Oil 7A	•	Chevron EP Machine Oil 10	•	CP Spindle Oil 7[3]	Dartmus SPO LM
PE-105-B	22	Spindle Oil (Up to 3000 rpm)	95-115	•	Pennex R & O Ind. Oil A	•	Chevron EP Machine Oil 22	•	Super Hyd. Oil 15	Dartmus SPO 16
PE-150-C	32	Light Way Oil	135-165	•	AW/AL Hyd. Oil 10[3]	Hydral AW 150[1]	•	•	Dectol R & O Oil 32[3]	Dartmus 10
PE-315-C	68	Medium Way Oil	284-346	•	Med. Hvy. Way Oil for Slideways	Hydral AW 315[1]	Chevron Vistac Oil 68X	Citgo Slide/Ate 68	HD Way Lube 31	Dartmus 1058
PE-1000-C	220	Heavy Way Oil	900-1100	Slide & Way	Hyslib #7 8910	•	Chevron Vistac Oil 220X	Citgo Slide/Ate 220	HD Way Lube 52	Dartmus 60
PE-700-D	150	Light Gear Oil	630-770	Lilagoard 55	Pennex R & O Ind. Oil E 5	GL Plus Gear, 80W 90	Chevron OC Turbine Oil 150	Citgo Pacemaker 150	Dectol R & O Oil 150	Dartmus 80/90
PE-1000-D	220	Medium Gear Oil	900-1100	Lilagoard 70	Pennex R & O Ind. Oil F	Verlub D	Chevron OC Turbine Oil 220	Citgo Extra Duty Circulating Oil 220	Dectol R & O Oil 220	Dartmus 9110
PE-2150-D	460	Heavy Gear Oil	1935-2365	Lilagoard 110	Pennex R & O Ind. Oil H	GL Plus Gear, 85W 90	Chevron EP Machine Oil 460	Citgo Extra Duty Circulating Oil 460	Dectol R & O Oil 460	Dartmus 140
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Lilagoard 40	Leaded Gear Oil #2	GL Plus Gear, 80W-90[10]	Chevron NL Gear Compound 68	Citgo EP Compound 68	Gear Oil 68	Dartmus 90 EP
PE-1500-E	320	Heavy Extreme Pressure Gear Oil	1350-1650	Lilagoard 80	Leaded Gear Oil #4	•	Chevron NL Gear Compound 320	Citgo EP Compound 320	Gear Oil 320	Dartmus 9140 EP
PE-1000-F	320	Clinging-Type Gear Shield (Open Gears)		Hardlad 115	Ca-Gear 1	Thata 770EP	Chevron Pinion Grease MP	Citgo Gear and Chain Oil 100	Cograrex L Lube[3]	Dartmus OG 1
PE-GPG-1	—	Gen. Purpose E.P. Lithium Base Grease	NLGI 2	Penelube 700	Lithium CX All Season	Prystar[1]	Chevron Polyurea EP Grease 2	Citgo HEP 2 Grease	Super-Sta Grease	Dartmus 123
PE-MG-1	—	Molybdenum Disulfide E.P. Grease		Penelube 725-MD	Moly Lithium CX All Season	Deluxe with Moly	Chevron Moly Grease 2	Citgo Extra Range Grease	Super Lube M Grease	Dartmus MG2

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Davis-Howland Oil Corp.	Delta Resins & Refractories, Inc.	Drydene Oil Co., Inc.	DuBois Chemicals	E/M Lubricants, Inc.	Exxon Co., U.S.A.	G & M Lubricants, Ltd.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Canvis OC 150	Deltatone Lite Hyd. Oil #930	Paradene 32 R & O	OS 664	K 16002	Teresstic 32 to 33	300 Hydrolube Light
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Canvis OC 200	Deltatone Med. Hyd. Oil #931	Paradene 46 R & O	MPO 15	•	Teresstic 46	300 Hydrolube Med.
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	Canvis OC 300	Deltatone Hvy. Med. Hyd. Oil #932	Paradene 68 R & O	MPO 16	K 16008	Teresstic 68	300 Hydrolube Med. Hvy.
PE-700-A	100	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	DRL 48	Deltatone Heavy Hyd. Oil #934	Paradene 150 R & O	EGO-80 90[3]	K 155 (SAE 30 W 40)	Teresstic 100[3]	300 Hydrolube Heavy
PE-150-HP	32	High Pressure (Anti Wear) Hydraulic Oil	135-165	DRL 44	Deltatone Lite Hyd. Oil #930	Paradene 32 AW/Blue Hyd. Light	OS 664	K 15002	Nuto H 32	330 Hydrolube Light
PE-215-HP	46	High Pressure (Anti Wear) Hydraulic Oil	194-236	DRL 45	Deltatone Med. Hyd. Oil #931	Paradene 46 AW/Blue Hyd. 10	MPO 15	•	Nuto 46	330 Hydrolube Med.
PE-315-HP	68	High Pressure (Anti Wear) Hydraulic Oil	284-346	DRL 46	Deltatone Hvy. Med. Hyd. Oil #932	Paradene 68 AW/Blue Hyd. 20	MPO 16	K 15008	Nuto 68	330 Hydrolube Med. Hvy.
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		DRL Syn-draulic	•	•	•	•	•	340 Hydra Safe
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water Glycol		DRL FR-200	•	•	•	•	•	350 Hydra Safe
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water-Oil Emulsion		DRL Hydro-draulic	•	•	Pyro Safe	K 4300	3110 FR Hyd. Fluid	360 Hydra Safe
PE-33-B	2	Very Light Spindle Oil (Over 6000 rpm)	33-35	Cavspin 3	Delta Extra Light Spindle Oil #160 B	Spindle Oil 7	•	•	•	•
PE-60-B	10	Light Spindle Oil (3000-6000 rpm)	54-65	Cavspin 6	Delta Light Spindle Oil #62 B	Spindle Oil 10	•	•	Spinesstic 10	•
PE-105-B	22	Spindle Oil (Up to 3000 rpm)	95-115	Cavspin 10	Delta Med. Spindle Oil #150 B	Spindle Oil 22	OS 664	K 16002	Spinesstic 22	Duban 100
PE-150-C	32	Light Way Oil	135-165	Way Oil 75	•	•	OS 664	K 16002	•	750 Waylube Light
PE-315-C	68	Medium Way Oil	284-346	Way Oil 80	Delta Med. Way Oil #72 E	Way Lube 80	MPO 16	K 15008	Febis K 68	750 Waylube Med.
PE-1000-C	220	Heavy Way Oil	900-1100	Way Oil 90	Delta Dyna Slip Way Oil #300 D	Way Lube 90	EGO-80 90	K 400 90	Febis K 220[11]	750 Waylube Heavy
PE-700-D	150	Light Gear Oil	630-770	Canvis OC 700	•	Paradene 150 AW	EGO-80 90 or MPO 20	K 455 80 W 140	Teresstic 150[12]	400 Supreme Gear Lube Light
PE-1000-D	220	Medium Gear Oil	870-1100	Canvis OC 1000	Delta F-3 Gear Compound #236 E	Paradene 220 AW/APC 80w90	EGO-80 90	K 400 90	Teresstic 220	400 Supreme Gear Lube Med.
PE-2150-D	460	Heavy Gear Oil	1935-2365	DH 167	Delta F-5 Gear Compound #257 E	Paradene 460 AW/APC 85w140	EGO 80 140	K 400 140	Teresstic 460 or Cylesstic TK 460	400 Supreme Gear Lube Heavy
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Compound 1	Delta EP Hypoid Gear Oil #258 E	EP Gear Lube #2	MPO 16	K 455 80 W 140	Spartan EP 68	440 Supreme Gear Lube Light
PE-1500-E	320	Heavy Extreme Pressure Gear Oil	1350-1650	Compound 4	Delta EP Hypoid Gear Oil #260 E	EP Gear Lube 85/EGO, 80w 140	EGO 80 140	K 400 140	Spartan EP 320	440 Supreme Gear Lube Heavy
PE-1000-F	320	Clinging-Type Gear Shield (Open Gears)		Open Gear #3	Delta Gear and Bearing Lube #270-E	•	OGG H	K 333	Surett N 80k[8]	700 Viscoplus
PE-GPG-1	—	Gen. Purpose E.P. Lithium Base Grease	NLGI 2	AP Lithium EP #2	Delta Lithium Grease 2 #242	Lithium EP #2	TPG	K 166	Lidok EP 2	•
PE-MG-1	—	Molybdenum Disulfide E.P. Grease		Poly Moly	Delta Moly Grease 2 #712	Moly EP #2	MPG 2[13]	ME 17	Beacon Q2	•

[illegible footnotes]

PLANT ENGINEERING'S CHART OF INTERCHANGEABLE LUBRICANTS

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Card Oil Products, Inc.	Georgia-Carolina Oil Co.	Getty Refining & Marketing Co. Eastern Region	Getty Refining & Marketing Co. Central Region	Graphite Products Corp.	Gulf Oil Corp.	E. F. Houghton & Co.	Imperial Oil & Grease Co.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	HydroGard R & O 32	G-C Safety Lift Light	Veedol Aturbrio 50	Skelux MP # 150	•	Gulf Harmony 32	Hydro-Drive MIH Light	Molub-Alloy 801
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	HydroGard R & O 46	G-C Safety Lift 15	Veedol Aturbrio 54	Skelux MP # 10	•	Gulf Harmony 46	Hydro-Drive MIH 15	Molub-Alloy 802
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	HydroGard R & O 68	G-C Safety Lift Med.	Veedol Aturbrio 60	Skelux MP # 20	•	Gulf Harmony 68	Hydro-Drive MIH 20	Molub-Alloy 803
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	HydroGard R & O 150	G-C Safety Lift X Heavy 40	Veedol Aturbrio 71	Skelux MP # 40	•	Gulf Harmony 115	Hydro-Drive MIH 40	Molub-Alloy 805
PE-150-HP	32	High Pressure (Anti-Wear) Hydraulic Oil	135-165	HydroGard AW 32	G-C Hy Press Light	Veedol Aturbrio AW 51	Skelux MP # 150	•	Gulf Harmony 32 AW	Hydro-Drive HP 150	Molub-Alloy 801
PE-215-HP	46	High Pressure (Anti-Wear) Hydraulic Oil	194-236	HydroGard AW 46	G-C Hy Press 15	Veedol Aturbrio AW 50	Skelux MP # 10	•	Gulf Harmony 46 AW	Hydro-Drive HP 200	Molub-Alloy 802
PE-315-HP	68	High Pressure (Anti-Wear) Hydraulic Oil	284-346	HydroGard AW 68	G-C Hy Press Med.	Veedol Aturbrio AW 61	Skelux MP # 20	•	Gulf Harmony 68 AW	Hydro-Drive HP 300	Molub-Alloy 803
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		SafeGard FR Fluid SF	•	•	•	•	•	Houghto-Safe 1000 Series	•
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water Glycol		SafeGard FR Fluid WG	•	•	•	•	Gulf FR Fluid G 200	Houghto-Safe 620	•
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water-Oil Emulsion		SafeGard FR Fluid WO	•	•	•	•	Gulf FR Fluid	Houghto-Safe 5000 Series	Astral 567
PE-32-B	2	Very Light Spindle Oil (Over 8000 rpm)	30-35	SpinGard 2	•	•	•	GP-80 # 40 Oil	•	•	•
PE-60-B	10	Light Spindle Oil (3600-8000 rpm)	54-66	SpinGard 10	G-C White Star Spindle 60	•	Skelux	GP 80 # 70 Oil	Gulfspin 10	•	Molub-Alloy S.O.L.
PE-100-B	22	Spindle Oil (Up to 3600 rpm)	95-115	SpinGard 22	G-C White Star Spindle 100	Aturbrio 12	Skelvis # 100	GP 80 # 100 Oil	Gulfspin 22	•	Molub-Alloy S.O.M.
PE-150-C	32	Light Way Oil	135-165	Gardway 32	G-C Hy Press Light	Veedol Aturbrio 53	Skelvis # 150	GP # 150 WO	Gulf Harmony 32 AW	Hydro-Drive MIH Light	Molub-Alloy M.W.O. 10
PE-315-C	68	Medium Way Oil	284-346	Gardway 68	G-C Hy Press Med.	Veedol Aturbrio 61	Skelvis # 20	GP # 350 WO	Gulfway 68	•	Molub-Alloy M.W.O. 20
PE-1000-C	220	Heavy Way Oil	900-1100	Gardway 220	G-C Hy Press X Heavy 50	Veedol Aturbrio 77	Skelvis # 50	GP # 1000 WO	Gulfway 220	Ru-Pul 200	Molub-Alloy M.W.O. 40
PE-700-D	150	Light Gear Oil	630-770	Geargard 150	G-C Trans. Lube 80	Veedol Aturbrio 71	Skelux MP # 40	GP # 70 MGO	Gulf Harmony 150D	Hydro-Drive MIH 40	Molub-Alloy 30
PE-1000-D	220	Medium Gear Oil	900-1100	Geargard 220	G-C Trans. Lube 90	Veedol Agrestube 80	GP Gear 90	GP # 90 MGO	Gulf Harmony 220	MP Gear Oil 90	Molub-Alloy 40
PE-2150-D	460	Heavy Gear Oil	1935-2365	Geargard 460	G-C Trans. Lube 140	Veedol Agrestube 90	GP Gear 140	GP # 140 MGO	Gulf Harmony 460	MP Gear Oil 140	Molub-Alloy 70
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Geargard EP 68	G-C Velvet EP 80	•	GP Gear 80	GP # 80 MGO	Gulf EP Lube HD 68	•	Molub-Alloy 804
PE-1500-E	320	Heavy Extreme Pressure Gear Oil	1350-1650	Geargard EP 320	G-C Velvet EP 90	Veedol Agrestube 90	•	GP # 90 MGO	Gulf EP Lube HD 320	•	Molub-Alloy 880
PE-1000-F	220	Cling Type Gear Shield (Open Gears)		Gardtac 220	G-C Sun Bay O.G. M-100	•	•	GP-OG Med	•	Texac "M"	Molub-Alloy 882 EP-H
PE-GPG-2	—	Gen. Purpose E.P. Lithium-Base Grease	NLGI 2	Card MP Lithium 2	G-C Sun Bay M-2	Alltemp 20	Supreme MP #2	GP #32	Gulfcrown Grease EP #2	Cosmolube 2 EP	Molub-Alloy 777 2
PE-MG-2	—	Molybdenum Disulfide E.P. Grease		Card Moly Hitemp EP	G-C Sun Bay EP Thread	Veedol Moly Chassis	Supreme Moly EP	GP # 35 HD	Gulflex Moly	•	Molub-Alloy 777-2

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	International Refining & Manufacturing Co.	The Inter-State Oil Co.	Kendall Refining (Div. of Witco Chemical Corp.)	Keystone Div. Pennwalt Corp.	Leahy-Wolf Co.	Lubrication Analysis Inc.	Lubriplate Div. Fiske Brothers Refining Co.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Irnco HL-14	Inter-State SRO H 150	Hykon Golden	KLC-6	Gold Seal Hydrol W	Hyd. Oil 150	HO-0
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Irnco HL-20	Inter-State SRO H 215	Kendl R & O 047 EP	KLC 5	Gold Seal Hydrol WH	Hyd. Oil 200	HO-1
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	Irnco HL-30	Inter-State SRO H 315	Kendl R & O 063 EP	KLC 4A	Gold Seal Hydrol S	Hyd. Oil 300	HO-2
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Irnco HL-60	Inter-State SRO H 700	Kendl R & O 080 EP	KLC-3	Gold Seal Hydrol 400	Hyd. Oil 700	HO-3
PE-150-HP	32	High Pressure (Anti-Wear) Hydraulic Oil	135-165	Irnco HL-15	Inter-State Resisted EP H 150	Hykon Golden	KLC-6	Hydrol Master WHD	Hyd. Oil AW 150	HO-0
PE-215-HP	46	High Pressure (Anti-Wear) Hydraulic Oil	194-236	Irnco HL-21	Inter-State Resisted EP H 215	Kendl R & O 047 EP	KLC-5	Hydrol Master WHHD	Hyd. Oil AW 250	HO-1
PE-315-HP	68	High Pressure (Anti-Wear) Hydraulic Oil	284-346	Irnco HL-31	Inter-State Resisted EP H 315	Kendl R & O 063 EP	KLC-4A	Hydrol Master SHD	Hyd. Oil AW 300	HO-2
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		•	•	•	•	•	•	•
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water-Glycol		•	•	•	•	•	FR-Oil 3	•
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water-Oil Emulsion		•	•	•	•	•	•	•
PE-32-B	2	Very Light Spindle Oil (Over 8000 rpm)	30-35	•	Inter-State S-32	•	•	•	Spindle Oil 32	•
PE-60-B	10	Light Spindle Oil (3600-8000 rpm)	54-66	Irnco S 6	Inter-State S 60	•	Spindle Oil #4	Lubemaster MAA	Spindle Oil 60	No. 0
PE-100-B	22	Spindle Oil (Up to 3600 rpm)	95-115	Irnco S 10	Inter-State S 100	Kendl 840	Hyd. Jack Oil	Lubemaster MA	Spindle Oil 100	No. 1
PE-150-C	32	Light Way Oil	135-165	Irnco W 15	Inter-State W 150	Kendl 845 EP	•	Tac Master EP 1000	Way Oil 150	No. 1
PE-315-C	68	Medium Way Oil	284-346	Irnco W-31	Inter-State W 315	Kendl 855 EP	GP 20	Tac Master EP 2000	Way Oil 300	No. 3 V
PE-1000-C	220	Heavy Way Oil	900-1100	Irnco W-100	Inter-State W 1000	Kendl 865 EP	GP 30	Tac Master EP 6000	Way Oil 1000	No. 4
PE-700-D	150	Light Gear Oil	630-770	Irnco HL-70	Inter-State Ind. Oil 700	Kendl R & O 080 EP	KLC-3	Gold Seal Hydrol 400	Gear Oil 700	APG 80
PE-1000-D	220	Medium Gear Oil	900-1100	Irnco HL-125F	Inter-State Ind. Oil 1000	Kendall NS MP 80W-90	1790	Gold Seal Hydrol 500	Gear Oil 1000	APG 90
PE-2150-D	460	Heavy Gear Oil	1935-2365	Irnco HL-215	Inter-State Ind. Oil 2150	Kendall All Oil Gear Lube SAE 140	1791	Gold Seal Hydrol 700	Gear Oil 2150	APG 140
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Irnco G-2 EP	Inter-State EP Ind. Oil 315	Kendall Outboard Hypoid	•	Industrial EP 3000	Gear Oil EP 300	APG 80
PE-1500-E	320	Heavy Extreme Pressure Gear Oil	1350-1650	Irnco G-6 EP	Inter-State EP Ind. Oil 1500	Kendall Super Three Star	WG 1	Industrial EP 6000	Gear Oil EP 1500	APG 140
PE-1000-F	220	Cling Type Gear Shield (Open Gears)		•	Inter-State Outside Cog & Gear	Kendall GR 12X	426	Metallic Gear Cote	Gear Grease 4000	Gear Shield
PE-GPG-2	—	Gen. Purpose E.P. Lithium-Base Grease	NLGI 2	Irnco MP 2	IS "Preferred" MP Grease	Kendall Grease L 426	81 EP Li	Lith Master 300	#2 Grease	No. 630-2
PE-MG-2	[illegible]	Molybdenum Disulfide E.P. Grease		Irnco Moly-Temp	Inter-State Moly EP Grease	Kendall Grease L 424	Moly 81 Li	Lith Moly Master 300	#2 M-Grease	Mo-Lith No. 2

[illegible footnotes]

PLANT ENGINEERING'S CHART OF INTERCHANGEABLE LUBRICANTS

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	A. Margolis & Sons Corp.	Metal Lubricants Co.	Mobil Oil Corp.	Non-Fluid Oil Corp.	The Ore-Lube Corp.	Pacer Lubricants, Inc.	[illegible] Inc.	Pennzoil Co.[10]
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Magnum T.I.P. 150-15-7	Meltron AW 405	DTE Light	1103 Anti-wear Hyd. Fluid	00220	Duramol T 150	*	AW Hyd. Oil 32
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Magnum T.I.P. 150-20-7	Meltron AW 410	DTE Med.	1104 Anti-wear Hyd. Fluid	00220	Duramol T 215	Hydrol EP #28	AW Hyd. Oil 46
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	Magnum T.I.P. 150-30-7	Meltron AW 420	DTE Hvy. Med.	1105 Anti-wear Hyd. Fluid	00220	Duramol T 315	Hydrol EP 63	AW Hyd. Oil 68
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Magnum M.P. 707	Meltron AW 440	DTE Oil Ex. Heavy	1107 ALH Fluid	00220	Duramol T 700	Hydrol EP 65	AW Hyd. Oil 150
PE-150-HP	32	High Pressure (Anti Wear) Hydraulic Oil	135-165	Magnum T.I.P. 150-15-7	Meltron AW 405	DTE 24	1103	00220	Power V 150 Hyd. Oil	Hydrol AW 32	AW Hyd. Oil 32
PE-215-HP	46	High Pressure (Anti Wear) Hydraulic Oil	194-236	Magnum T.I.P. 150-20-7	Meltron AW 410	DTE 25	1104	00220	Power V 215 Hyd. Oil	Hydrol AW 46	AW Hyd. Oil 46
PE-315-HP	68	High Pressure (Anti Wear) Hydraulic Oil	284-346	Magnum T.I.P. 150-30-7	Meltron AW 420	DTE 26	1105	00220	Power V 315 Hyd. Oil	Hydrol AW 68	AW Hyd. Oil 68
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		Magnum FR Fluid PE		Pyrogard 53	*	00141	*	Hi Temp Synthetic Oil	*
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water Glycol		Magnum FR Fluid 200	Metsyn FR #200	Nyvac FR 200	*	00266	*	*	*
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water Oil Emulsion		Magnum FR Emulsion Fluid	*	Pyrogard D	*		*	*	Invert Hyd. Fluid FR
PE-32-B	2	Very Light Spindle Oil (Over 8000 rpm)	30-35	Magnum L.V.S. 35	*	Velocite Oil #3	*	00105	*	*	*
PE-60-B	10	Light Spindle Oil (3000-8000 rpm)	54-66	Magnum L.V.S. 60	Metspin #5	Velocite Oil #6	# 124 Spindle Oil	00107	Spindle Oil 70	*	Pennzoil HS Spindle Oil
PE-105-B	22	Spindle Oil (Up to 3000 rpm)	95-115	Magnum L.V.S. 105	Metspin #3	Velocite Oil #10	# 164 Spindle Oil	00109	Spindle Oil 100	*	AW Hyd. Oil 32
PE-150-C	32	Light Way Oil	135-165	Magnum M.P. 167	Meltac WL 321	Vactra Oil #1	1150 Way Oil	*	Towlube 150	*	*
PE-315-C	68	Medium Way Oil	284-346	Magnum M.P. 307	Meltac WL 322	Vactra Oil #2	1151 Way Oil	00300	Towlube 300	*	Pennzoil Way Oil Med.
PE-1000-C	220	Heavy Way Oil	900-1100	Magnum M.P. 100	Meltac WL 324	Vactra Oil #4	1153 Way Oil	00301	Towlube 1000	900 Gear Lube SAE 90	Pennzoil Way Oil Heavy
PE-700-D	150	Light Gear Oil	630-770	Magnum M.P. 707	Meltron AW 440	DTE Ex. Hvy.	A-60 Gear Oil	00171	Golden Ind. Gear Oil AGMA 4 EP	*	AW Hyd. Oil 150
PE-1000-D	220	Medium Gear Oil	900-1100	Magnum M.P. 907	Meltron AW 450	DTE BB	A-80 Gear Oil	00714	Golden Ind. Gear Oil AGMA 5 EP	900 Gear Lube SAE 90	AW Hyd. Oil 220
PE-2150-D	460	Heavy Gear Oil	1935-2365	Magnum EP Gear # 140	Meltron AW 460	DTE HH	A-70 Gear Oil	00172	Golden Ind. Gear Oil AGMA 7 EP	902 Gear Lube SAE 140	AW Hyd. Oil 460
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Magnum EP Gear 80	Metlubelite 101 CP	Mobilgear 626	A-90/EPV	00171	Golden G Gearsyl AGMA 2 EP	*	Maxol EP 68 or MP 600
PE-1000-E	220	Heavy Extreme Pressure Gear Oil	1000-1000	Magnum EP Gear 90	Metlubelite 105 CP	Mobilgear 630	A 95/EPV	00172	Golden G Gearsyl AGMA 5 EP	900 Gear Lube SAE 90/140	Maxol EP 220 or MP 600
PE-1000-S	220	Open Type Gear Shield (Open Gears)		Magnum Moly Clng.	*	Mobiltac A	0 SR	00184	Pennzoil Gear Oil 100	Pennzgrip 3	*
PE-GPG-2	—	Gen. Purpose E.P. Lithium-Base Grease	NLGI 2	Magnum Centrifugal EP #2	Metlco FM 2	Mobilux EP2	G 66/EPV	10116	Sutton EP #2	Lithoplex EP MP 2	TM 200, MP 300, EP 1 C
PE-MD-2	—	Molybdenum Disulfide E.P. Grease		Magnum H.D. MD Lith.	Metcomoly 1433	Mobiltemp 78	Chem Plex 82648	10050	Lib-O-Moly #2	Crown Gold Moly #2	Moly-white 700

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Phillips Petroleum Co.	Phoenix Petroleum Co., Ltd.	Henry E. Sanson & Sons, Inc.	Schaeffer Mfg. Co.	Sentinel Lubricants Corp.	Shell Oil Co.	[illegible] Oil Co.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Magnus Oil 32	HS 301	No-Gum Hyd. Oil Light	Micron Moly HTC SAE 10	Sentinel 5-10 Hyd. Oil	Turbo 32	Tem Hyd. Oil #5
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Magnus Oil 46	HS 302	No-Gum Hyd. Oil 10	Micron Moly HTC SAE 10	Sentinel 5-10/20 Hyd. Oil	Turbo 46	Tem Hyd. Oil #21
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	Magnus Oil 68	SD 603	No-Gum Hyd. Oil 20	Micron Moly HTC SAE 20	Sentinel 5-10/30 Hyd. Oil	Turbo 68	Tem Hyd. Oil #31
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Magnus Oil 150	SD 605	No-Gum Hyd. Oil 40	Micron Moly HTC SAE 30	Sentinel 5-10/50 M.P. Oil	Turbo 150	Tem Hyd. Oil #68
PE-150-HP	32	High Pressure (Anti Wear) Hydraulic Oil	135-165	Magnus A Oil 32	HS 301	AW Hyd. Oil 150	Micron Moly HTC SAE 10	Sentinel 5-10 Hyd. Oil	Tellus 32	Tem AW Hyd. Oil #15
PE-215-HP	46	High Pressure (Anti Wear) Hydraulic Oil	194-236	Magnus A Oil 46	HS 302	AW Hyd. Oil 215	Micron Moly HTC SAE 10	Sentinel 5-10/20 Hyd. Oil	Tellus 46	Tem AW Hyd. Oil #21
PE-315-HP	68	High Pressure (Anti Wear) Hydraulic Oil	284-346	Magnus A Oil 68	HS 303	AW Hyd. Oil 315	Micron Moly HTC SAE 30	Sentinel 5-10/30 Hyd. Oil	Tellus 68	Tem AW Hyd. Oil #31
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		*	PPC Phosphate Ester	Hydra Safe FE Series[4]	*	Sentinel H.F. 66	*	*
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water Glycol		*	PPC Water Glycol	Hydra Safe Premium Glycol Series[4]	*	Sentinel H.F. 860	*	*
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water Oil Emulsion		*	*	Hydra Mul Premium Emulsion Fluid	*	Sentinel H.F. 750	Irus F	*
PE-32-B	2	Very Light Spindle Oil (Over 8000 rpm)	30-35	*	HS 250	*	*	Sentinel S.P.O. "L"	*	*
PE-60-B	10	Light Spindle Oil (3000-8000 rpm)	54-66	*	HS 300H	No-Gum Spindle Oil #7	*	Sentinel S.P.O. LM	Tellus 10	*
PE-105-B	22	Spindle Oil (Up to 3000 rpm)	95-115	Magnus Oil 32	Mulbrel Light	No-Gum Spindle Oil #9	Spindle Oil SAE 5	Sentinel S.P.O. M	Tellus 22	*
PE-150-C	32	Light Way Oil	135-165	*	SD 501	No-Gum Hyd. Way Lube 150	*	Sentinel 5-10	Tonna 32	*
PE-315-C	68	Medium Way Oil	284-346	*	PPC Way 47	No Drip Way Lube #282	*	Sentinel 5-10/30	Tonna 68	*
PE-1000-C	220	Heavy Way Oil	900-1100	*	PPC Way 50	No Drip Way Lube Heavy	*	Sentinel 5-30	Tonna 220	*
PE-700-D	150	Light Gear Oil	630-770	Magnus Oil 150	SD 505	No-Gum Hyd. Oil 40	R 100 or Moly Universal SAE 80	Sentinel 5-75/90	Turbo 150	Tem Compound #3
PE-1000-D	220	Medium Gear Oil	900-1100	Magnus Oil 220	SD 509	No-Gum Lube Oil 550P	R 100 or Moly Universal SAE 90	Sentinel 5-80/140	Turbo 220	Tem Compound #4
PE-2150-D	460	Heavy Gear Oil	1935-2365	Hp Tar 460 (2000B)	AG 200 B	No-Gum Gear Oil #2100	Pure Mineral SAE 140	Sentinel 5-140	Turbo 460	Tem Compound #7
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Philube All Purpose Gear Oil, SAE 80W	SD 503	No-Gum EP Gear Oil #315	*	Sentinel 5-75/90 EP	Omala 68	Tem Compound #3
PE-1000-E	220	Heavy Extreme Pressure Gear Oil	1000-1000	Philube All Purpose Gear Oil, SAE 80W-90	320 Gear Oil	No-Gum Lube Oil 1000 V	R 100 or Moly Universal Gear Lube SAE 90	Sentinel 80/140 EP	Omala 220	Tem Gear Lube 80 W 90
PE-1000-S	220	Open Type Gear Shield (Open Gears)		Philube D.I. Grease	Super Open Gear XL	No-Chip 110	Moly Gear Cote Open Gear 100	Sentinel 5 O.G.	Omala H	*
PE-GPG-2	—	Gen. Purpose E.P. Lithium-Base Grease	NLGI 2	Philube EP 2	PPC-7 Plus	Syndolube #2	Moly Lube 600 EP #2, or Moly Guard	Sentinel 5-120	Alvania EP 2	Tem HD Lithium #2
PE-MD-2	—	Molybdenum Disulfide E.P. Grease		Philube MW Grease	PPC-1 Plus	Syndolube #244	Industrial 2020 #2 or Moly Extra 1007 #3	Sentinel 5-MD 2	Super Duty	Tem HD Moly Grease

[1] No comparable product
[2] [illegible]
[3] [illegible]
[4] [illegible]
[5] [illegible]
[6] [illegible]
[7] [illegible]
[8] [illegible]
[9] [illegible]
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[11] [illegible]
[12] [illegible]
[13] [illegible]
[14] [illegible]
[15] [illegible]
[16] [illegible]
[17] [illegible]

PLANT ENGINEERING'S CHART OF INTERCHANGEABLE LUBRICANTS

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Southwestern Petroleum Corp.	Standard Oil Co. (Ohio) Boron Oil Co.	Stewart-Warner Corp. Alemite Div.	D. A. Stuart Oil Co. of America	Sun Petroleum Products Co.	Synthetic Oil Corp. of America[a]	Tech-Lube Corp.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Swepco Ind. Oil 702-1	Industron 44	Hyd. HD Oil #0	Dasco PS 15 Hyd. Oil	Sunvis 816	SOC Hyd. 135 3	1 HQ 1
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-235	Swepco Ind. Oil 702-1	Industron 48	Hyd. HD Oil #1	Dasco PS 20 Hyd. Oil	Sunvis 821	•	1 H
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	Swepco Ind. Oil 702-2	Industron 53	Hyd. HD Oil #2	Dasco PS 30 Hyd. Oil	Sunvis 831	•	1 H/50
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Swepco Ind. Oil 702-4	Industron 66	Hyd. HD Oil #3	•	Sunvis 875	•	1 H0
PE-150-HP	32	High-Pressure (Anti-Wear) Hydraulic Oil	135-165	Swepco AW Hyd. Oil 704-10	Industron 44	Hyd. HD Oil #0	Dasco PS 15 Hyd. Oil	Sunvis 706, Sunvis 816 WR	SOC Hyd. 135 3	THQ 1
PE-215-HP	46	High-Pressure (Anti-Wear) Hydraulic Oil	194-235	Swepco AW Hyd. Oil 704-10	Industron 48	Hyd. HD Oil #1	Dasco PS 20 Hyd. Oil	Sunvis 747, Sunvis 821 WR	•	TH10
PE-315-HP	68	High-Pressure (Anti-Wear) Hydraulic Oil	284-346	Swepco AW Hyd. Oil 704-20	Industron 53	Hyd. HD Oil #2	Dasco PS 30 Hyd. Oil	Sunvis 764, Sunvis 831 WR	•	H20
PE-FRH-1	—	Fire-Resistant Hyd. Fluid/Synthetic		•	•	•	Dasco FR430 Hyd. Fluid	Sunguard 360	SOC Hyd. 135 5	H 650
PE-FRH-2	—	Fire-Resistant Hyd. Fluid/Water Glycol		•	•	•	Dasco FR200 Hyd. Fluid	•	•	TH150WG
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water Oil Emulsion		Swepco FR Hyd. Oil 718	[illegible] FR	•	Dasco FR Hyd. Fluid	Sunsafe 450	•	•
PE-33-S	2	Very Light Spindle Oil (Over 8000 rpm)	28-35	•	Industron 32	•	Dasco 1473	•	•	•
PE-60-S	10	Light Spindle Oil (2800-8000 rpm)	54-65	•	Industron 34	•	•	Solnus 55	•	1 S O 10
PE-100-S	22	Spindle Oil (Up to 2800 rpm)	95-116	•	Industron 40	Hyd. HD Oil #0	Astral 0045	Sunvis 811	•	1 S O
PE-150-G	32	Light Way Oil	135-165	•	Factoway 43	Hyd. HD Oil #1*	•	Lubeway 1080, Way Lube 1176	•	1 HQ 1 HD
PE-315-G	68	Medium Way Oil	284-346	Swepco Gear Lube 201-80/90	Factoway 50	Hyd. HD Oil #2*	[illegible] 7148 Way Lube	Sunoco Way Lube 1180	•	1 H/80 HD
PE-1000-G	220	Heavy Way Oil	929-1100	Swepco Gear Lube 201-90	Factoway 90	Hyd. HD Oil #4*	[illegible] 7184 Way Lube	Sunoco Way Lube 1190	•	175/80 HD
PE-700-G	150	Light Gear Oil	630-770	Swepco Gear Lube 201-80/90	Industron 66	HD Gear Oil #3	[illegible] 7134	Sunvis 875 & 776	SOC GO 90	1 H
PE-1000-G	220	Medium Gear Oil	929-1100	Swepco Gear Lube 201-90	Industron 100	HD Gear Oil #5	[illegible] 7136	Sunvis 900 & 780	SOC GO 140	175/80
PE-2150-G	460	Heavy Gear Oil	1935-2365	Swepco Gear Lube 201-140	Industron 150	HD Gear Oil #7	[illegible] 7137	Sunvis 9112	•	1 140
PE-315-E	68	Light Extreme-Pressure Gear Oil	283-347	Swepco Gear Lube 201-80/90	Gearep 80	HD Gear Oil #3	[illegible] 7132	Sunep 1050	•	1 80/90
PE-1500-E	320	Heavy Extreme-Pressure Gear Oil	1350-1650	Swepco Gear Lube 201-90	Gearep 80W-140	HD Gear Oil #7	•	Sunep 1080	SOC GO 140	190/140
PE-1000-O	220	Cling-Type Gear Shield (Open Gears)		Swepco Outside Gear Lube 804	Gearep OG	Alemite Gear Shield	•	Sunep Compound 260 EP	•	TCOG
PE-GPG-2	—	Gen. Purpose E.P. Lithium-Base Grease	NLGI 2	•	Bearing Gard 2	EP Lithium	•	Prestige 742 EP	•	•
PE-MG-2	—	Molybdenum Disulfide E.P. Grease		Swepco Moly Grease 101	Bearing Gard 2	Moly EP Lithium	•	Sunaplex 992 EP(M), Prestige Moly 2 EP	•	TCM2

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Texaco Inc.	Tosco Corp. Western Region	Tosco Corp. Eastern Region	Tower Oil & Technology Co.	Tri State Industrial Lubricants, Inc.	U.S. Industrial Lubricants	Ultrachem Inc.[a]	Union Carbide Corp.[a]
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Regal Oil R & O 32	Azolea 32	Azolea F32	Hydrol CC	Hydro-Flo #15	UIL-10	Chemlube 300	Ucon LB-135XY-68
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-235	Regal Oil R & O 46	•	Azolea T-46	Hydrol D	Hydro-Flo #2	UIL-10	Chemlube 500	Ucon LB 170XY 35
PE-315-A	68	Med. Heavy Inhibited Hyd. & Gen. Purpose	284-346	Regal Oil R & O 68	Azolea 68	Azolea T-68	Hydrol EE	Hydro-Flo #3	UIL 20	Chemlube 205	Ucon LB-300XY-35
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Regal Oil R & O 150	Azolea 220	Azolea T-300	Hydrol F	Hydro-Flo #5	UIL-30	Chemlube 280	Ucon LB 600XY 35
PE-150-HP	32	High-Pressure (Anti-Wear) Hydraulic Oil	135-165	Rando Oil HD 32	Azolea AW 32	Azolea AW 32H	Hydrol AW-3	Hydro-Flo AW-15	UIL-10	Chemlube 217	Ucon Hyd. Fluid WS-34
PE-215-HP	46	High-Pressure (Anti-Wear) Hydraulic Oil	194-235	Rando Oil HD 46	Azolea AW 46	•	Hydrol AW-4	Hydro-Flo AW-2	UIL-10	Chemlube 217	•
PE-315-HP	68	High-Pressure (Anti-Wear) Hydraulic Oil	284-346	Rando Oil HD 68	Azolea AW 68	Azolea AW 68H	Hydrol AW-5	Hydro-Flo AW-3	UIL-20	Chemlube 217	•
PE-FRH-1	—	Fire-Resistant Hyd. Fluid/Synthetic		Safetytex 46	•	•	•	•	FR S	•	•
PE-FRH-2	—	Fire-Resistant Hyd. Fluid/Water Glycol		Hydraulic Safety Fluid 46	•	✓	•	Fire-Resist AFH AW	FR WG	•	Ucon Hydrolube LL-[illegible]
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water Oil Emulsion		Fire Resist Hydrofluid 68	•		Safol Hyd. Fluid	•	FR WO	•	•
PE-33-S	2	Very Light Spindle Oil (Over 8000 rpm)	28-35	•	•	•	Dual AA	#30 Spindle	Polymer-140	•	•
PE-60-S	10	Light Spindle Oil (2800-8000 rpm)	54-65	Spindura 10	•	Azolea T-10	Dual A	#60 Spindle	Polymer 140	•	•
PE-100-S	22	Spindle Oil (Up to 2800 rpm)	95-116	Spindura 22	•	Azolea T-22	Dual B	#1 Spindle	Polymer-140	•	•
PE-150-G	32	Light Way Oil	135-165	Cleartex D*	Base w/Anti Wear 32	Base Way Oil 32	#15 Way & Gear Lube	Sta-Lube #16	UIL-30	•	•
PE-315-G	68	Medium Way Oil	284-346	Way Lube 68	Base w/Anti Wear 68	Base Way Oil 68	#47 Way Lube	Sta-Lube #3	UIL-30	•	•
PE-1000-G	220	Heavy Way Oil	929-1100	Way Lube 220	Base w/Anti Wear 220	•	#95 Way & Gear Lube	Sta-Lube #8	UIL-60	•	•
PE-700-G	150	Light Gear Oil	630-770	Regal Oil R & O 150	•	EP Circulating Oil 150	Express Gear Lube F	Gearmate #05	UIL 80	FLP 80/140	Ucon Gear Lube 68
PE-1000-G	220	Medium Gear Oil	929-1100	Regal Oil R & O 220	All Purpose Gear Oil 80	EP Circulating Oil 220	Express Gear Lube GH	Gearmate #9	UIL 90	FLP 80/140	Ucon Gear Lube 150
PE-2150-G	460	Heavy Gear Oil	1935-2365	Regal Oil 320	All Purpose Gear Oil 140	EP Circulating Oil 460	Express Gear Lube J	Gearmate #2100	UIL-140	FLP 80/140	Ucon Gear Lube 270
PE-315-E	68	Light Extreme-Pressure Gear Oil	283-347	Meropa 68	Base w/Anti Wear 68	EP Circulating Oil 68	Express Gear Lube EF	Gearmate EP #3	UIL-30	Chemlube 1147	•
PE-1500-E	320	Heavy Extreme-Pressure Gear Oil	1350-1650	Meropa 320	All Purpose Gear Oil 80	EP Circulating Oil 320	Express Gear Lube GH	Gearmate EP #1500	UIL 90	Chemlube 1145	Ucon GRL 650
PE-1000-O	220	Cling-Type Gear Shield (Open Gears)		Crater 2X	Outside Gear Compound	Lens Compound #2	Kotal	Sta-Lube EP #5	Gear Lube	FLP 1600	•
PE-GPG-2	—	Gen. Purpose E.P. Lithium-Base Grease	NLGI 2	Multifak EP 2	EP #2 Grease	Multi Purpose Supreme #2	Grease R	GP-LG #2	Multi 2	Vanlube 352/Vactum 4075	•
PE-MG-2	—	Molybdenum Disulfide E.P. Grease		Molytex EP 2	Moly Poly Grease	•	Grease ME 1	GP-LG #2 Moly	Multi 2 Moly	FLP 500	•

[illegible footnotes]

PLANT ENGINEERING'S CHART OF INTERCHANGEABLE LUBRICANTS

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	Union Oil Company of California: Western Region	Union Oil Company of California: Eastern Region	United Refining Co.	Viscosity Oil Co.	West Penn Oil Co., Inc.	The White & Bagley Co.	White & Bagley of Michigan, Inc.	Arthur C. Withrow Co.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Turbine Oil 32	Unax RX 32	EnLAm R & O 150	PIO 32T	W/P HDM 150	W & B Super Hyd. Oil 150	Penn-Mar Super Hyd. Oil 150	5 Light Lube Oil
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Turbine Oil 46	Unax RX 46	EnLAm R & O 200	PIO 46T	W/P HDM 200	W & B Super Hyd. Oil 225	Penn-Mar Super Hyd. Oil 225	6 Med. Lube Oil
PE-315-A	68	Med.-Heavy Inhibited Hyd. & Gen. Purpose	284-346	Turbine Oil 68	Unax AW 68	EnLAm R & O 300	PIO 68T	W/P HDM 300	W & B Super Hyd. Oil 300	Penn-Mar Super Hyd. Oil 300	8 Med. Hvy. Lube Oil
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Turbine Oil 150	Unax RX 150	EnLAm R & O 650	PIO 150AZ	W/P HDM 650	W & B Super Hyd. Oil 650	Penn-Mar Super Hyd. Oil 650	8 Extra Heavy Lube Oil
PE-150-HP	32	High Pressure (Anti-Wear) Hydraulic Oil	135-165	Unax AW 32	Unax AW 32	EnLAm AW 150	PIO 32AZ	W/P AWH 150	W & B EP Hyd. Oil 150	Penn-Mar EP Hyd. Oil 150	H Light AW Hyd. Oil
PE-215-HP	46	High Pressure (Anti-Wear) Hydraulic Oil	194-236	Unax AW 46	Unax AW 46	EnLAm AW 200	PIO 46AZ	W/P AWH 200	W & B EP Hyd. Oil 225	Penn-Mar EP Hyd. Oil 225	H Med. AW Hyd. Oil
PE-315-HP	68	High Pressure (Anti-Wear) Hydraulic Oil	284-346	Unax AW 68	Unax AW 68	EnLAm AW 300	PIO 68AZ	W/P AWH 300	W & B EP Hyd. Oil 300	Penn-Mar EP Hyd. Oil 300	H Med. Hvy. AW Hyd. Oil
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic	•	•	•	•	•	•	•	•	•
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water Glycol		•	•	•	•	•	•	•	
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water Oil Emulsion		FR Fluid	FR Fluid	•	FRH 46KE	•	•	•	Withrowlo 841 Hyd. Fluid
PE-33-B	2	Very Light Spindle Oil (Over 8000 rpm)	29-35	•	•	•	Vertex 40	W/P Westspin #3	W & B Premium Spindle Oil 45	Penn-Mar R & O Spindle Oil 45	•
PE-60-B	10	Light Spindle Oil (3600-8000 rpm)	54-66	•	•	EnLAm R & O 55	8 6	W/P Westspin #6	W & B Universal Spindle Oil 60	Penn-Mar R & O Spindle Oil 60	1160 AW Hyd. Oil
PE-100-B	22	Spindle Oil (Up to 3600 rpm)	95-115	Turbine Oil 32	Unax 32	EnLAm R & O 100	8 10	W/P Westspin # 10	W & B Universal Spindle Oil 100	Penn-Mar R & O Spindle Oil 100	H Light AW Hyd. Oil
PE-150-C	32	Light Way Oil	135-165	Way Oil HD 32	•	EnLAm Powerway 150	Vertex 1	W/P Powerway Light	W & B Light Hydraulic & Way Lubricant	Penn-Mar Light Hyd. & Way Lube	•
PE-315-C	68	Medium Way Oil	284-346	Way Oil HD 68	Way Oil HD 68	EnLAm Powerway 300	Vertex 2	W/P Powerway Med.	W & B Medium Way Lubricant	Penn-Mar Med. Way Lube	Withrowlo 625-300 Way Oil
PE-1000-C	220	Heavy Way Oil	900-1100	Way Oil HD 220	Way Oil HD 220	EnLAm Powerway 900	Vertex 4	W/P Powerway Heavy	W & B Heavy Way Lubricant	Penn-Mar Heavy Way Lube	Withrowlo 625-900 Way Oil
PE-700-D	150	Light Gear Oil	630-770	Unax 150	Unax 150	EnLAm Pean 40	PIO 150AZ	W/P Mineral Gear Light	W & B Hydrive Oil H	Penn-Mar Light Gear Oil	Withrowlo 635 Lube Oil
PE-1000-D	220	Medium Gear Oil	900-1100	Unax 220	Unax 220	EnLAm Mineral Gear 90	PIO 215AZ	W/P Mineral Gear Med.	W & B Hydrive Oil J	Penn-Mar Med. Gear Oil	Withrowlo 637 Lube Oil
PE-2150-D	460	Heavy Gear Oil	1935-2365	Unax 460	Unax 460	EnLAm Mineral Gear 140	PIO 320AZ	W/P Mineral Gear Heavy	W & B Hydrive Oil L	Penn-Mar Heavy Gear Oil	Withrowlo 638 Lube Oil
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Extra Duty NL 2 EP	Extra Duty NL 2 EP	EnLAm APG Lube 2 EP (90)	REX AA	W/P APG 80	W & B EP Gear Oil SAE 80 W	Penn-Mar EP Gear Oil #2	Withrowlo 639 Lube Oil
PE-1500-E	320	Heavy Extreme Pressure Gear Oil	1350-1650	Extra Duty NL 6 EP	Extra Duty NL 6 EP	EnLAm APG Lube 6 EP (90)	REX DD	W/P APG 90	W & B EP Gear Oil SAE 90	Penn-Mar EP Gear Oil #3	AP Gear Oil SAE 90
PE-1000-G	—	Oper Type Gear Shield (Open Gears)		Gearite Heavy	Gearite Heavy	EnLAm Open Gear[a]	Open Gear #2	W/P OGEP	Olsen Open Gear Lubricant	Penn-Mar Open Gear Shield 500	•
PE-GPG-2	—	Gen. Purpose E.P. Lithium Base Grease	NLGI 2	Unoba EP #2	Unoba EP #2	Enclube 202 EP	EP Lith #2	W/P Lith No. 2 EP	Olsen Multi Purpose Lubricant	Penn-Mar Kote 2-1?30 2	Withrowlo 672-2 EP Grease
PE-MG-2	—	Molybdenum Disulfide E.P. Grease		Unoba Moly HD #2	Unoba Moly HD #2	Enclube 282	HD Moly #2	W/P Moly Lith No. 2 EP	Olsen Moly Lubricant	Penn-Mar Kote 2-1430 2	MolyOne MDK-2 EP Grease

Plant Engineering Designation	ISO Viscosity Grade	Lubricant Type	Viscosity, SUS at 100 F	World-Wide Lubricants, Ltd.	Wynn Oil Co.
PE-150-A	32	Light Inhibited Hydraulic & Gen. Purpose	135-165	Moly Hyd. 150	•
PE-215-A	46	Med. Inhibited Hydraulic & Gen. Purpose	194-236	Moly Hyd. 225	•
PE-315-A	68	Med.-Heavy Inhibited Hyd. & Gen. Purpose	284-346	Moly Hyd. 315	•
PE-700-A	150	Heavy Inhibited Hydraulic & Gen. Purpose	630-770	Moly Hyd. 700	•
PE-150-HP	32	High Pressure (Anti-Wear) Hydraulic Oil	135-165	Moly Hyd. AW150	•
PE-215-HP	46	High Pressure (Anti-Wear) Hydraulic Oil	194-236	Moly Hyd. AW225	•
PE-315-HP	68	High Pressure (Anti-Wear) Hydraulic Oil	284-346	Moly Hyd. AW315	•
PE-FRH-1	—	Fire Resistant Hyd. Fluid/Synthetic		Sol 1 Lube "S"	•
PE-FRH-2	—	Fire Resistant Hyd. Fluid/Water Glycol		80 A Cal 300	•
PE-FRH-3	—	Fire Res. Hyd. Fluid/Water Oil Emulsion		Sol 1 Lube "FR"	Hydra Gale Heavy Med
PE-33-B	2	Very Light Spindle Oil (Over 8000 rpm)	29-35	#30 Moly Spindle	•
PE-60-B	10	Light Spindle Oil (3600-8000 rpm)	54-66	#60 Moly Spindle	•
PE-100-B	22	Spindle Oil (Up to 3600 rpm)	95-115	# 100 Moly Spindle	•
PE-150-C	32	Light Way Oil	135-165	Moly Way # 15	•
PE-315-C	68	Medium Way Oil	284-346	Moly Way #3	•
PE-1000-C	220	Heavy Way Oil	900-1100	Moly Way #9	Way Lube 300
PE-700-D	150	Light Gear Oil	630-770	Moly Gear 750	•
PE-1000-D	220	Medium Gear Oil	900-1100	Moly Gear 900	•
PE-2150-D	460	Heavy Gear Oil	1935-2365	Moly Gear 2250	•
PE-315-E	68	Light Extreme Pressure Gear Oil	283-347	Moly Gear EP 325	•
PE-1500-E	320	Heavy Extreme Pressure Gear Oil	1350-1650	Moly Gear EP 1500	•
PE-1000-G	220	Oper Type Gear Shield (Open Gears)		Moly Open Gear # 1000	•
PE-GPG-2	—	Gen. Purpose E.P. Lithium Base Grease	NLGI 2	#2 WL Grease	Multi Purpose Grease
PE-MG-2	—	Molybdenum Disulfide E.P. Grease		#2 ML Grease	Verplex Moly Grease

[illegible footnotes]

pose lubricants and greases are usually of better quality than the older, specialized products they replace. The improved quality means longer lubrication intervals, less total volume of lubricant used, reduced cost for applying the lubricant, and less downtime for maintenance or repair.

The cost of downtime of production machinery is quite high, and the use of better quality lubricants, even at substantially higher prices, can be inexpensive insurance against equipment failure. In addition, the high cost of the lubricant, plus the high labor maintenance cost, necessitates the use of quality lubricants that extend lubrication intervals and can mean a tremendous savings in labor and downtime.

A simple, yet often overlooked, means of conserving lubricant is to detect and correct all leaks. The loss of a few drops of oil from a loose fitting or a worn seal may not seem like much of a problem, but the maintenance personnel responsible for trying to reduce oil consumption should calculate what such a loss can mean over a year. If only one drop of oil is lost every 10 seconds, 39 6 gallons will be lost in a year. Should one drop of oil be lost every second, the yearly loss would be 409 gallons. If losses from what may be considered inconsequential leaks are multiplied by the costs of today's lubricants, it is easy to see how many dollars can be wasted by neglecting small leaks.

Other areas of conservation include improved storing and handling practices, better control in sampling lubricant deliveries, periodic sampling and analysis of machine oils, use of filtering to prolong lubricant life, and reclamation.

If industry were to recycle most of the oil that is currently discarded, over 83,000 barrels per day could be saved. This is an extremely conservative estimate; most lubricant experts believe that industrial oil can be recycled at least 10 times before it has to be discarded. Theoretically, if oil is purified after every use, and contaminants are not allowed to remain in it for long periods, its effective life can stretch over many years.

Approximately 2.8 billion gallons of lubricants will be sold in the United States in 1980. Half of this oil is consumed during use and must be replaced with new oil. Only about 75 million gallons are reclaimed each year. The remaining oil is dumped in landfills, spread on roads, mixed and burned with fuel oil, or incinerated without energy recovery. Roughly 3 4 million gallons of contaminated—but relatively high-quality—oil are wasted every day.

Lubricant experts agree that oil does not wear out; it must be discarded only when dust, dirt, carbon, chips, acids, gums, sludge, water, rust, or oxidation products cause the breakdown of unstable constituents. If these products of contamination are properly removed, the oil will be as good as new.

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PEE 80010

IX. STAFF

A. Personnel Requirements

The operation of the Charlevoix Water Filtration Plant and the overall maintenance of its equipment is accomplished by qualified personnel under the direction of the Plant Superintendent.

The present January 1987 personnel requirements for plant operation are as follows:

1 - Superintendent

2 - Plant Operators

B. Job Descriptions and Staff Qualifications

This section details the individual staff member's job duties and employment standards, along with general staffing information related to each job classification.

1. Superintendent (1 required)

   a. Definition

   Under general administrative direction, organizes and directs the administration and operation of the Filtration Plant; supervises and directs the work of all employees; and performs other duties as required.

   b. Examples of Duties

   Supervises the maintenance of a sanitary, palatable and continuous supply of water to the Charlevoix area; supervises the operation and maintenance of all equipment and structures; directs the requisitioning of all materials and equipment used in plant operation and maintenance; directs the requisitioning of water treatment chemicals; assists consulting engineering firms in planning plant expansion; interviews salesmen and industrial representatives regarding chemicals and problems; and performs other duties as required.

   c. Knowledge and Abilities

   Knowledge of the function and operation of major water treatment equipment; knowledge of costs, methods, and problems associated with chemicals; knowledge of the principles and practices of plant operation

and administration; ability to establish and maintain an effective relationship with the public, with industrial and sales representatives, and with public officials and agencies; and ability to make decisions that will insure safe, palatable water.

d. License Needed

F-2

2. Operator (2 required)

a. Definition

Under general direction, assists in the overall operation and administration of the Filtration Plant and performs other duties as required.

b. Examples of Duties

Conducts water purification procedures, laboratory chemical and bacteriological analysis, distribution sampling, and new main disinfection; maintains and repairs operating equipment; prepares and maintains records and reports of purification data, pumpage of raw, filtered and high service water; performs other duties as required.

c. Knowledge and Abilities

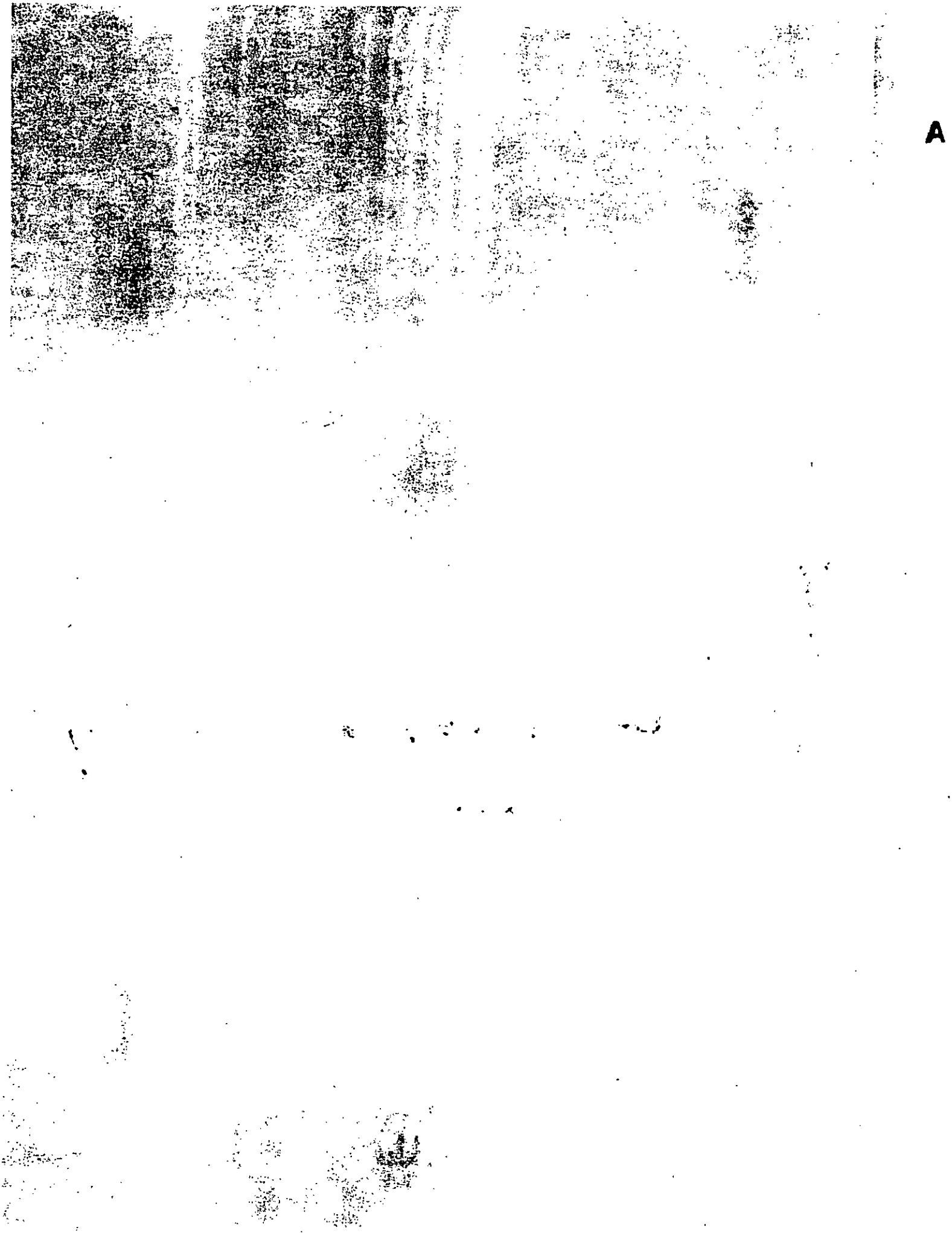
Knowledge of principles and laboratory techniques of micro-biology, chemistry and chemical processing; knowledge of the function, operation and maintenance of major water treatment equipment; ability to maintain safe, palatable water; ability to make accurate chemical and physical analysis of water and other materials.

d. License Needed

F-4

X. APPENDICES

- **A. Pipework Flow Diagram**
- **B. Hydraulic Profile**
- **C. Chemical System Schematics**
  - **1. Ammonia Schematic**
  - **2. Polymer Feed Schematic**
  - **3. Liquid Alum Feed Schematic**
  - **4. Chlorine Schematic**
  - **5. Fluoride Feed Schematic**
- D. Mechanical System Schematics
  - 1. Natural Gas Schematic
  - 2. Turbidimeter Schematic
  - 3. High Pressure Air Schematic
  - 4. Potable and Service Water Schematic
- E. Hydronic Schematic
- F. Electrical Diagrams
  - 1. Motor Control Center-A, One-Line Diagram
  - 2. Motor Control Center-B, One-Line Diagram
  - 3. Motor Control Centers C & D, One-Line Diagram
- G. Instrumentation
  - 1. Instrumentation, One-Line Diagram
  - 2. Instrumentation, Chemical System Diagram
  - 3. Instrumentation, One-Line Diagram Legend
- H. Recommendations for the Storage and Handling of Lqiuid Alum
- I. Metric System Reference, Glossary of Terms and Abbreviations
- J. Safe Drinking Water Act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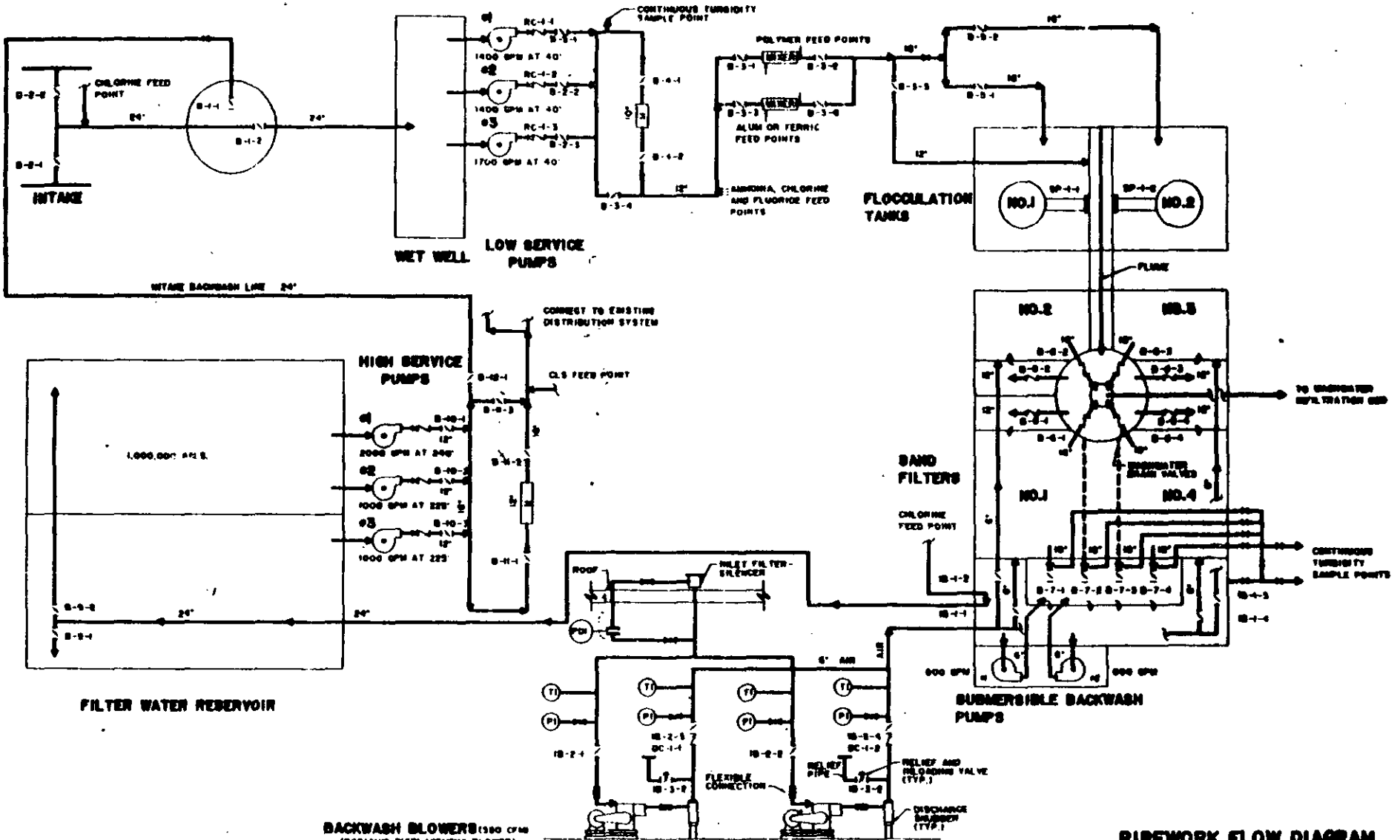
APPENDIX A

Pipework Flow Diagram



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CHECK VALVE
BUTTERFLY VALVE
GLOBE VALVE
FLOW METER

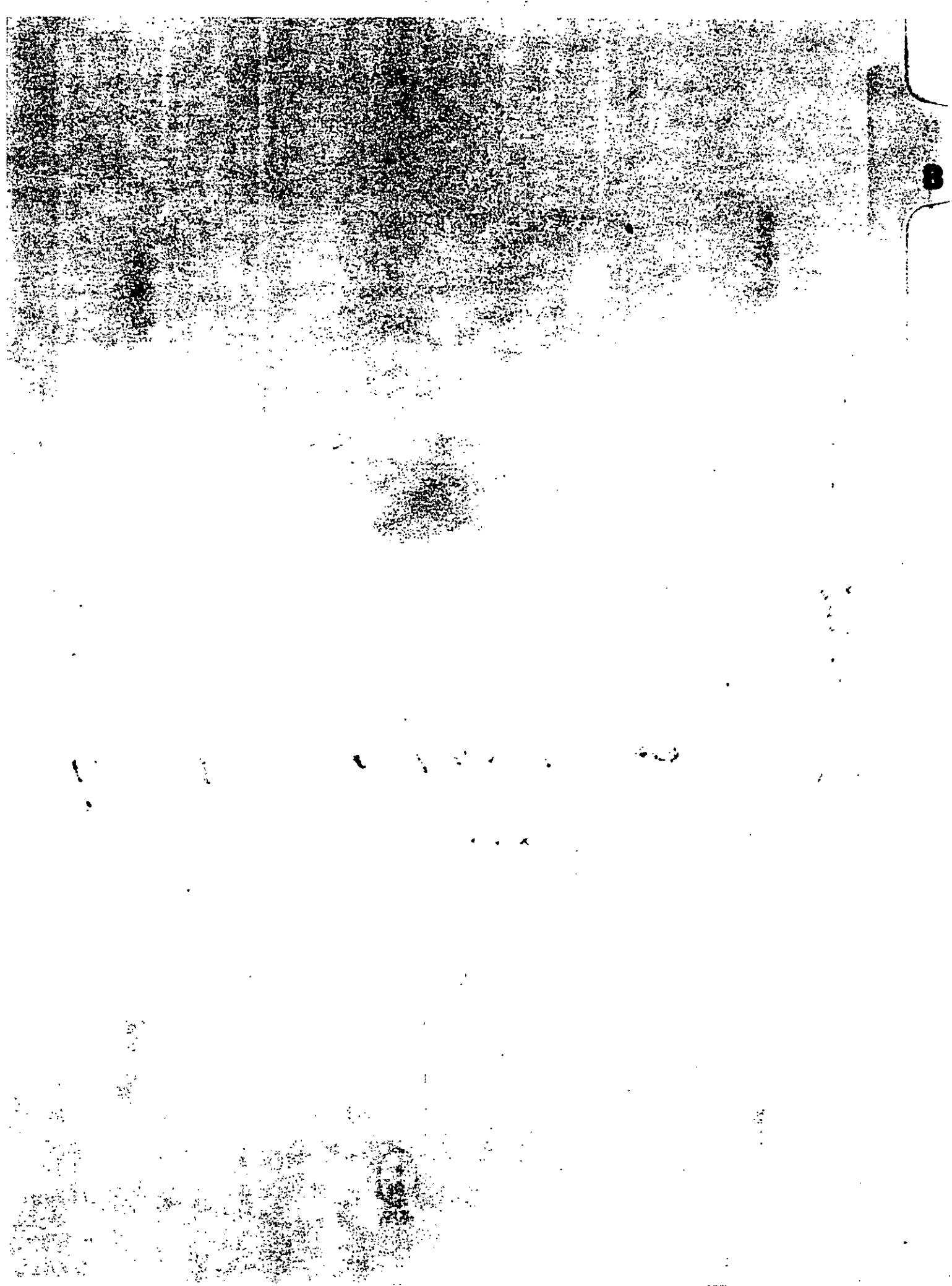
PI PRESSURE INDICATOR
TI TEMPERATURE INDICATOR
PDI PRESS DIFFERENTIAL INDICATOR
STOP PLATE

REDUCER

PIPEWORK FLOW DIAGRAM

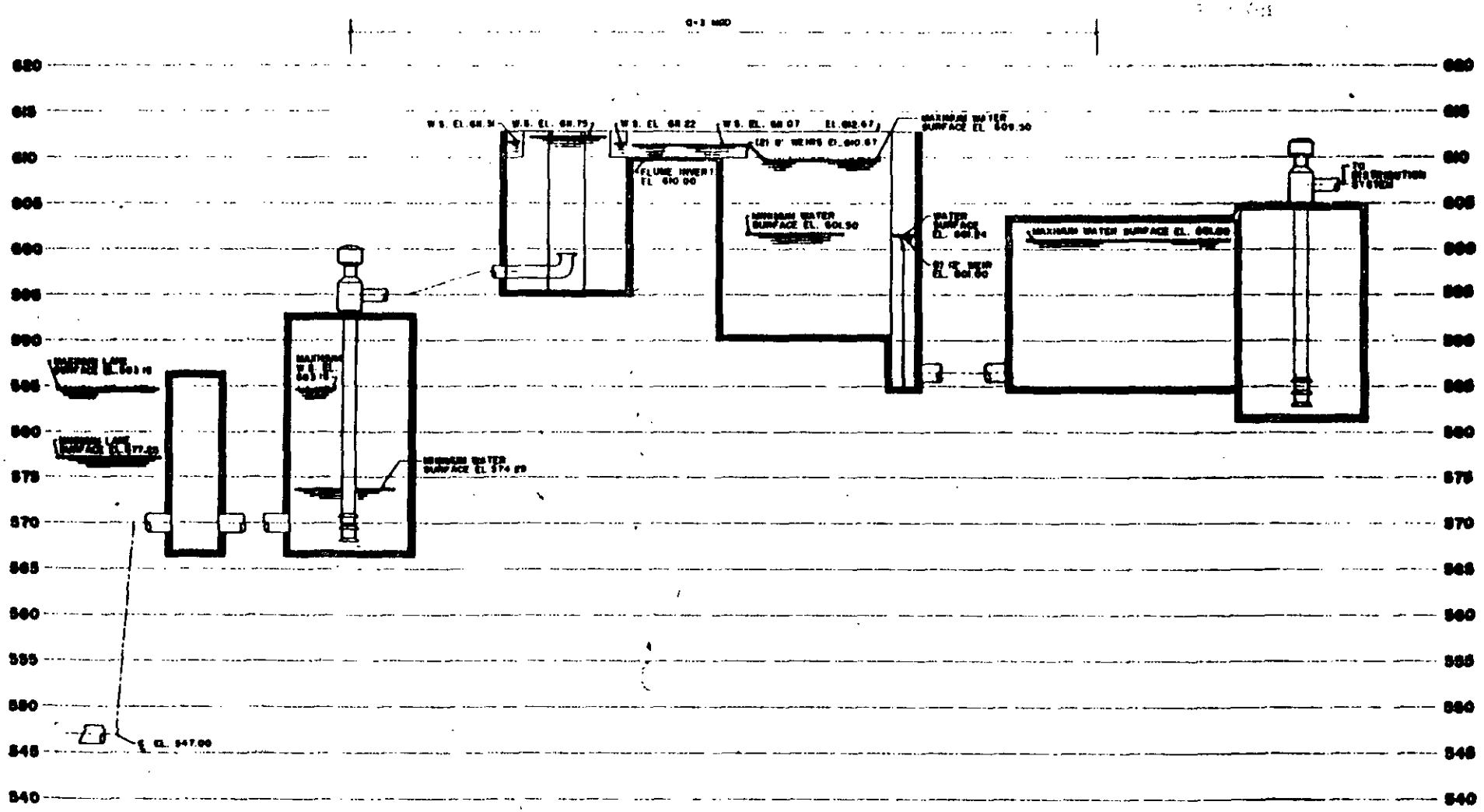
EXHIBIT A-1

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0083



APPENDIX B

Hydraulic Profile



HYDRAULIC PROFILE

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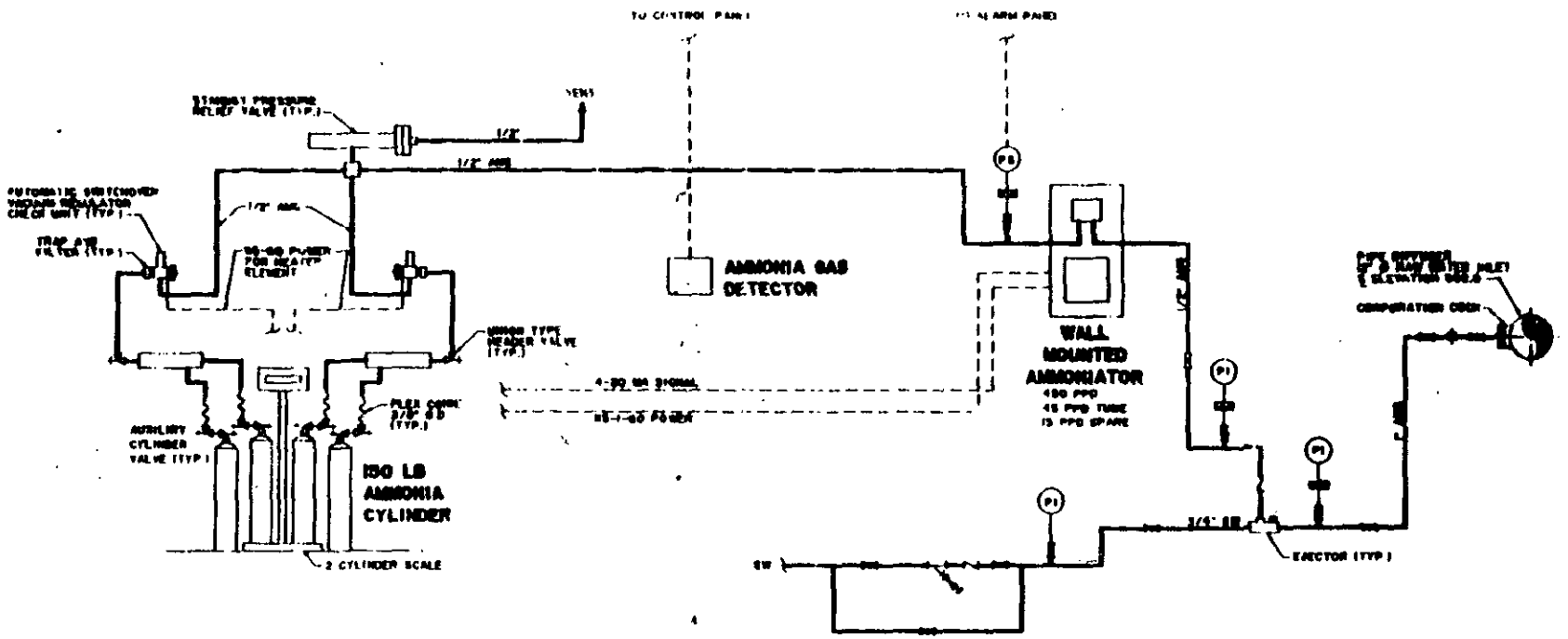
EXHIBIT B-1

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0063

APPENDIX C

Chemical System Schematics

1. Ammonia Schematic
2. Polymer Feed Schematic
3. Liquid Alum Feed Schematic
4. Chlorine Schematic
5. Fluoride Feed Schematic



AMMONIA SCHEMATIC

NAME
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N ARBOR, MICHIGAN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS

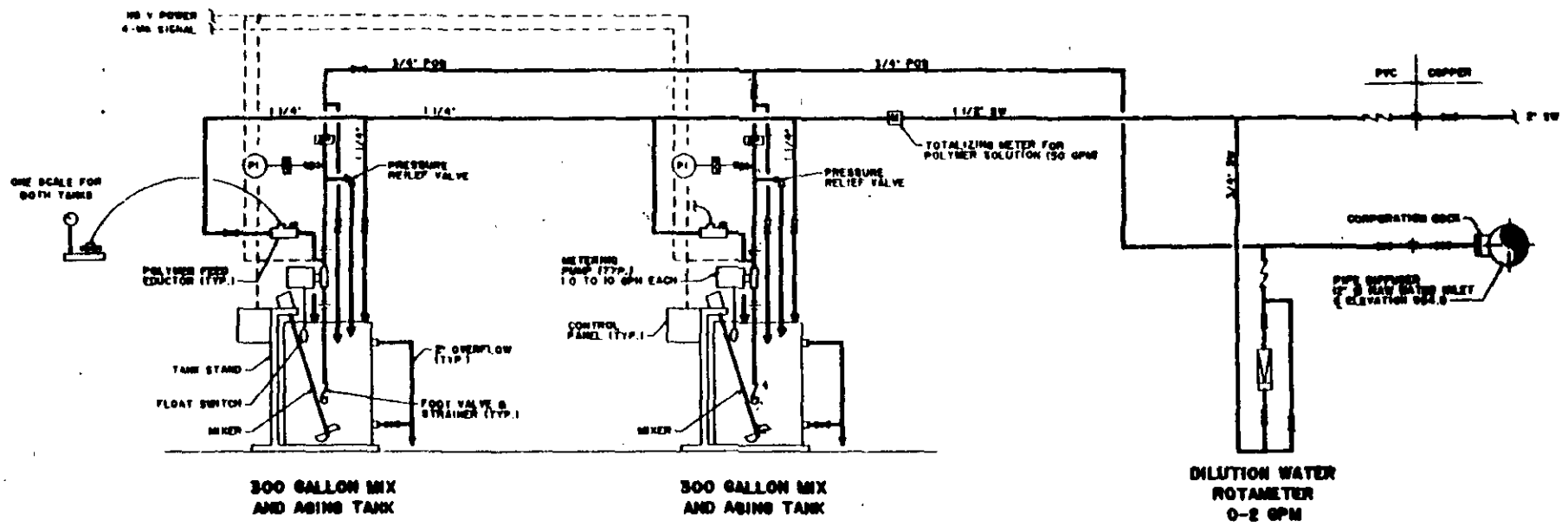
OMAHA, NEBRASKA

CHECK VALVE
BALL VALVE
WYE STRAINER
UNION

PI PRESSURE INDICATOR
PS PRESSURE SWITCH

EXHIBIT C-1

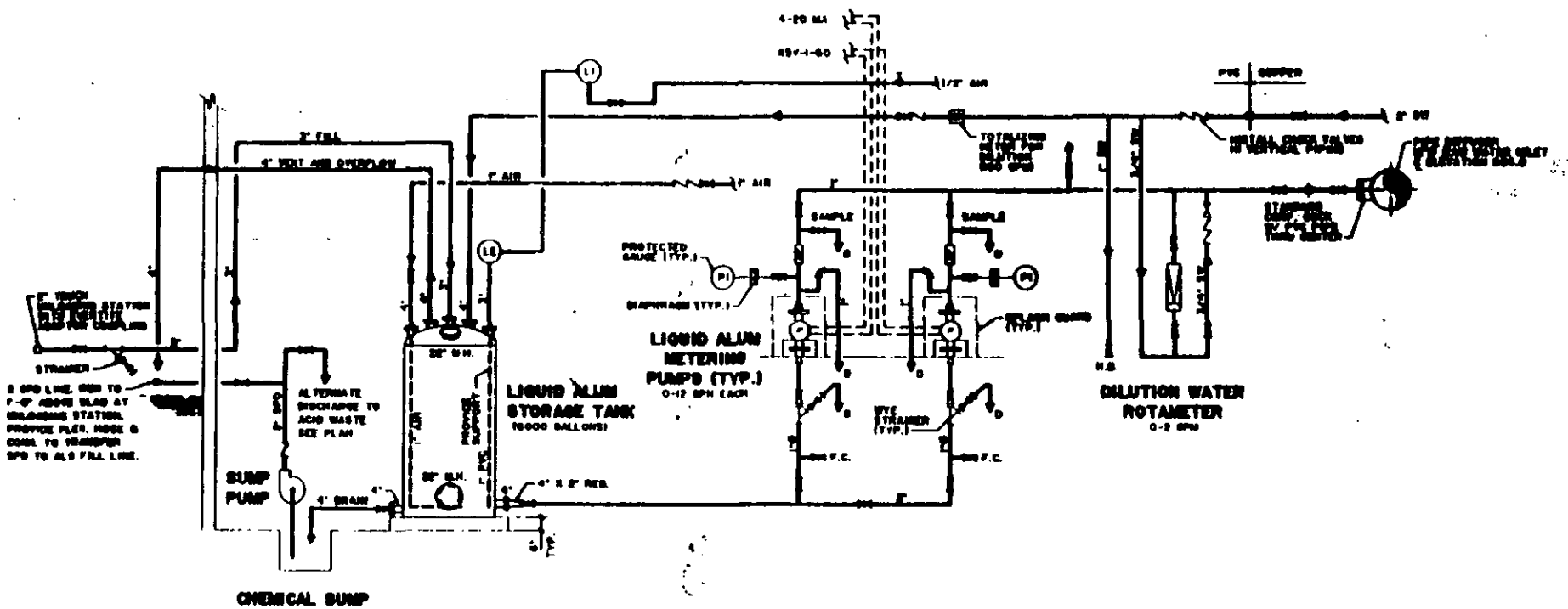
SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0083



POLYMER FEED SCHEMATIC

McNAMEE PORTER & SEELEY ENGINEERS ARCHITECTS ANN ARBOR, MICHIGAN	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA	CV CHECK VALVE BV BALL VALVE BP BACKPRESSURE VALVE UNION	PI PRESSURE INDICATOR	EXHIBIT C-2

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0065



LIQUID ALUM FEED SCHEMATIC

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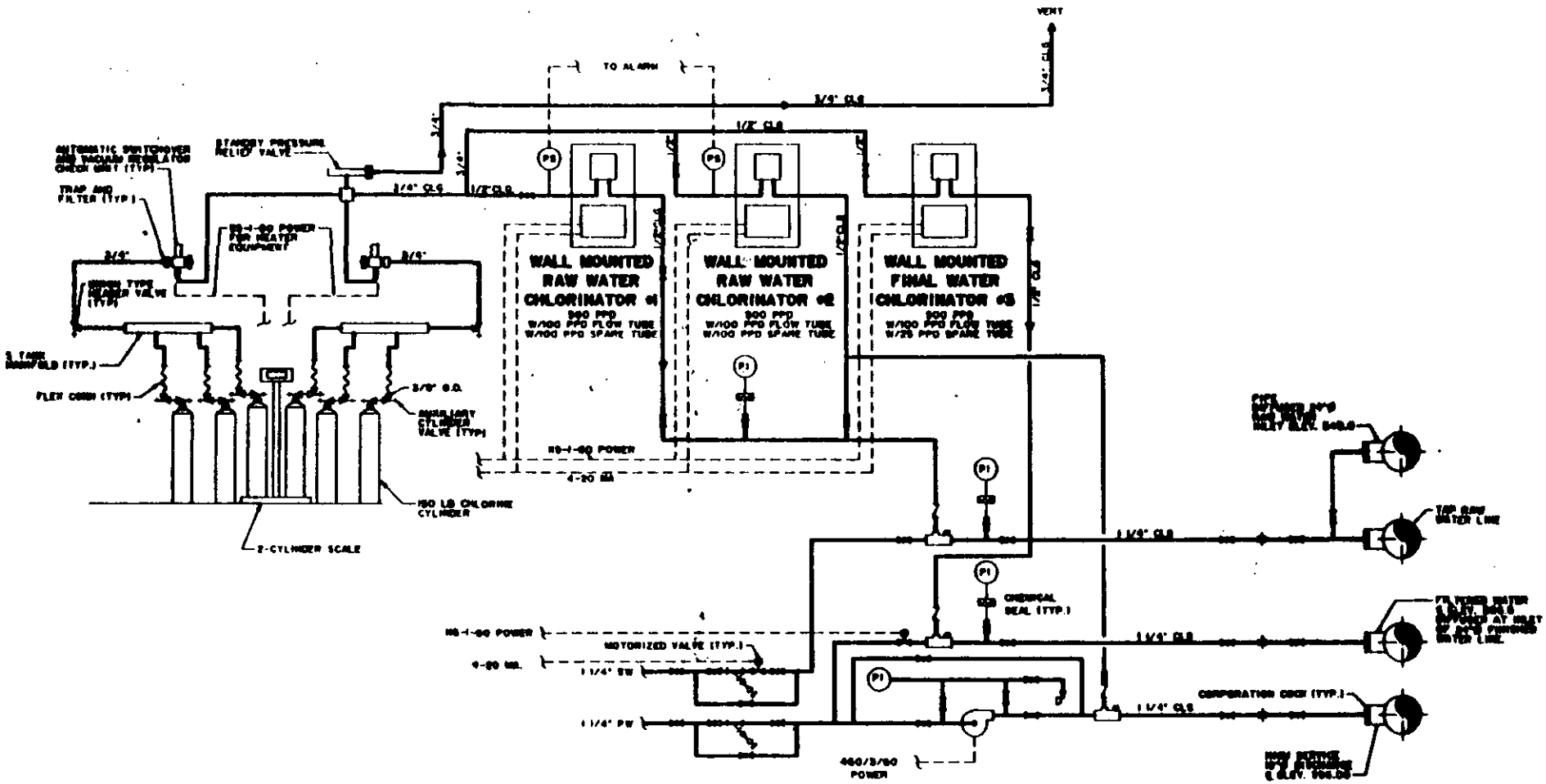
CORPS OF ENGINEERS
OMAHA, NEBRASKA

CHECK VALVE
BALL VALVE
UNION
AIRSET ASSEMBLY
PRESSURE RELIEF VALVE
BACKPRESSURE VALVE
PI PRESSURE INDICATOR

EXHIBIT C-3

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0053



CHLORINE SCHEMATIC

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U.S. ARMY ENGINEER DISTRICT
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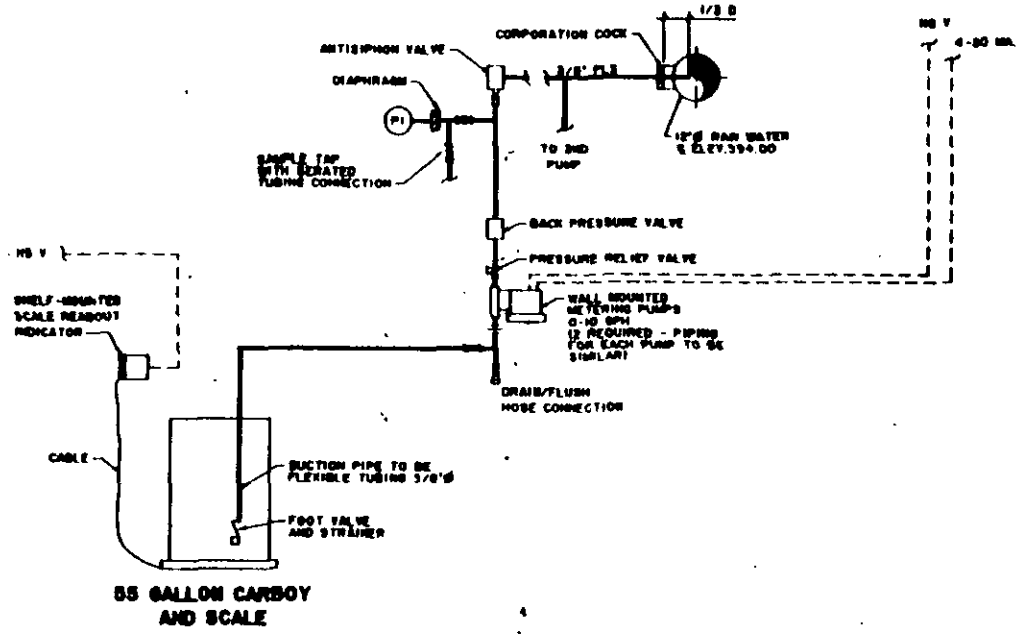
OMAHA, NEBRASKA

CHECK VALVE
BALL VALVE
WYE STRAINER
UNION

PI PRESSURE INDICATOR

EXHIBIT C-4

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0065



FLUORIDE FEED SCHEMATIC

EXHIBIT C-5	SUPERFUND SITE WATER FILTRATION PLANT CHARLEVOIX, MICHIGAN OPERATION AND MAINTENANCE MANUAL CONTRACT NO. DACW-45-84-C-0163

U.S. ARMY ENGINEER DISTRICT
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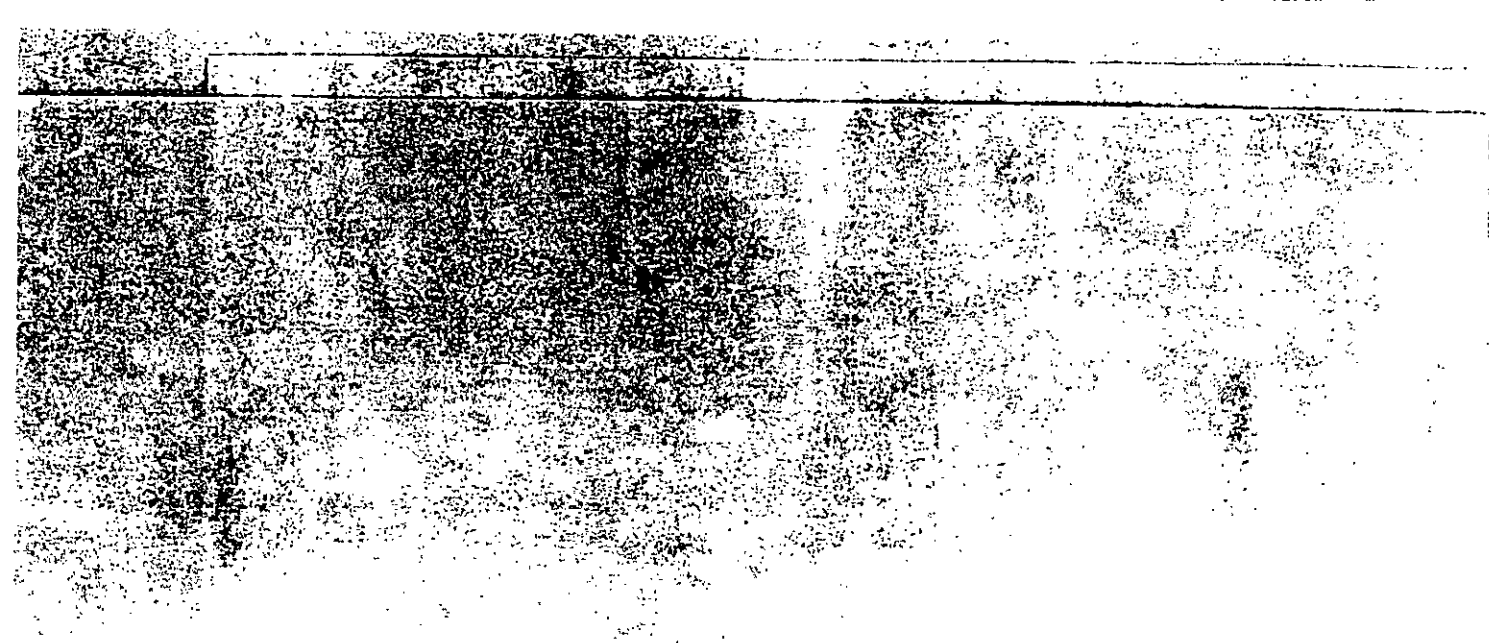
BV BALL VALVE
PI PRESSURE INDICATOR

NAMEE
RTER & SEELEY
GINEERS ARCHITECTS
N ARBOR, MICHIGAN

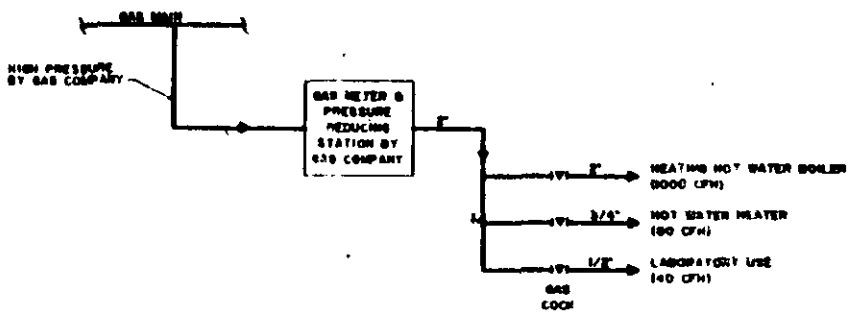


D

APPENDIX D

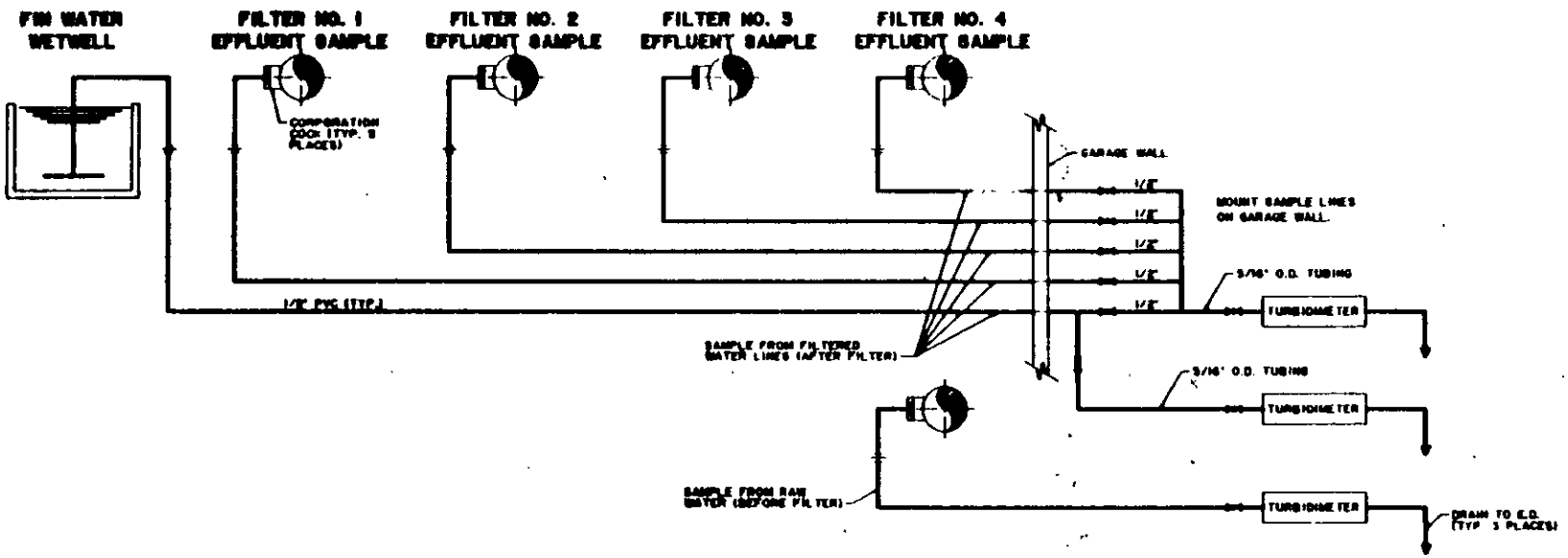
Mechanical System Schematics

1. Natural Gas Schematic
2. Turbidimeter Schematic
3. High Pressure Air Schematic
4. Potable and Service Water Schematic



NATURAL GAS SCHEMATIC

McNAMEE PORTER & SEELEY ENGINEERS ARCHITECTS ANN ARBOR, MICHIGAN	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS OMAHA, NEBRASKA	EXHIBIT D-1	SUPERFUND SITE WATER FILTRATION PLANT CHARLEVOIX, MICHIGAN OPERATION AND MAINTENANCE MANUAL CONTRACT NO. DACW-45-84-C-0063



TURBIDIMETER SCHEMATIC

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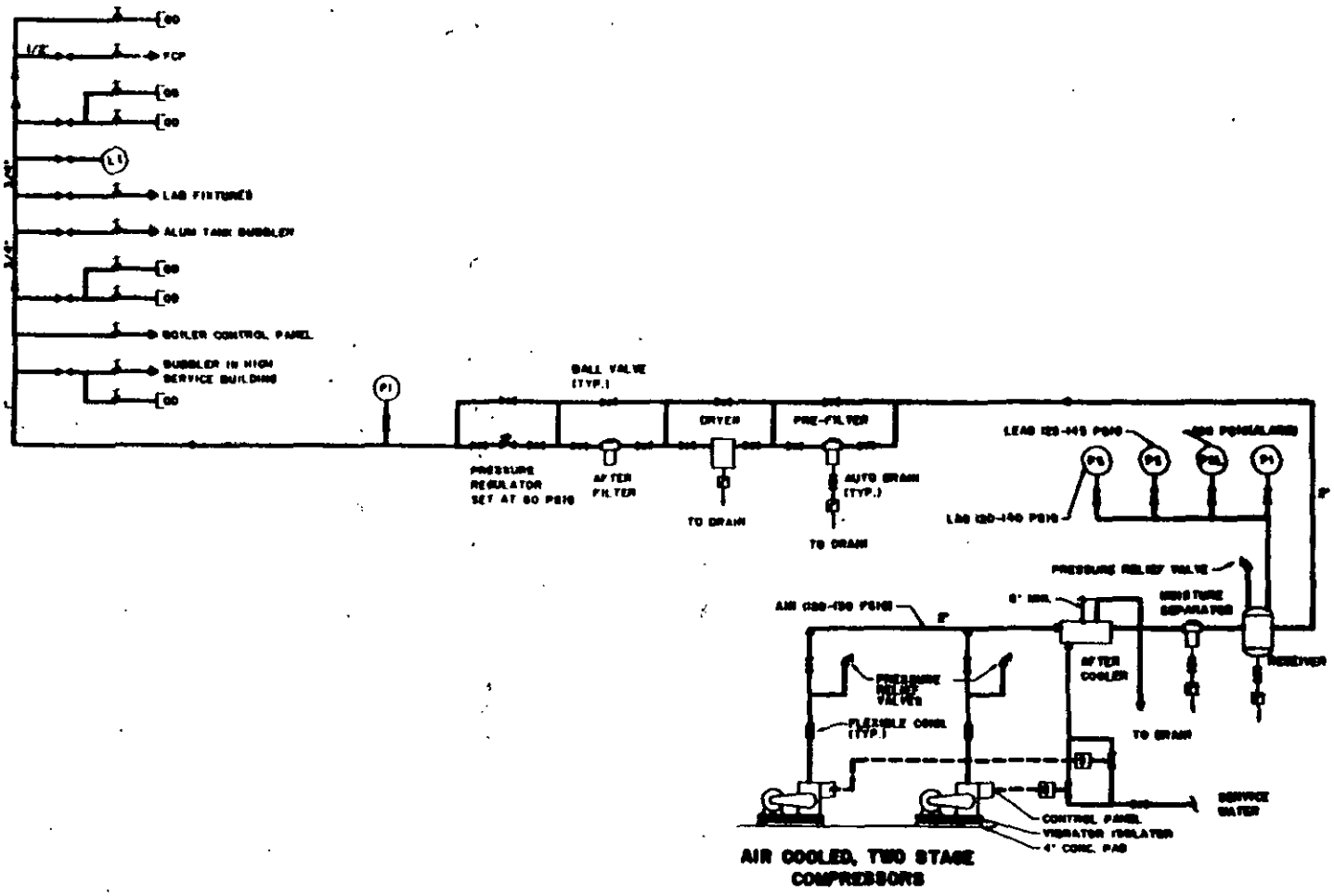
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

BALL VALVE
UNION

EXHIBIT D-2

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0163



AIR COOLED, TWO STAGE COMPRESSORS

HIGH PRESSURE AIR SCHEMATIC

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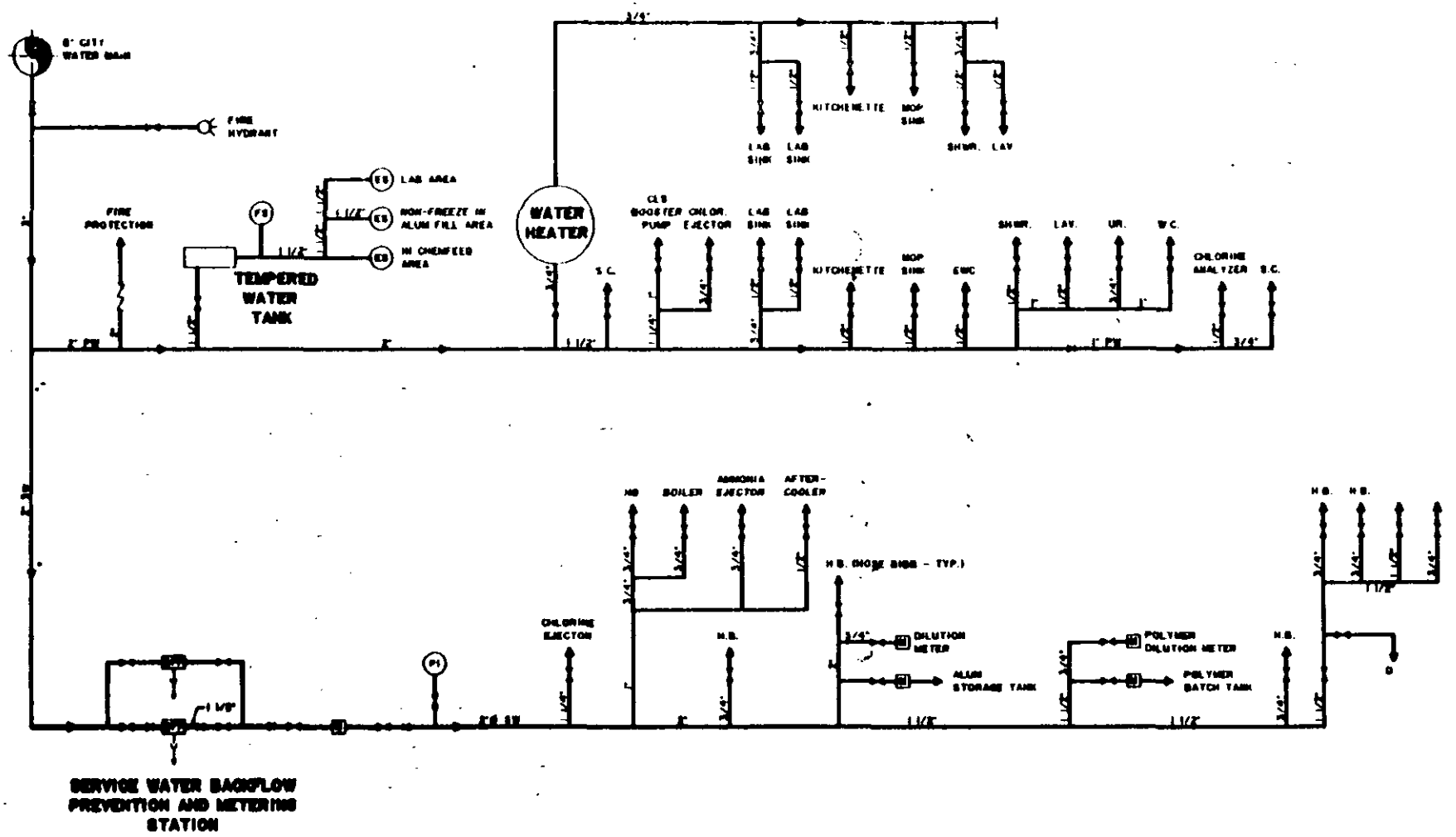
- RED — REDUCER
- GV — GATE VALVE
- AV — AIRVET ASSEMBLY
- S — SOLENOID
- QD — QUICK DISCONNECT
- PI — PRESSURE INDICATOR

EXHIBIT D-3

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0063



POTABLE AND SERVICE WATER SCHEMATIC

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OMAHA, NEBRASKA

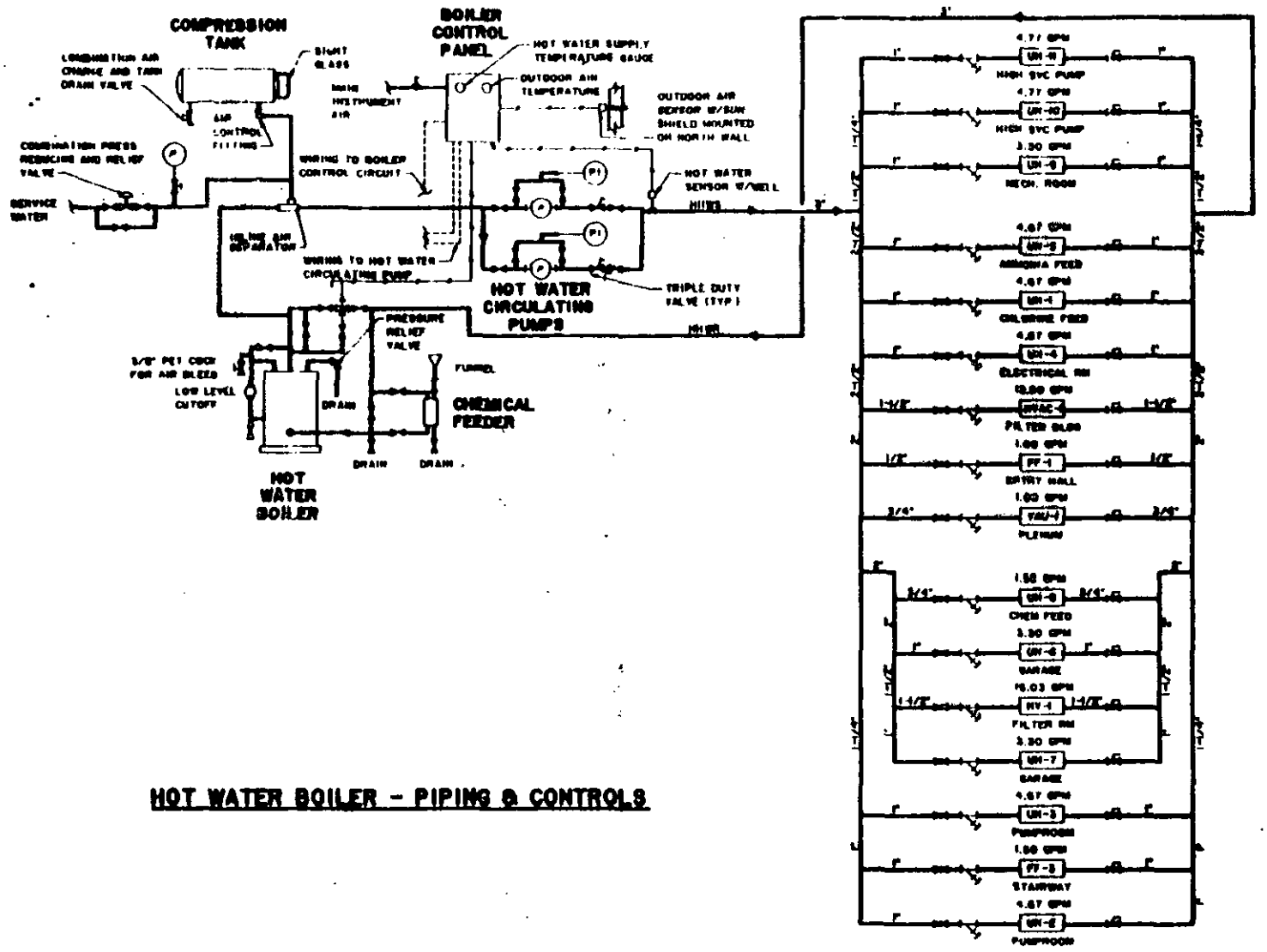
CHECK VALVE
GATE VALVE
REDUCER
BACKFLOW PREVENTER
METERING
H.B. HOSE BIBB
BALL VALVE
PRESSURE INDICATOR
EMERGENCY SHOWER
FLOW SWITCH
S.C. SILL COCK

EXHIBIT D-4

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0163

APPENDIX E

Hydronic Schematic



HOT WATER BOILER - PIPING & CONTROLS

HYDRONIC SCHEMATIC

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ANN ARBOR, MICHIGAN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

GATE VALVE
3 WAY VALVE
BALL VALVE

HELIXE PUMP
PRESSURE INDICATOR

EXHIBIT E-1

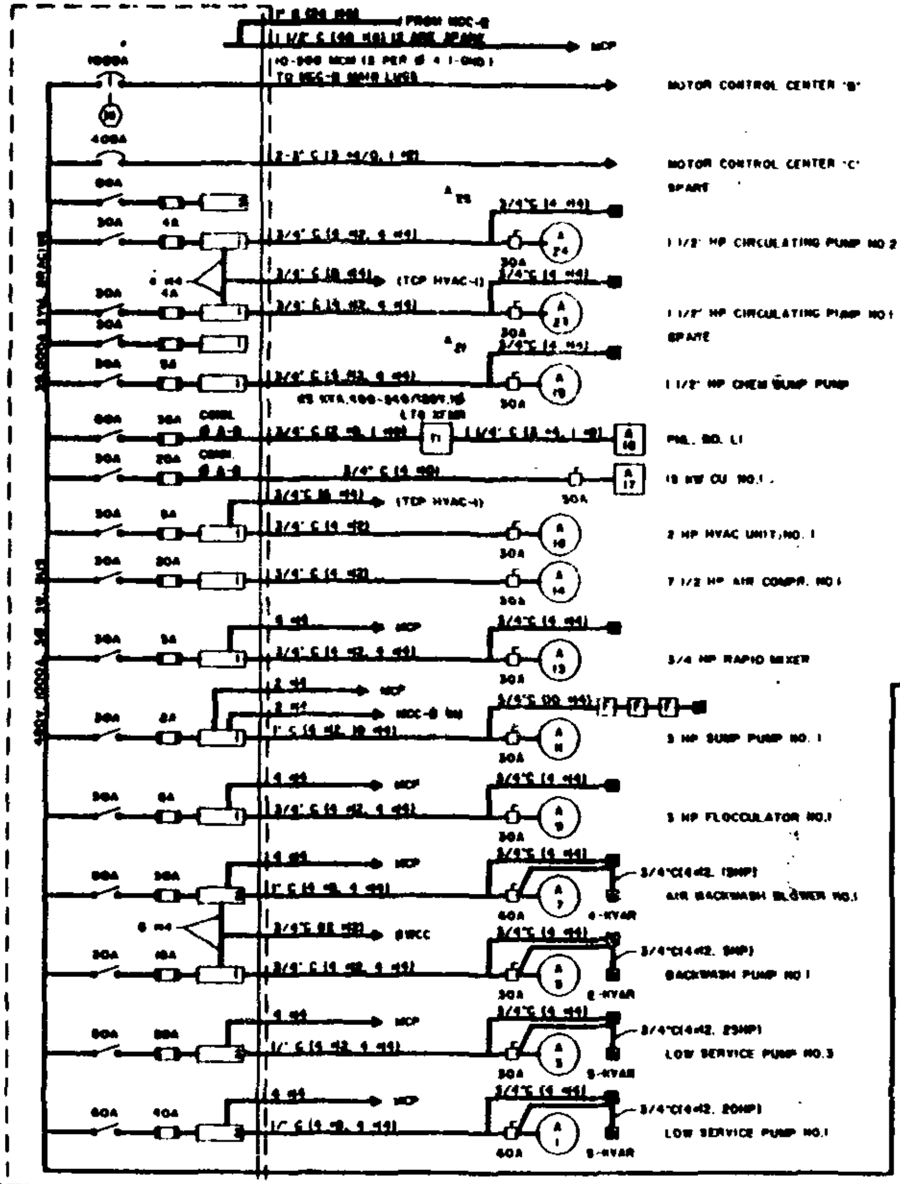
SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0165

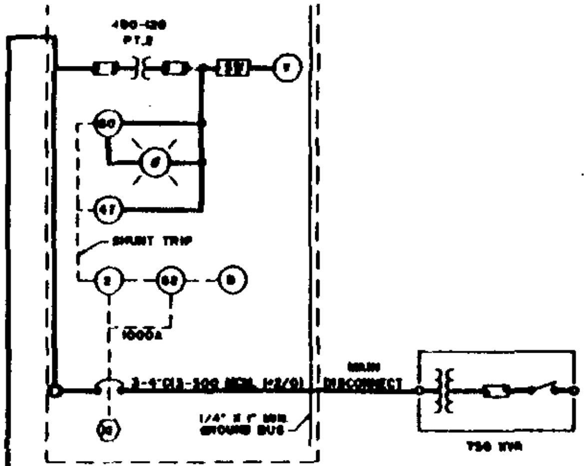
F

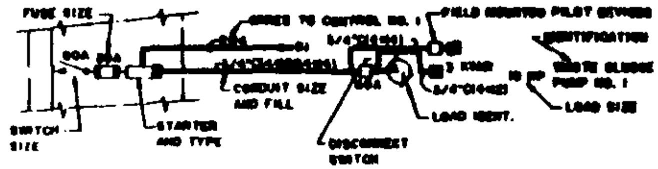
APPENDIX F

Electrical Diagrams

1. Motor Control Center A, One-Line Diagram
2. Motor Control Center B, One-Line Diagram
3. Motor Control Centers C & D, One-Line Diagram







M.C.C. LEGEND EXAMPLE

SYMBOL LEGEND	
RES	RESISTOR
PT	POTENTIAL TRANSFORMER
CT	CURRENT TRANSFORMER
A	AMMETER
V	VOLTMETER
AS	AMMETER SWITCH
VS	VOLTMETER SWITCH
PF	POWER FACTOR METER
W	WATTMETER
CS	CONTROL SWITCH
TI	TEMPERATURE INDICATOR
LI	LEVEL INDICATOR
AP	ALARM POINT
L.S.	LONG TIME-SHORT TIME
L.S.I.	LONG TIME,SHORT TIME,INST.
K	KEY INTERLOCK
CPT	CONTROL POWER TRANSFORMER
(3)	NUMBER OF DEVICES REQUIRED
G.F.I.	GROUND FAULT INTERRUPTER

RELAY LEGEND

DEVICE NO.	[illegible] OR EQUAL	WEST/CAT NO. OR EQUAL	DESCRIPTION
2	EAGLE SIGNAL AGASTAT OR EQUAL		D-C OPERATED TIME DELAY [illegible] SYNC. TIMER WITH 0-[illegible] SEC. RANGE
27	IAV-54	CV-[illegible]	SHORT TIME UNDERVOLTAGE
43	SB-1	W	SELECTOR SWITCH
47	ICR-[illegible]	CP	PHASE SEQUENCE & UNDERVOLTAGE
SS/CS	SB-1	W	SELECTOR SWITCH
60	[illegible]	CVQ	VOLTAGE BALANCE
AUX.P.S.	[illegible]		AUX. D-C POWER SUPPLY
62	EAGLE SIGNAL AGASTAT OR EQUAL		PNEUMATIC TIME DELAY
[illegible]	IAV-[illegible]	CV-[illegible]	SHORT TIME LOW PICK UP OVERVOLTAGE
[illegible]	SB-1	W	LOCKABLE CONTROL SWITCH
[illegible]	HFA	[illegible]	MULTI-CONTACT AUXILIARY
[illegible]	HEA	WL	MULTI-CONT. AUX. HAND RESET
[illegible]			[illegible] CONTROL RELAY CONNECT ACROSS [illegible]

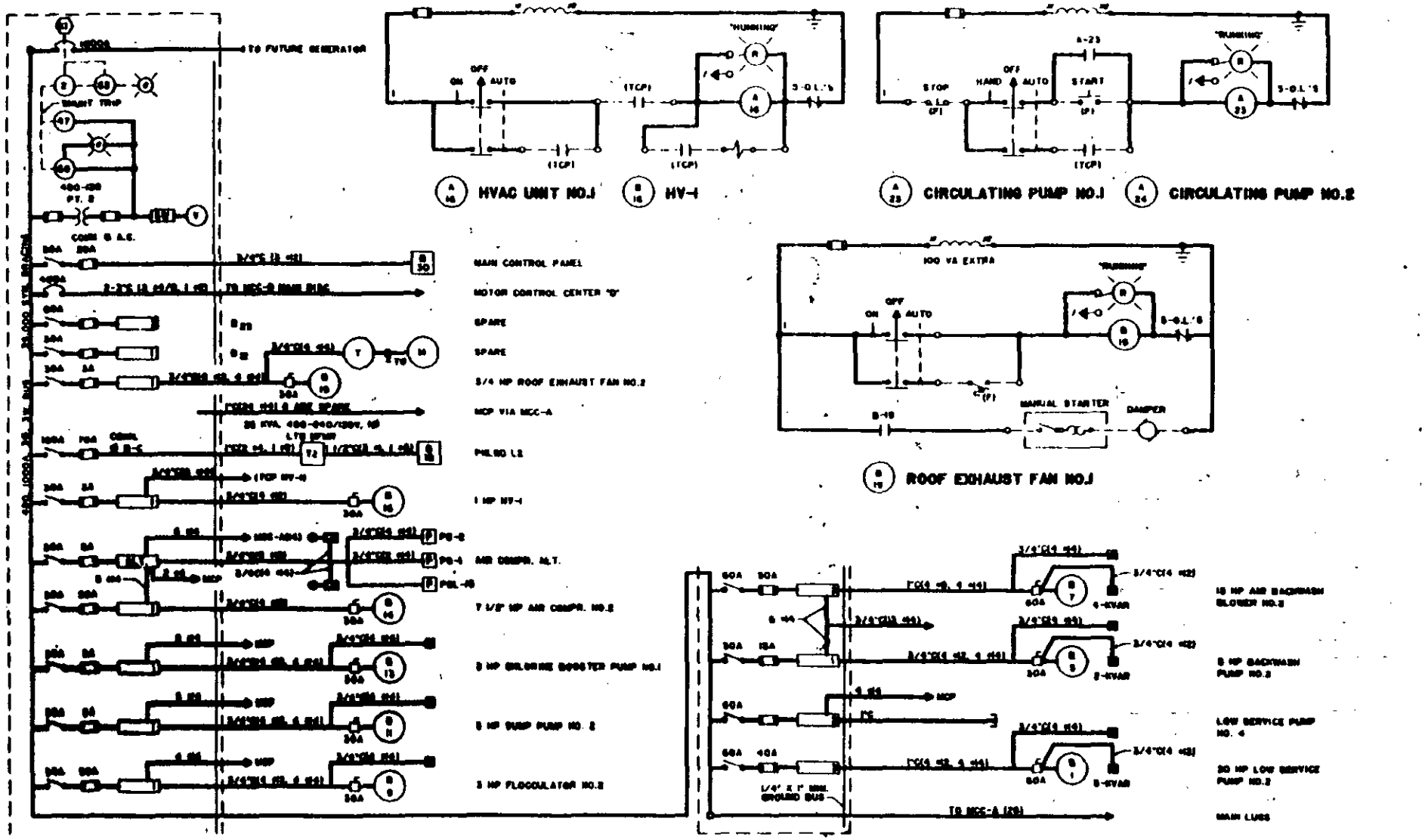
MOTOR CONTROL CENTER-A ONE LINE DIAGRAM

McNAMEE PORTER & SEELEY
ENGINEERS ARCHITECTS
ANN ARBOR, MICHIGAN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

EXHIBIT F-1

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0163



MOTOR CONTROL CENTER B-ONE LINE DIAGRAM

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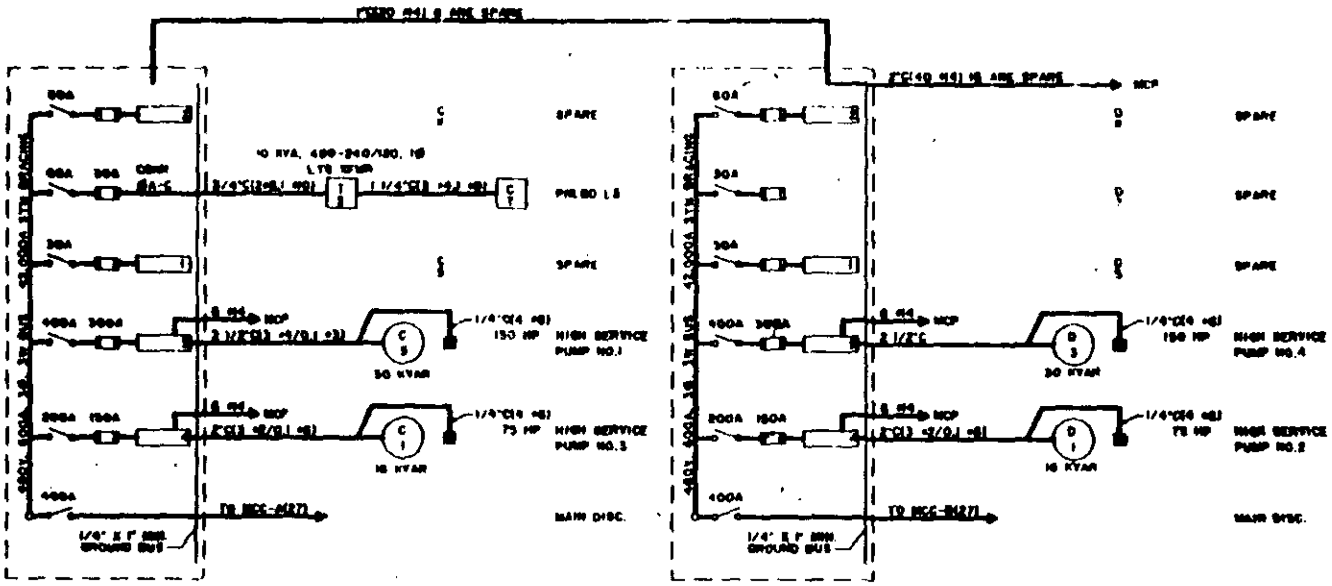
ENGINEERS ARCHITECTS
ANN ARBOR, MICHIGAN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

SEE LEGEND SHEET F-1

EXHIBIT F-2

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0163



MOTOR CONTROL CENTER C

MOTOR CONTROL CENTER D

PANEL SCHEDULE

FILTER BUILDING — SURFACE PANEL "L-F" — [illegible]

120/208,3Ø,4W. 125 AMP MAIN BREAKER 225 AMP BUS, 42 CIRCUITS

LOAD	P	CB AMP	CIR NO	PH	CIR NO	CB AMP	P	LOAD
LIGHTS PUMP ROOM	1	20	1	A	2	20	1	[illegible]
LIGHTS FILTER ROOM	1	20	3	B	4	20	1	TURBIDIMETERS
PUMP ROOM GFI C.B.	1	20	5	A	6	20	2	LIGHT CONTRACTOR & OUTDOOR LIGHTS & P.E. CONTROL
PUMP ROOM AND FILTER ROOM GFI C.B.	1	20	7	B	8			
GARAGE	1	20	9	A	10	15	1	DRINKING FOUNTAIN
MECH. ROOM	1	20	11	B	12	20	1	KITCHEN UNIT
CHLORINE AND AMMONIA ROOM	1	20	13	A	14	20	1	[illegible]
CREW ROOM	1	20	15	B	16	20	1	[illegible]
CREW ROOM	1	20	17	A	18	20	1	[illegible]
KITCHENETTE RANGE	2	50	19 / 21	B / A	20 / 22	50	2	WELDING OUTLET
LIH 5, EF 5 AMMONIA FEED ROOM	1	20	23	B	24	20	1	LIH 4, EF 3 ELEC. ROOM; EF 2 STAIR NO.102
LIH 1, EF 1 CHLORINE FEED ROOM; EF 4 ENTRY CORRIDOR	1	20	25	A	26	20	1	LIH 9 MECH. ROOM
LIH 6, EF 7 [illegible] FEED ROOM	1	20	27	B	28	20	1	LIH 8, EF 7 PUMP ROOM
LIH 6, LIH 7, EF 8 GARAGE	1	20	29	A	30	20	1	TOILET ROOM GFI C.B.
AIR COMPRESSOR DRYER	1	20	31	B	32	20	1	CHLORINE FEED PUMP, AMMONIA FEED PUMP, POLYMER MIXER
TEMP. CONTROL PANELS	1	20	33	A	34	20	1	POLYMER FEED PUMP, FLUORIDE FEED PUMP
FILTER ROOM GFI C.B.	1	20	35	B	36	20	1	ALUM FEED PUMP
SPARE	1	20	37	A	38	20	1	SPARE
SPARE	1	20	39	B	40	20	1	SPARE

PANEL SCHEDULE

SURFACE PANEL "L-H" HIGH SERVICE PUMP BUILDING

120/240,1Ø,3W,100 AMP MAIN BREAKER

LOAD	P	CB AMP	CIR NO	PH	CIR NO	CB AMP	P	LOAD
INTERIOR LIGHTS GFI C.B.	1	20	1	A	2	20	2	LIGHTING CONTRACTOR NO.2 OUTDOOR LIGHTS & P.E. CONTROL
UPPER LEVEL GFI C.B.	1	20	3	B	4			
LOWER LEVEL	1	20	5	A	6	20	1	UH 10, UH 11 UPPER LEVEL
SUMP PUMP	1	20	7	B	8	20	1	EF 9, EF 9 UPPER LEVEL
SPARE	1	20	9	A	10	20	1	FR 7 FLOW RATE PRIMARY EFF.
SPARE	1	20	11	B	12	20	1	SPARE

PANEL SCHEDULE

FILTER BUILDING — SURFACE PANEL "L-F" — CONTROL ROOM

120/240 1Ø,3W,100 AMP MAIN BREAKER

LOAD	P	CB AMP	CIR NO	PH	CIR NO	CB AMP	P	LOAD
LIGHTS, OFFICE, & LAB	1	20	1	A	2	20	1	[illegible]
ELEC. ROOM	1	20	3	B	4	20	1	CONTROL ROOM & LAB
OFFICE	1	20	5	A	6	20	1	EF 10 LAB HOOD EXHAUST
LAB EQUIPMENT	1	20	7	B	8	20	1	LAB EQUIPMENT
LAB EQUIPMENT	1	20	9	A	10	20	1	LAB AUTOCLAVE
LAB EQUIPMENT	1	20	11	B	12	20	1	LAB VACUUM PUMP
LAB EQUIPMENT	1	20	13	A	14	20	1	LAB EQUIPMENT
TELEPHONE	1	20	15	B	16	20	1	CHLORINE ANALYZER
BACKWASH CONTROL CABINET	1	20	17	A	18	20	1	BOILER
SPARE	1	20	19	B	20	20	1	SPARE
SPARE	1	20	21	A	22	20	1	SPARE

MOTOR CONTROL CENTER C & D—ONE LINE DIAGRAM

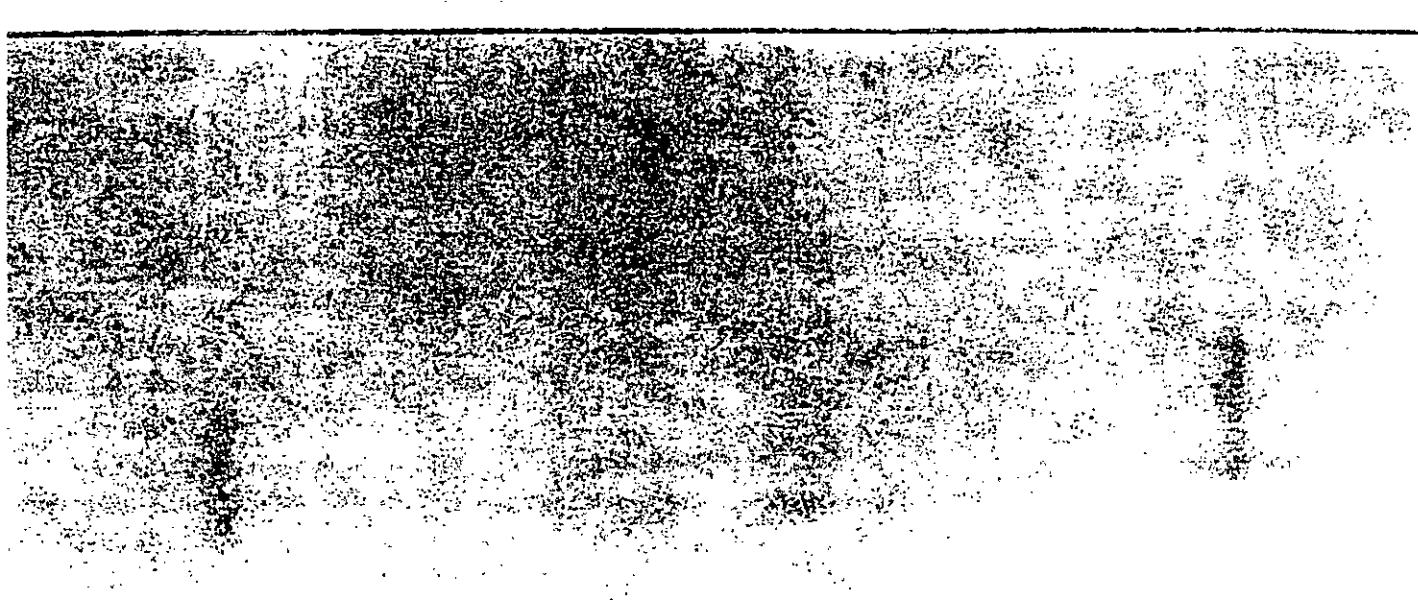
McNAMEE PORTER & SEELEY
ENGINEERS ARCHITECTS
ANN ARBOR, MICHIGAN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

SEE LEGEND SHEET F-1

EXHIBIT F-3

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0183



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APPENDIX G

Instrumentation

1. Instrumentation, One-Line Diagram
2. Instrumentation, Chemical System Diagram
3. Instrumentation, One-Line Diagram Legend

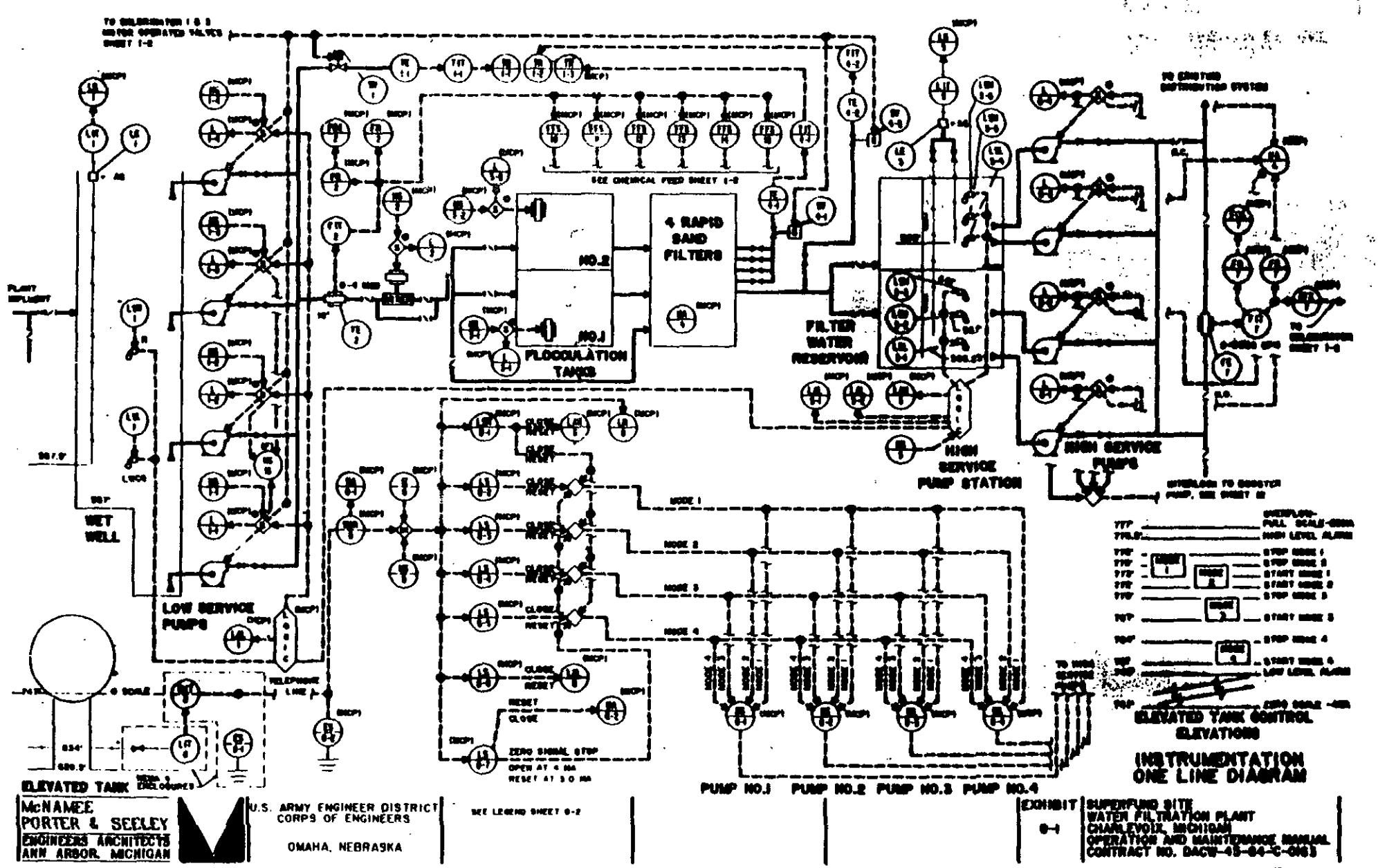

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EXHIBIT
6-1

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0163

FLOW DIAGRAM SYMBOL LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
------	ELECTRICAL SIGNAL	○	FIELD OR LOCALLY MOUNTED DEVICE
———	AIR LINE	R	RESET
———	HYDRAULIC SIGNAL	T	TRIP
~~	ELECTROMAGNETIC OR SONIC SIGNAL	AS	AIR SUPPLY
———	CONNECTION TO PROCESS, OR MECHANICAL LINK	DO	DISSOLVED OXYGEN
	AIR SET ASSEMBLY	GS	GAS SUPPLY
	GATE VALVE OR KNIFE GATE	HS	HYDRAULIC SUPPLY
	GLOBE VALVE	NS	NITROGEN SUPPLY
	BUTTERFLY VALVE, DAMPER OR LOUVER	ORP	OXYGEN REDUCTION POTENTIAL
	PARSHALL FLUME	SS	STEAM SUPPLY
	FLOW ORIFICE	SP	SET POINT
	VENTURI OR HIGBY FLOW TUBE	WS	WATER SUPPLY
◇	◇ INTERLOCKING ◈ EXCLUSIVE OR ◈ AND ◈ OR ◈	PV	PROCESS VARIABLE
◇	◇ ALTERNATOR ◇ MOTOR STARTER ◇ PURGE	F.O.	FAIL OPEN
		F.C.	FAIL CLOSE
		LWCO	LOW WATER CUT-OFF
▲	COMPUTER LOGIC SYSTEM	(MCP)	MAIN CONTROL PANEL
●	NOT FURNISHED BY INSTRUMENTATION	%	GAIN OR PROPORTIONAL CONTROL
	MOTOR	∫	INTEGRAL OR RESET CONTROL
	IN-LINE FLOW ELEMENT (ULTRA SONIC)	D	DERIVATIVE OR RATE CONTROL
	IN-LINE FLOW ELEMENT (PROPELLER TYPE)	V	VELOCITY ALGORITHM
	ROTAMETER	I-O	ON-OFF CONTROL
	TERMINAL OR TRANSITION POINT	√	SQUARE ROOT EXTRACTOR
	MOTOR	Σ	ADD OR TOTALIZE
	SOLENOID VALVE OPERATOR	-	SUBTRACT OR DIFFERENCE
	SOLENOID VALVE OPERATOR-DETENTED	>	HIGHEST MEASURED VARIABLE
	STROKE OR POSITION ACTUATOR CYLINDER (OPEN-SHUT & THROTTLING)	<	LOWEST MEASURED VARIABLE
		E/I , I/P	CONVERT ONE TO ANOTHER
⊖	BOARD OR PANEL MOUNTED DEVICE-(DASH LINE THRU CIRCLE INDICATES DEVICE MOUNTED BEHIND PANEL)	X , ÷	MULTIPLY , DIVIDE
		±	BIAS OR REVERSING
	MOTOR OPERATED (OPEN-SHUT & THROTTLING)	f(x)	CHARACTERIZE - (EQUATION /1/S/E/ETC.)

I.S.A. STANDARD LETTER FUNCTIONS

SYMBOL	FIRST LETTER	SUCCEEDING LETTERS
A	ANALYSIS , ANALOG	ALARM
B	BURNER , FLAME	BATCH
C	CONDUCTIVITY , COMMAND	CONTROL (FEEDBACK TYPE)
D	DENSITY , SPECIFIC GRAVITY	—
E	VOLTAGE	PRIMARY ELEMENT
F	FLOW RATE	RATIO
G	GAUGE	GLASS
H	HAND , MANUAL	HIGH
I	CURRENT	INDICATE
J	POWER	SCAN
K	TIME , TIME SCHEDULE	CONTROL (OR FEEDBACK)
L	LEVEL , LIGHT	LOW
M	MOISTURE , HUMIDITY	MIDDLE , MODULATE
N	—	—
O	OVERLOAD	ORIFICE
P	PRESSURE , VACUUM	POINT
Q	QUANTITY	TOTALIZE , INTEGRATE
R	RADIOACTIVITY	RECORD , PRINT , RECEIVE
S	SPEED , FREQUENCY , SAFEGUARD	SWITCH
T	TEMPERATURE , TURBIDITY	TRANSMIT , TRANSFORM
U	MULTIVARIABLE	MULTIFUNCTION
V	VIBRATION , VISCOSITY	VALVE , DAMPER , LOUVER
W	WEIGHT , FORCE	
X	—	—
Y	—	RELAY , COMPUTE
Z	POSITION	DRIVE , ACTUATE

INSTRUMENTATION ONE LINE DIAGRAM LEGEND

McNAMEE PORTER & SEELEY
ENGINEERS ARCHITECTS
ANN ARBOR, MICHIGAN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

EXHIBIT 8-3

SUPERFUND SITE
WATER FILTRATION PLANT
CHARLEVOIX, MICHIGAN
OPERATION AND MAINTENANCE MANUAL
CONTRACT NO. DACW-45-84-C-0053

APPENDIX H

Recommendations for the Storage and Handling of Liquid Alum

Allied Chemical

CUSTOMER ENGINEERING
TECHNICAL SERVICE
P.O. BOX 6, SOLVAY, N.Y. 13209
INDUSTRIAL CHEMICALS DIVISION

RECOMMENDATIONS FOR THE STORAGE AND HANDLING OF LIQUID ALUM

Introduction

The enclosed data covers the recommended equipment and piping for the storage and handling of Liquid Alum delivered in either tank cars or tank transports.

If further information is required, contact your nearest Industrial Chemicals Division Sales Representative or Customer Engineering directly at the above address.

Contents

DATA SHEET LA-1 - EQUIPMENT AND PIPING FOR LIQUID ALUM AT AMBIENT TEMPERATURES

A. PHYSICAL PROPERTIES

1. Description

Liquid alum, an aqueous solution of aluminum sulfate, $Al_2(SO_4)_3$ plus H_2O, is a very pale green liquid. The commercial strength 36.5° Baume', has 8.3% available Al_2O_3.

2. Physical Constants

Density (gm/cc) at 60°F	1.34
Density (lb/gal) at 60°F	11.2
Gallons/ton at 60°F	180
Viscosity (cp) at 32°F	52
Viscosity (cp) at 70°F	21
Boiling point (°F)	214
Freezing point (°F)	5

3. Conversion from Dry Alum

There are 5.4 pounds of dry alum (17% Al_2O_3) per gallon of liquid alum. Convert dry alum to liquid alum as follows:

$$\frac{\text{pounds dry basis}}{\text{5.4 pounds per gallon}} = \text{gallons liquid basis}$$

B. SHIPMENTS

1. Tank Car Delivery

Liquid alum is shipped in 8000 and 10000 gallon rubber lined steel tank cars. Minimum storage tank capacity for tank car delivery is 15000 gallons. (See paragraph B3.) Compressed air at 30 psig maximum is required to unload tank cars. The product outlet connection is a 2" standard Ever-Tite adapter; the air connection is a 3/4" or 1" standard Ever-Tite adapter. The customer's alum hose should have a 2" standard Ever-Tite coupler with dust plug; the air hose should have a 3/4" or 1" standard Ever-Tite coupler with dust plug.

B. SHIPMENTS - Continued

2. Tank Transport Delivery

Liquid alum is shipped in 5000 gallon stainless steel tank transports, except where individual state road weight allowances restrict shipments to smaller transports. Minimum storage tank capacity for tank transport delivery is 7500 gallons. (See paragraph B3.) Liquid alum transports are usually self-unloading by means of a pump mounted on the tractor. The unloading connections are shown in Drawing No. 35106.

3. Storage Tank Capacity

Liquid alum storage tanks should be sized either to conform with recommendations in paragraphs B1 and B2, or to hold at least ten days' requirements, whichever is larger.

C. STORAGE ARRANGEMENTS

1. Gravity System

Gravity flow to process is preferred. It eliminates initial pump cost and attendant maintenance.

2. Pump System

If a gravity system is not feasible, a pump, sized for head and flow requirements, should be installed to transfer alum to the process.

3. Air System

Pressurizing a storage tank containing a corrosive liquid, such as liquid alum, is not recommended.

4. Special Note

Liquid alum begins crystallizing near 30°F and freezes at about 5 °F. Storage tanks should be installed indoors or in a heated enclosure. Equipment installed outdoors should be provided with heating coils, electric heating cable tracing, and insulation to maintain a temperature above 45°F.

D. EQUIPMENT AND PIPING

1. Storage Tank

The storage tank should be sized as outlined in paragraph B. It should have an access manhole and nozzles, as shown in Drawings Nos. 35105 and 35106. Materials of construction include the following:

a. Fiberglas/epoxy, such as manufactured by Filament Structures Div., Amercoat Corporation, Ardmore, Oklahoma 73401; Owens-Corning Fiberglas Corporation, Toledo, Ohio 43601; Justin Enterprises, Inc., Fairfield, Ohio 45014; Jones & Hunt, Inc., Orwigsburg, Pennsylvania 17961; and others.

b. Rubber lined steel, as outlined in Drawing No. 49577, available through various tank lining fabricators, including B. F. Goodrich Company, Akron, Ohio 44318; Gates Engineering Div., Glidden Company, Wilmington, Delaware 19899; Atlas Minerals and Chemicals Div., Electric Storage Battery Company, Mertztown, Pennsylvania 19539; and others.

c. PVC (polyvinyl chloride) bag liners in a steel or wood stave tank. Suppliers of PVC bag liners include Johnson & Carlson, Chicago, Illinois 60622; Flexi-Liner Company, Pasadena, California 91101; and others.

2. Storage Tank Gauging

A pneumatic bubbler gauge, which measures the air pressure required to displace alum from a vertical tube in the tank, is recommended.

Typical pneumatic bubbler gauges are available from Petrometer Corporation, Long Island City, New York 11101; The Meriam Instrument Company, Cleveland, Ohio 44102; Uehling Instrument Co., Paterson, New Jersey 07509; and others.

3. Pumps and Measuring Equipment

a. Transfer Pumps: A centrifugal pump, with wetted parts of Alloy 20 or Type 316 stainless steel, sized for the total head and required flow, is recommended. Pumps should be connected directly to the motor, but should not be close coupled. Motor speeds over 1800 rpm should be avoided. Pumps operating at higher speeds will have shorter life, and will require more maintenance.

Typical pumps are available from The Duriron Co., Inc., Dayton, Ohio 45404; The LaBour Co., Inc., Elkhart, Indiana 46514; and others.

D. EQUIPMENT AND PIPING - Continued

3. Pumps and Measuring Equipment - Continued

b. Controlled Volume Pumps: A piston pump, with wetted parts of Alloy 20 or Type 316 stainless steel, or a diaphragm pump, with TFE diaphragms, is recommended.

Typical pumps are available from Lapp Insulator Co., Inc., LeRoy, New York 14482; Wallace & Tiernan Div., Pennwalt Corporation, Belleville, New Jersey 07109; and others.

c. Pump Packing: Graphited, lubricated asbestos, or TFE impregnated asbestos packings are recommended.

d. Rotameters: PVC (polyvinyl chloride) or Type 316 stainless steel rotameters, with Hastelloy C floats, are recommended. Suppliers include Brooks Instrument Div., Emerson Electric Co., Hatfield, Pennsylvania 19440; Schutte & Koerting Co., Cornwells Heights, Pennsylvania 19020; Fischer & Porter Co., Warminster, Pennsylvania 18974; Wallace & Tiernan Div., Pennwalt Corp., Belleville, New Jersey 07109; and others.

e. Mechanical Feeders: "Rotodip," such as manufactured by B-I-F Div., The New York Air Brake Co., Providence, Rhode Island 02901; and other mechanical feeders with wetted parts of Type 316 stainless steel or PVC (polyvinyl chloride), are recommended.

f. Head/Measuring Tanks: The same materials of construction as outlined for storage tanks, paragraph D1, are recommended. Head tanks are usually elevated with an overflow back to the storage tank, and are used to maintain constant pressure on rotameters or other similar measuring instruments. Measuring tanks are usually sized for a certain batch, and are equipped with a calibrated, visible sight gauge for filling.

4. Valves

a. Ball Valves: PVC (polyvinyl chloride) valves with TFE retaining rings are recommended. Suppliers include Interpace Corp., Parsippany, New Jersey 07054; Vanton Pump & Equipment Corp., Hillside, New Jersey 07205; and others.

b. Gate, Globe and Y Valves: Alloy 20 or Type 316 stainless steel valves, 150 lb ASA flanged, OS&Y, with TFE packing are recommended. Suppliers include The Duriron Co., Inc., Dayton, Ohio 45404; Aloyco Inc., subsidiary of Walworth Co., Linden, New Jersey 07036; and others.

D. Equipment and Piping - Continued

4. Valves - Continued

c. Plug Valves: Alloy 20 or Type 316 stainless steel valves, 150 lb ASA flanged with TFE sleeves, are recommended. Suppliers include The Duriron Co., Inc., Dayton, Ohio 45404; Continental Manufacturing Co., Cincinnati, Ohio 45242; and others.

d. Special Note: Valves should be installed with the stems positioned vertically upward or horizontally, but not downward.

5. Piping

a. Plastic Pipe: Schedule 80 PVC (polyvinyl chloride) normal impact, or PVDC (polyvinylidene chloride) pipe, with socket weld fittings, is recommended. Pipe should be adequately supported when installed.

b. Lead Pipe: Chemical lead pipe with 1/4" minimum wall thickness is recommended with 6% antimony lead, 125 lb flanges, or with lap joint or Van Stone connections.

c. Stainless Steel Pipe: Schedule 10 or Schedule 40 Type 316 stainless steel pipe, with all welded fittings, is recommended.

d. Special Note: Natural gum rubber hoses and semi-flexible polyethylene pipes, with PVC or Type 316 stainless steel inserts can be used, if they are suitable for the pressures involved.

PVC is the recommended piping material if it is adequately supported and temperatures do not exceed 120°F. For temperatures above 120°F, PVDC (150°F max.), lead, or stainless steel are recommended. Due to their high coefficient of expansion with temperature changes, PVC and PVDC should not be anchored at both ends of a piping run. The unloading line to the storage tank should be PVDC, lead, or stainless steel.

6. Gaskets

Red rubber or compressed asbestos gaskets, 1/16" thick, are recommended.

7. Painting

Exterior surfaces should be prepared by sandblasting or mechanical brushing, and then painted with a suitable PVC base paint, such as available from Mobil Chemical Co., Edison, New Jersey

Charlevoix O&M 08817.

E. SAFETY

Liquid alum is not a hazardous material. Its buffered acidic action is, in some instances, irritating when in contact with eyes, skin, or mucous membranes. Normal precautions should be employed to prevent spraying or splashing liquid alum, particularly when the material is hot. Face masks and protective clothing may be used to protect eyes and clothing. Liquid alum should be flushed immediately from the eyes and skin with copious amounts of water, since prolonged contact may be irritating.

F. CARE OF EQUIPMENT AND PIPING

The following information applies to rubber lined storage tanks and piping:

1. The temperature of liquid alum should preferably be kept below 110°F to insure long life of lining. The temperature should never exceed 140°F.

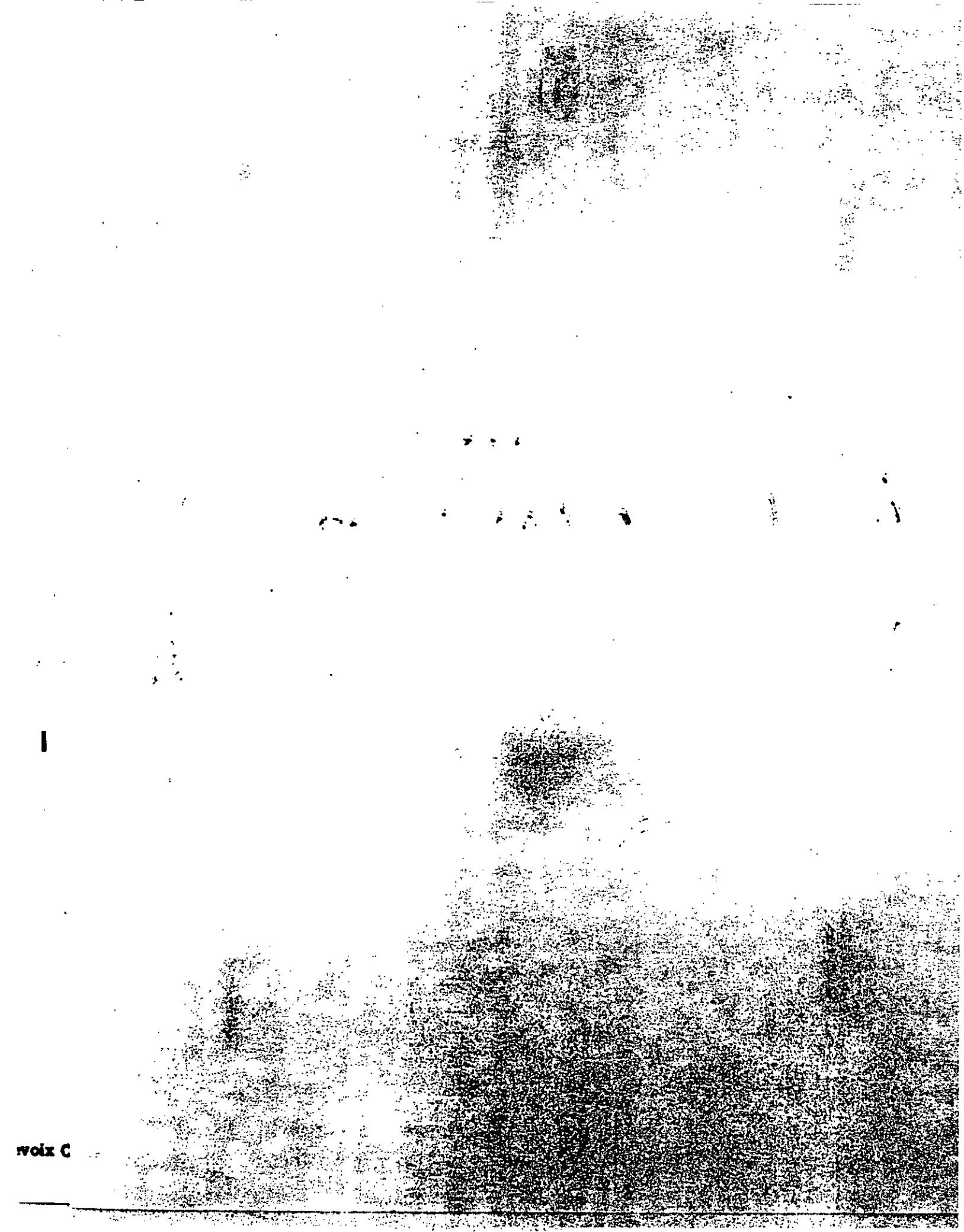
2. Equipment for rodding or entering a rubber lined tank should have no rough, gritty, or sharp edges, which could damage lining.

3. Foreign matter, such as nuts, bolts, or broken glass from a sampling bottle, should be removed immediately. The lining should then be checked for damage.

4. The rubber lining should never be subjected to organic solvents, such as oils, benzene, gasoline, etc. Strong caustics soften rubber linings.

5. All connections should have gaskets and should not be rubber lining-to-rubber lining joints. To prevent ultimate curing together or sticking, all gaskets must be graphited with fine dry graphite before the surfaces are brought together.

6. Use care in removing and replacing joints in order not to damage the lining. If any damage is noted, repair should be initiated immediately.



APPENDIX I

1. Metric System Reference
2. Glossary of Terms
3. Abbreviations (General)
4. Abbreviations (Instrumentation)

1. METRIC SYSTEM REFERENCE

There are three basic metric units and they are: meters which measure length; grams which measure weight (mass); and liters which measure volume or capacity. The metric system is based on the number 10 with prefixes to specify the multiple or fraction of the basic unit. The prefixes commonly used are:

Prefix	Multiplier	Prefix	Multiplier
mega, M	1,000,000	deci, d	0.1
kilo, k	1,000	centi, c	0.01
hecto, h	100	milli, m	0.001
deca, da	10	micro,	0.000001

CONVERSION FACTORS

English Unit	Symbol	English to Metric Multiply by	Metric to English Multiply by	Metric Units	Symbol
acre	ac	4046.9	0.00024711	square meters	m^2
acre - feet	acre-ft.	1233.5	0.0008107	cubic meters	m^3
cubic feet	cu. ft.	0.02832	35.315	cubic meters	m^3
cubic feet	cu. ft.	28.32	0.035315	liters	l
cubic feet/gallon	cu. ft./gal.	7.482	0.0001336	liters/cubic meter	l/m^3
cubic feet/pound	cu. ft./lb.	0.06243	16.02	cubic meters/kilogram	m^3/kg
cubic yard	cu. yd.	0.7646	1.308	cubic meters	m^3
feet	ft.	0.3048	3.281	meters	m
gallon	gal.	3.785	0.2642	liters	l
gallon	gal.	0.003785	264.2	cubic meters	m^3
gallon per day/sq. foot	gpd/sq. ft.	0.04074	24.55	cubic meter/sq. meter per day	$m^3/m^2 \cdot d$
gallon per minute	gpm	0.06308	15.85	liters per second	l/s
gallon per minute/sq. foot	gpm/sq. ft.	0.67902	1.473	liters/sq. meter per second	$l/m^2 \cdot s$
pound	lb.	0.4536	2.205	kilograms	kg
pounds/1,000 cubic feet	lb./1,000 sq. ft.	16.02	0.06243	grams/cubic meter	g/m^3
pound/day/cubic foot	lb./day/cu. ft.	16.02	0.06243	kilograms/cu. meter per day	$kg/m^3 \cdot d$
pound/million gallon	lb./mil. gal.	0.1198	8.344	grams/cubic meter	g/m^3
million gallon	mil. gal.	3785.0	0.0002642	cubic meters	m^3
million gallons/day	mgd	3785.0	0.0002642	cubic meters/day	m^3/day
million gallons/day	mgd	0.0438	22.83	cubic meters/second	m^3/s
pounds/cubic foot	pcf	16.02	0.06243	kilograms/cubic meter	kg/m^3
pounds/square foot	psf	4.882	0.2048	kilograms/square meter	kg/m^2
pounds/square inch	psi	0.0703	14.22	kilograms force/sq. centimeter	$kg\ f/cm^2$
square feet	sq. ft.	0.0929	10.76	square meter	m^2
square inch	sq. in.	645.2	0.00155	square millimeter	mm^2

RECOMMENDED UNITS OF EXPRESSION

Description	English Unit	Metric Unit
Water Flow	gallons per day, cubic feet per second million gallons per day gallons per minute	 cubic meters per second cubic meters per day liters per second
Hydraulic Loading	gallons per day per square foot of surface area	cubic meters per day per square meter of surface area
Volume	million gallons, cubic feet, or gallons	cubic meters or liters

2. GLOSSARY OF TERMS

Absorption. The taking up of one substance into the body of another.

Adsorption. The adherence of a gas, liquid, or dissolved material on the surface or interface zone of another substance.

Aeration. The bringing about of intimate contact between air and a liquid by one or more of the following methods: (a) spraying the liquid in the air; (b) bubbling air through the liquid; and (c) agitating the liquid to promote surface absorption of air.

Aerobic. (1) A condition in which "free" or dissolved oxygen (O_2) is present. (2) Requiring, or not destroyed by, the presence of free oxygen.

Alkalinity. Buffering, or acid neutralizing, capacity of water due primarily to its carbonate, bicarbonate, and hydroxide content.

Ambient Temperature. Temperature of the surroundings.

Anaerobic. (1) A condition in which "free" or dissolved oxygen (O_2) is not present. (2) Requiring, or not destroyed by, the absence of free oxygen.

Available Oxygen. The quantity of dissolved oxygen available for oxidation of organic matter in a water body.

Bacteria. Single celled microorganisms of primary importance in most biological wastewater treatment processes.

Batch Reactor. Reactor in which flow is neither entering nor leaving on a continuous basis.

Bioassay. Estimating the toxicity of an effluent by testing its effect on living organisms.

Biodegradation. The destruction or mineralization of organic materials by microorganisms.

Biological Examinations. A microscopic survey of the types of microorganisms present in a sample.

Bypass. A pipe or conduit which permits water to be moved around a water treatment plant or any unit of the plant. This is usually found in plants and is utilized to prevent flooding of units, or in case of shutdown for repair work, flow can be moved to parallel units.

Catalyst. A substance that speeds up a chemical reaction without being altered itself.

Chemical Oxygen Demand (COD). A measure of the oxygen-consuming capacity of inorganic and organic matter present in wastewater. It is expressed as the equivalent amount of oxygen required as determined using a chemical oxidant in a standard test. It does not differentiate between stable and unstable organic material and thus does not necessarily correlate with biochemical oxygen demand (BOD).

Chlorination. The application of chlorine or chlorine compounds to water or wastewater, usually for disinfection, but frequently to obtain other biological or chemical results.

Chlorine Contact Chamber. A detention basin where chlorine which has been diffused through the treated effluent is being held a required time to provide the necessary disinfection.

Chlorine Demand. The difference between the amount of chlorine added to the water and the amount of residual chlorine remaining at the end of a specific contact time. The chlorine demand for given water varies with the amount of chlorine applied, time of contact, temperature, pH, and the nature and amount of impurities in the water.

Ciliate. A type of protozoan characterized by short, filamentous cilia used for mobility and/or capturing food.

Coagulation. The clustering of suspended solids into larger particles or flocs caused by the addition of a chemical (coagulant) or by biological processes. The coagulant is usually ferric chloride or alum.

COD. See Chemical Oxygen Demand.

Coliform-Group Bacteria. A group of bacteria found in the intestines of man which are used as indicators of fecal pollution and the presence of pathogenic bacteria in water.

Colloids. Finely divided, non-settleable solids which may be removed by coagulation or biochemical action.

Combined Available Residual Chlorine. That portion of the total residual chlorine remaining in water at the end of a specified contact period which will react chemically and biologically as chloramines, or organic chloramines.

Combined Residual Chlorination. The application of chlorine to water in an amount to produce directly or through the distribution of ammonia, or of certain organic nitrogenous compounds, a combined chlorine residual.

Composite Samples. Samples collected at regular intervals, sometimes in proportion to the existing flow, and then combined to form a sample representative of flow over a period of time.

Concentration. (1) The amount of a given substance dissolved or suspended in a unit volume of solution. (2) The process of increasing the solids per unit volume in a liquid.

Cytoplasm. Contents of a biological cell excluding the nucleus.

Degradation. The conversion of a substance to simpler compounds.

Density. Mass per unit volume of any substance.

Design Parameters. Various criteria used to determine size, shape, quantity, and/or methods in the design of units and processes in a treatment plant.

Detention Time. The time required to fill a tank at a given flow or the theoretical time required for a given flow of wastewater to pass through a tank (volume divided by flow rate).

Dewater. To extract a portion of the water present in sludge or slurry.

Diffuser. A device (porous plate, tube, bag) used to break the air or carbon dioxide stream from a blower system into fine bubbles in a liquid.

Disinfection. The process by which pathogenic (disease-causing) microorganisms are killed. Chlorination is the most frequently used method in wastewater treatment.

Dissolved Oxygen (DO). Molecular or "free" oxygen (O_2) dissolved in water.

Dissolved Solids. Very small, non-settling particles defined by the method of measurement.

Diurnal Flow. Flow that shows marked and regular variations through the course of a day.

DO. See Dissolved Oxygen.

Dry Suspended Solids. The weight of the suspended matter in water or other liquid after drying for one hour at 103°C.

Ecology. The branch of biology dealing with the relationships between organisms and their environment.

Effluent. Water or liquid - raw, partially or completely treated; flowing from a basin, treatment process, or treatment plant.

Enzymes. Substances produced by living organisms that speed up chemical changes.

Endogenous Respiration. Utilization of internal cellular material as food under aerobic conditions when an adequate external food supply is unavailable.

Floc. Groups or "clumps" that have come together and formed a small gelantinous mass. Found in flocculation tanks and clarifiers.

Flocculation. An action resulting in the gathering of fine particles to form larger particles.

Grab Sample. A single sample of water taken all at one time from one place.

Head. A term used in expressing the pressure or energy of fluids in terms of the height of a vertical column of water.

Head Loss. Energy lost, expressed in head, from flowing fluids due to friction and turbulence.

Heterotrophic. A term describing organisms which use organics as the source of cell carbon.

High-Rate Filter. A filter operated at a high average daily dosing rate, usually between 2.4 and 4.0 gallons per square foot per minute.

Hydraulic Detention Time. The theoretical time required to displace the contents of a tank or unit at a given discharge rate (volume of tank divided by discharge rate).

Influent. Water or other liquid (raw or partially treated) flowing into a reservoir, basin, treatment process or treatment plant.

Low-Rate Filter. A filter designed to be operated with a hydraulic load of 1.8 to 2.4 gpm/sq.ft. of filter surface. Also called standard-rate filter.

Mechanical Aeration. A class of processes by which the surface of an aeration tank is mechanically agitated to cause spray or wave resulting in aeration of the liquid.

Metabolism. The life process in which food is utilized.

Micronutrients. Inorganic nutrients required in only trace amounts.

Microorganism. Very small organisms that can be seen only through a microscope.

Motile. Capable of movement.

Nematode. Unsegmented worm.

Nitrification. The biochemical conversion of unoxidized nitrogen (ammonia and organic nitrogen) to oxidized nitrogen and phosphorus.

Nutrients. Elements which are needed to support living cells such as carbon, hydrogen, oxygen, nitrogen and phosphorus.

Organic Matter. High energy carbon compounds, usually from plant or animal sources, but sometimes synthetic.

Overflow Rate. One of the criteria for the design of settling tanks in treatment plants; expressed in gallons per day per sq. ft. of surface area in the settling tank.

Oxygen Uptake Rate. The rate at which oxygen is transferred to water under aeration.

Parshall Flume. A device which measures the critical depth to determine flow.

Peak Load. The maximum rate of flow to a water treatment plant.

pH. An expression of the intensity of the alkaline or acidic strength of a water.

Photosynthesis. The use of sunlight to obtain the energy necessary to synthesize new cell material.

Pin Floc. Very fine floc particles with poor settling characteristics.

Plain Sedimentation. Sedimentation without the aid of chemicals.

Plug Flow Reactor. Idealized continuous flow reactor in which fluid particles are discharged in the same order in which they entered.

Postchlorination. Application of chlorine to the final treated water or effluent following plant treatment.

Preaeration. A preparatory treatment of water consisting of aeration to remove gases, add oxygen, and aid coagulatin.

Prechlorination. Chlorination at the headworks of the plant; influent chlorination prior to plant treatment.

Pretreatment. The use of racks, screens, and grit removal devices to remove metal, rocks, sand, and similar materials which may hinder the operation of a treatment plant.

Primary Treatment. The first phase of water treatment, consisting of separating the readily settleable solids by sedimentation.

Photoplasm. The material of a living cell.

Protozoa. Animal-like microorganisms.

Raw Water. Water before it receives any treatment.

Reactor. Any vessel in which a chemical or physical reaction takes place.

Recirculation Rate. The rate of return of part of the effluent from a treatment process to the incoming flow.

Respiration. The process by which a cell takes up oxygen and gives off the carbon dioxide formed in energy-producing reactions.

Rotifer. A small, multi-celled animal that gets its name from the rotating action of rows of cilia near its mouth.

Sedimentation. The process of settling suspended solids by gravity.

Settleable Matter. See Settleable Solids.

Settleable Solids. That matter in water which will not stay in suspension during a preselected settling period, either settling to the bottom or floating to the top.

Settled Water. Water from which most of the settleable solids have been removed by sedimentation.

Side Water Depth (SWD). The depth of water measured along a vertical exterior wall.

Sludge. The solids separated from liquids during processing.

Sludge Blanket. A layer of sludge suspended within an enclosed body of water, such as a settling tank.

Solids Loading. The weight or mass of solids applied to a treatment process per unit time.

Soluble. Capable of dissolving readily.

Stablization. Conversion to a form that resists change.

Stage. A process which is followed or preceded by a similar process.

Standard-Rate Filter. See Low-Rate Filter.

Supernatant. Liquid removed from settled sludge.

Suspended Matter. See Suspended Solids.

Suspended Solids (SS). Solids that either float on the surface of, or are in suspension in, water or other liquids, and which are largely removable by laboratory filtering.

Synthesis. The creation of new material from elementary building blocks.

Toxicity. The ability to poison organisms.

Turbidity. Cloudiness of water due to suspended solids.

Virus. The smallest form capable of producing diseases in man or other higher organisms.

Volatile Matter. See Volatile Solids.

Volatile Solids. Defined by testing method (see Standard Method), but may be roughly defined as combustible solids.

Wet Well (or Pump Well). A compartment in which a liquid is collected and held for flow equalization and then pumped through the plant.

Zooglea. A jelly-like coating developed by bacteria.

3. ABBREVIATIONS (GENERAL)

A	Amps
Btu	British thermal unit
Btuh	British thermal unit per hour
CF, cu.ft.	Cubic Feet
CFM, cfm	Cubic Feet per Minute
CFS, cfs	Cubic Feet per Second
CI	Cast Iron (pipe)
CY, cu.yd.	Cubic Yard
°C	Degrees Centrigrade
°F	Degrees Fahrenheit
D.I.	Ductile Iron (pipe)
D.O.	Dissolved Oxygen
EPA	Environmental Protection Agency
FT, ft.	Feet
fps	feet per second
FRP	Fiberglass Reinforced Polyester
gpcd	gallons per capita per day
GPD, gpd	Gallons per Day
GPH, gph	Gallons per Hour
GPM, gpm	Gallons per Minute (694 gpm = 1 mgd)
H-O-A	Hand-Off-Automatic
HP, Hp	Horsepower
HR, hr	Hour
Hz	Hertz (cycles per second)
IN, in.	Inches
LB, lb.	Pounds
LF, lin.ft.	Lineal Feet
LP	Lighting Panel
MCP	Main Control Panel
mA	Milliamp
MG, mg	Million Gallons
MCC	Motor Control Center
MGD, mgd	Million Gallons per day (1 mgd = 694 gpm)
MG/L, mg/l	Milligrams per Liter (1 mg/l = 1 ppm = 8.34 lb. per million gallons)
ml	Milliliter
ODP	Open Drip Proof (Motor)
O&M	Operation and Maintenance
P	Phosphorus
pH	Hydrogen Ion Concentration
ph	Phase (single or three-phase)
PP	Power Panel
PPD, ppd	Pounds per Day
PPM, ppm	Parts per Million (see MG/L, above)
PSI, psi	Pounds per Square Inch
PSIA, psia	Pounds per Square Inch (Absolute Pressure)
PSIG, psig	Pounds per Square Inch (Gauge Pressure)
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
RPM, rpm	Revolutions per Minute
SCFM	Standard Cubic Feet per Minute
SDI	Sludge Density Index
SF, sq.ft.	Square Feet

SS	Suspended Solids, or Stainless Steel
SVI	Sludge Volume Index
SWD	Side Water Depth
TDH	Total Dynamic Head
TDS	Total Dissolved Solids
TEEP	Totally Enclosed Explosion Proof (Motor)
TEFC	Totally Enclosed Fan-Cooled (Motor)
TENV	Totally Enclosed Non-Ventilated (Motor)
TSS	Total Suspended Solids
V	Volts

4. ABBREVIATIONS (Instrumentation)

The Instrumentation Society of America (ISA) has prepared the following abbreviations table to describe the functions of instrumentation equipment. These abbreviations appear in this Operation and Maintenance Manual and in the Contract Drawings. Examples of how to use the table are as follows:

Example 1: TR
"T" as a first letter means "Temperature" or "Turbidity"
"R" as a succeeding letter means "Record" or "Print"

Experience indicates the infrequent usage of "Print", therefore, it can be ruled out. Therefore, TR could mean either:
Temperature Recorder
Turbidity Recorder

Example 2: FIT
"F" as a first letter means "Flow Rate"
"I" as a succeeding letter means "Indicate"
"T" as a succeeding letter means "Transmit" or "Transform"

Again, experience would indicate that "Transform" is inappropriate. Therefore, FIT would mean:
Flow Rate Indicating Transmitter

Note that this notation system generally applies to the process instrumentation flow diagrams. The control logic schematics would appear to use conflicting symbols for the following:
"CR" can mean "Control Relay"
"TR" can mean "Timing Relay"

"TDR" can mean "Timing Delay Relay"
"TS" can mean "Time Switch", note that in a flow diagram that a "Time Switch" is a "KS"
"L" when used by itself always means "Light" in both contexts.

You may wonder, "How do I know which word description is correct or whether or not an exception is being used?" The answer lies in the context of the sentence in which the abbreviation appears or in the relationship between one instrument and another, as they are shown in the instrumentation drawings. For example:

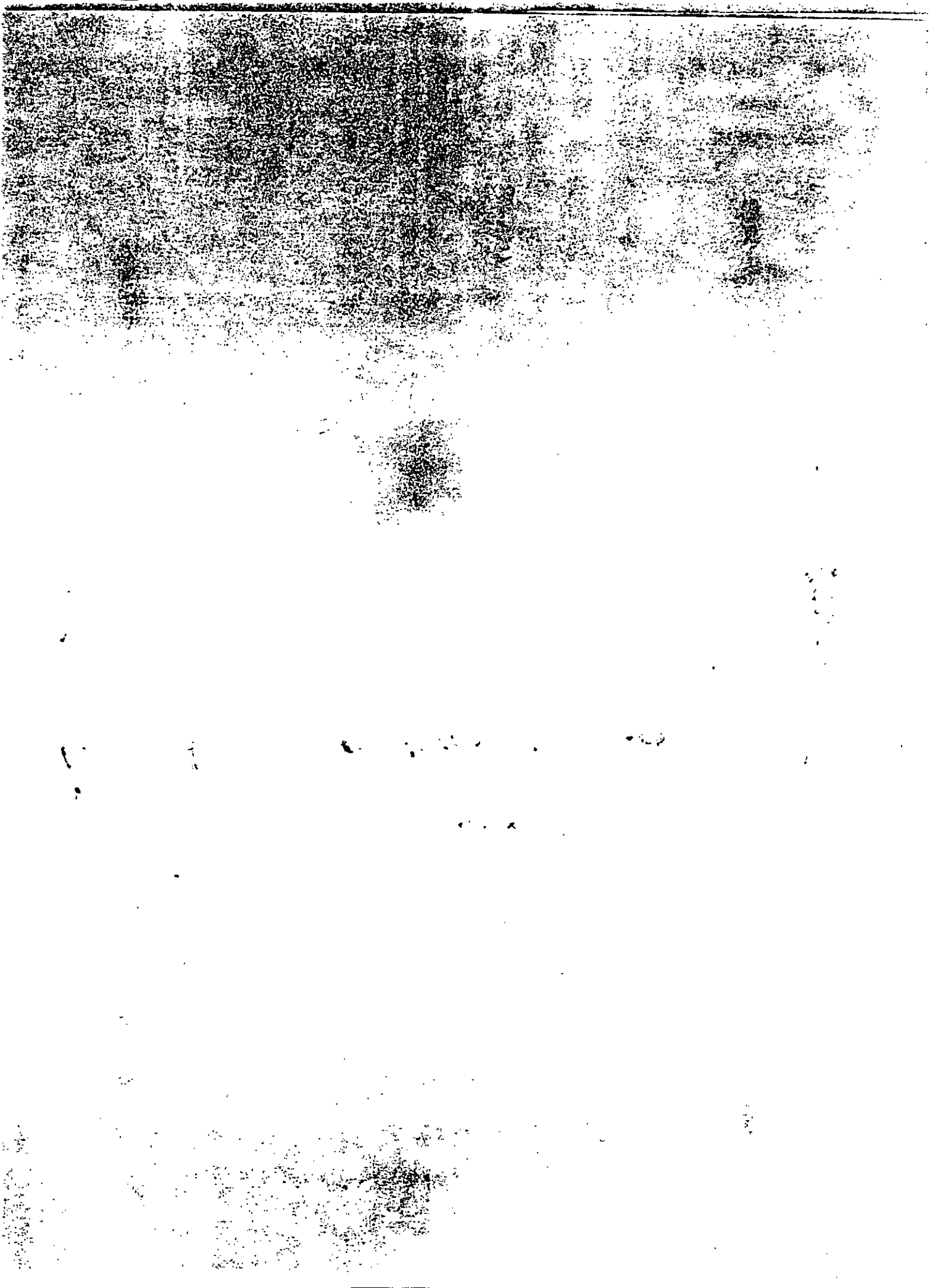
"When plant influent high level flow occurs, float switch LSH-1 closes timer TR-145 through relay CR-141 located in the mian control panel."

In this case, "LSH" means "Level Switch High", "TR" means "Timer Relay" and "CR" means "Control Relay". "CR" could not possibly mean "Conductivity Recorder" in this case.

Table III-1

ISA ABBREVIATION TABLE

Letter	First Letter	Succeeding Letter	Letter	First Letter	Succeeding Letter
A	Analysis	Alarm	O	Overload	Orifice
B	Burner, Flame	Batch	P	Pressure, Vacuum	Point
C	Conductivity	Control (feedback type)	Q	Quantity	Totalize, Integrate
D	Density, Specific Gravity	—	R	Radioactivity	Record, Print
			S	Speed, Frequency	Switch
E	Voltage	Primary Element		Solenoid	
F	Flow Rate	Ratio	T	Temperature	Transmit,
G	Gauging	Glass		Turbidity	Transform
H	Hand, Manual	High	U	Multivariable	Multifunction
I	Current	Indicate	V	Vibration,	Valve, Damper,
J	Power	Scan		Viscosity	Louver
K	Time, Time Schedule	Control (no feedback)	W	Weight, Force	—
			X	—	—
L	Level	Low, Light	Y	—	Relay, Compute
M	Moisture,	Middle			
N	—	—	Z	Position	Drive, Actuate



APPENDIX J

Safe Drinking Water Act

State of Michigan

SAFE DRINKING WATER ACT

Act 399 P.A. 1976 and Administrative Rules

MICHIGAN DEPARTMENT OF PUBLIC HEALTH

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Safe Drinking Water Act
Act 399 of 1976

SAFE DRINKING WATER ACT

Act 399, 1976, p. ____, Imd. Eff. Jan. 4, 1977

AN ACT to protect the public health; to provide for supervision and control over public water supplies; to prescribe the powers and duties of the department of public health; to provide for the submission of plans and specifications for waterworks systems and the issuance of construction permits therefor; to provide for the classification of public water supplies and the examination, certification and regulation of persons operating those systems; to provide for continuous, adequate operation of privately owned, public water supplies; to authorize the promulgation of rules to carry out the intent of the act; and to provide penalties.

The People of the State of Michigan enact:

325.1001 Short title.

Sec. 1. This act shall be known and may be cited as the "safe drinking water act".

HISTORY: New 1976, p. ____ Act 399, Imd. Eff. Jan. 4, 1977.

325.1002 Definitions.

Sec. 2. As used in this act:

(a) "Bottled drinking water" means water which is ultimately sold, provided, or offered for human consumption in a closed container.

(b) "Contaminant" means a physical, chemical, biological, or radiological substance or matter in water.

(c) "Department" means the department of public health or its authorized agent or representative.

(d) "Director" means the director of public health or his authorized agent or representative.

(e) "Imminent hazard" means that in the judgment of the director there is a violation, or a condition which may cause a violation, of the state drinking water standards at a public water supply requiring immediate action to prevent endangering the health of people.

(f) "Living unit" means a house, apartment, or other domicile occupied or intended to be occupied on a day to day basis by an individual, family group, or equivalent.

(g) "Person" means an individual, partnership, copartnership, cooperative, firm, company, public or private association or corporation, political subdivision, agency of the state, agency of the federal government, trust, estate, joint structure company, or any other legal entity, or their legal representative, agent, or assigns.

(h) "Plans and specifications" means drawings, data, and a true description or representation of an entire waterworks system or parts thereof as it exists or is to be constructed, and a statement on how a waterworks system is to be operated.

(i) "Political subdivision" means a city, village, township, charter township, county, district, authority or portion or combination thereof.

(j) "Public water supply" means a waterworks system which provides water for drinking or household purposes to persons other than the supplier of the water, except those waterworks systems which supply water to only 1 living unit. Those waterworks systems serving 2 to 14 living units shall be subject to only those provisions of the act necessary to assure proper construction and operation such that the quality of water distributed meets the state drinking water standards; specifically, the provisions of sections 4 and 10 shall not apply to waterworks systems serving 2 to 14 living units.

(k) "State drinking water standards" means quality standards setting limits for contaminant levels or establishing treatment techniques to meet standards necessary to protect the public health.

(l) "Supplier of water" or "supplier" means a person who owns or operates a public water supply, and includes a water hauler.

(m) "Water hauler" means a person engaged in bulk vehicular transportation of water to other than the water hauler's own household which is intended for use or used for drinking or household purposes.

(n) "Waterworks system" or "system" means a system of pipes and structures through which water is obtained and distributed, including but not limited to wells and well structures, intakes and cribs, pumping stations, treatment plants, storage tanks, pipelines and appurtenances, or a combination thereof, actually used or intended for use for the purpose of furnishing water for drinking or household purposes.

HISTORY: New 1978, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1003 Power and control over public water supplies and supplier of water; inspection of waterworks system.

Sec. 3. Subject to limitations contained in this act, the department shall have power and control over public water supplies and suppliers of water. The director may enter upon the waterworks system of a supplier of water at reasonable times for the purpose of inspecting the system and carrying out this act and rules promulgated under this act.

HISTORY: New 1978, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1004 Filing plans and specifications of waterworks system; general plan of waterworks system; evaluation of proposed system; return or rejection of plans and specifications; plans and specifications for improvements; permit for construction; violation; permit as condition to expenditures.

Sec. 4. (1) A supplier of water shall file with the department the plans and specifications of the entire waterworks system owned or operated by the supplier, unless the department determines that its existing records are adequate. A general plan of the waterworks system for each public water supply shall be provided to the department by a supplier of water and shall be updated as determined necessary by the department.

(2) Upon receipt of the plans and specifications for a proposed waterworks system, the department shall evaluate the adequacy of the proposed system to protect the public health by supplying water meeting the state drinking water standards. If upon evaluation the department determines the plans and specifications to be inadequate, the department may return the plans and

325.1006 Maximum contaminant levels; incorporation by reference.

Sec. 6. The maximum contaminant levels for inorganic and organic chemicals, microbiological contaminants and turbidity, which are part of the national interim primary drinking water regulations, and which have been promulgated by the United States environmental protection agency under authority of Public Law 93-523 (1974) before this act taking effect, are hereby incorporated by reference and shall have the same force and effect as a rule promulgated pursuant to this act. A standard which is incorporated by reference pursuant to this subsection shall remain effective until a rule is promulgated pursuant to this act which covers the same or similar subject or the standard is rescinded by rule promulgated pursuant to this act.

HISTORY: New 1978, p ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1007 Collecting and analyzing water samples; reporting results of analyses; fees.

Sec. 7. The supplier of water shall collect water samples or have them collected on a schedule at least equal to that outlined in the rules, shall cause those samples to be analyzed in a laboratory approved by the department or by the United States environmental protection agency for contaminants listed in the state drinking water standards, and shall report the results of the analyses to the department in a timely manner as specified in the rules. If the supplier fails to meet this responsibility, the department shall collect the water samples routinely as specified in the rules, analyze the samples at the department's laboratory, and charge the supplier for these services according to a schedule of fees the department shall establish by rule. The fees for performing the services shall bear a reasonable relation to the cost to the department for collecting the water samples, analyzing the samples, and reporting the results of the analyses to the supplier of water. The fees shall be deposited in the state treasury to the credit of the general fund.

HISTORY: New 1978, p ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1008 Design and operation standards of public water supplies; considerations.

Sec. 8. The department shall give due consideration to the size, type, location, and other conditions at public water supplies for the purpose of specifying design and operation standards.

HISTORY: New 1978, p ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1009 Classification of water treatment and distribution systems; advisory board of examiners; certificates of competency; supervision of water treatment and distribution system; individuals eligible for certificate.

Sec. 9. (1) The department shall classify water treatment and distribution systems with regard to size, type, location, and other physical conditions for the purpose of establishing the skill, knowledge, and experience that individuals need to maintain and operate the systems effectively.

(2) The director shall appoint an advisory board of examiners which shall assist the department in the examination of individuals as to their competency to operate water treatment systems and water distribution systems. The advisory board shall make recommendations to the department relative to the certification of those individuals.

(3) The membership of the advisory board shall consist of 2 certified water treatment operators, 2 certified water distribution operators, 1 superintendent or manager of a supplier of water, 1 representative of the administrative branch of a local governmental agency, 2 members of the public at large, and 1 professor of sanitary or environmental engineering at a university in the state. A representative of the department shall be the nonvoting secretary for the board.

(4) For individuals meeting the requirements, the department shall issue certificates acknowledging their competency to operate a specified class of waterworks system or portion thereof. The department may suspend or revoke a certificate as specified by rule.

(5) A water treatment and distribution system shall be under the supervision of a properly certified operator as specified in the rules.

(6) Those individuals now certified to operate water treatment systems under the existing mandatory certification rules being R325.551 through R325.572 of the Michigan administrative code, and those meeting the requirements of the voluntary distribution system operator certification program administered by the department, shall be considered to meet the requirements of this section and shall be issued a certificate in an appropriate class in accordance with the certifications system established under this act.

(7) Those individuals who are superintendents of distribution systems shall be considered to meet the requirements of this section only for the waterworks system by which they are now employed, and shall be issued a certificate for continuing operation of that distribution system upon receipt by the department of a completed application within 1 year after the effective date of this act.

HISTORY: New 1978, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1010 Approval of privately owned public water supply; escrow account to correct deficiencies in public water supply.

Sec. 10. (1) Beginning 1 year after the effective date of this act, approval of the department shall not be granted to a privately owned public water supply which serves a group of living units, unless by resolution of its governing body the city, village, or township in which the water supply is to be located refuses to accept ownership and operational responsibility of the public water supply.

(2) If a local governmental agency does not accept ownership and operational responsibility of a public water supply which serves a group of living units, the department may issue a construction permit or other approval for an acceptable project requiring as a condition of the permit an appropriate amount, but not more than $50,000.00, based on the size, type, and complexity of the waterworks system, to be placed in escrow by the developer or private owner. The department may remove funds from this escrow account to cause deficiencies to be corrected if the public water supply is not operated, maintained, and expanded as necessary to protect the public health. If it is necessary for the department to withdraw funds from an escrow account, the funds shall be replaced within 90 days by the developer, private owner, or organization then responsible for the public water supply.

HISTORY: New 1978, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1011 Review and certification of laboratories testing water.

Sec. 11. The department shall review and certify laboratories used or intended for use in the testing of water from public water supplies.

HISTORY: New 1978, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1012 Laboratory capability to test for contaminants.

Sec. 12. The department shall maintain a laboratory capability to test for those contaminants in water which are included in the state drinking water standards and any other contaminant which may be of concern to the director.

HISTORY: New 1976, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1013 Chemicals and materials; approval; list; prohibition.

Sec. 13. All chemicals and materials which may come in contact with the water or be used in treatment processes shall be approved by the department before being utilized in a public water supply. A list of approved chemicals and materials shall be published by the department. A person shall not wilfully introduce or permit or suffer the introduction of a chemical or material into a public water supply which has not first been approved by the department.

HISTORY: New 1976, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1014 Reports; records.

Sec. 14. A supplier of water shall file with the department such reports and shall maintain such records as the department may by rule require.

HISTORY: New 1976, p. ____, Act 399, Imd. Eff. Jan. 4, 1977

325.1015 Protection of public health; notice to supplier of water; inspection of waterworks system; order; public hearing; emergency order; action limiting water use.

Sec. 15. (1) When deemed necessary for protection of the public health, the department shall notify a supplier of water of the need to make changes in operations, to provide treatment, to make structural changes in existing systems, or to add additional capacity as necessary to produce and distribute an adequate quantity of water meeting the state drinking water standards.

(2) The department shall inspect a waterworks system or a part thereof, and the manner of operation of the system or part. If upon inspection the department determines the waterworks system to be inadequate or so operated as to not adequately protect the public health, the department may order the supplier of water to make alterations in the waterworks system or its method of operation as may be required or deemed advisable by the department to assure the public water supply shall be adequate, healthful, and in conformance with state drinking water standards. If the supplier does not request a public hearing within 30 days after receipt of the order, the order shall be final and binding on the supplier of water. If the department receives a request for a public hearing within the specified 30 days, the public hearing shall be immediately arranged. A supplier of water shall comply with a final order of the department.

(3) If a public water supply poses an imminent hazard to the public health, the department may issue an emergency order immediately, without notice or hearing, requiring such action as the department determines is necessary to protect the public health. Normal administrative procedures as required by Act No. 306 of the Public Acts of 1969, as amended, shall proceed concurrently with an emergency order upon written request of the supplier of water received within 15 days. An emergency order shall be effective immediately and binding until modified or rescinded by the department or a court of competent jurisdiction.

(4) The department may take appropriate action to limit water use from a public water supply until such time as satisfactory improvements are made in

the system or operation to provide for a continuous, adequate supply of water meeting the state drinking water standards.

HISTORY: New 1976, p. ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1016 Agreements, contracts, or cooperative arrangements for purpose of administering act; grants of money or other aid.

Sec. 16. The department may enter into agreements, contracts, or cooperative arrangements under terms and conditions appropriate with other state agencies, federal agencies, interstate agencies, political subdivisions, educational institutions, local health departments, or other organizations or individuals for the purpose of administering this act. The department may solicit and receive grants of money or other aid from federal and other public or private agencies or individuals for the administration of this act or a portion thereof, to conduct research and training activities or cause them to be conducted, to cause waterworks systems or portions thereof to be constructed, or for other program purposes.

HISTORY: New 1976, p. ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1017 Bottled drinking water.

Sec. 17. (1) Suppliers of water providing bottled drinking water shall utilize a water source meeting the requirements of this act. Bottling or packaging facilities and their operation shall remain under the supervision of the Michigan department of agriculture as provided for in Act No. 39 of the Public Acts of 1968, as amended, being sections 289.701 to 289.727 of the Michigan Compiled Laws and regulation no. 549, being sections R285.549.1 through R285.549.29 of the Michigan administrative code, and other pertinent rules and laws.

(2) Suppliers of water providing bottled water from out of state shall submit proof to the director that the source and bottling facilities were approved by the state agency having jurisdiction. The director shall determine the acceptability of another state's inspection, surveillance, and approval procedures and techniques.

HISTORY: New 1976, p. ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1018 Water haulers; license; source of water; water quality.

Sec. 18. Water haulers shall obtain an annual license from the department for their containers, equipment, and operation. The source of water shall be acceptable to the department and the water quality shall meet the state drinking water standards.

HISTORY: New 1976, p. ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1019 Noncompliance with state drinking water standards; notification of users; litigation.

Sec. 19. (1) If water delivered by or the operation of a public water supply is found not to be in compliance with the state drinking water standards, the department shall require the supplier of water to notify its users of the extent and nature of the noncompliance. Notification of users shall be in a form and manner prescribed or otherwise approved by the department.

(2) Notification received pursuant to this section or information obtained from the notification may not be used against a person in a litigation, except a prosecution for perjury or for giving a false statement.

HISTORY: New 1976, p. ___, Act 399, Imd. Eff. Jan. 4, 1977.

325.1020 Variances or exemptions.

Sec. 20. The department may authorize variances or exemptions from the state drinking water standards in accordance with Public Law 93-523 (1974) and the federal rules and regulations.

HISTORY: New 1976, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1021 Violation as misdemeanor; penalty.

Sec. 21. A person who violates this act or the rules promulgated hereunder or an order issued pursuant to this act is guilty of a misdemeanor and shall be punished by a fine of not more than $5,000.00 for each day of violation, or by imprisonment for not more than 1 year, or both.

HISTORY: New 1976, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1022 Enforcement of act, rules, or orders; penalty.

Sec. 22. At the request of the department, the attorney general may bring an injunctive action or other appropriate action in the name of the people of the state to enforce this act, rules promulgated under this act, or an order issued pursuant to this act or the rules. In addition to other relief granted under this section, the court may impose a civil penalty of not more than $5,000.00 for each day of violation.

HISTORY: New 1976, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.

325.1023 Conditional effective date.

Sec. 23. This act shall not take effect unless House Bill No. 6251 of the 1976 regular session of the legislature is enacted into law.

HISTORY: New 1976, p. ____, Act 399, Imd. Eff. Jan. 4, 1977.
COMPILER'S NOTE: House Bill No. 6251, referred to in Sec. 23, became P.A. 1976, No. 399, Eff. Mar. 31, 1977.

PREFACE

The following administrative rules in this publication are reprinted from the text of the Michigan Administrative Code and are made available to the Department of Public Health pursuant to §24.258 of the Michigan Compiled Laws. The rules were filed with the Secretary of State on December 27, 1977, and took effect 15 days after filing.

DEPARTMENT OF PUBLIC HEALTH

BUREAU OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

SUPPLYING WATER TO THE PUBLIC

(By authority conferred on the department of public health by sections 33 and 63 of Act No. 306 of the Public Acts of 1969, and sections 5 and 14 of Act No. 399 of the Public Acts of 1976, being §§24.233, 24.263, 325.1005, and 325.1014 of the Michigan Compiled Laws)

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PART 1. GENERAL PROVISIONS

R 325.10101. Purpose.

Rule 101. These rules are promulgated by the department for the purpose of protecting the public health and implementing the act, and to specify certain standards and criteria for public water supplies which are consistent and compatible with the provisions of the act and the federal act.

HISTORY: 1984 ACS 94, p. ___.

R 325.10102. Definitions; A to B.

Rule 102. As used in these rules:

(a) "Act" means Act No. 399 of the Public Acts of 1976, being §§325.1001 to 325.1023 of the Michigan Compiled Laws, and known as the Safe Drinking Water Act.

(b) "Advisory board" means the advisory board of examiners appointed by the director pursuant to subsection (2) of section 9 of the act.

(c) "Alteration" means the modification of, or addition to, an existing waterworks system, or a portion thereof, which affects flow, capacity, system service area, source, treatment, or reliability.

(d) "Approved basement" means a basement with walls and floor constructed of concrete or its equivalent, essentially watertight, effectively drained, and in daily use.

(e) "Aquifer" means an underground water bearing formation that is saturated and transmits water in sufficient quantities to serve as a source of water supply.

(f) "Artesian" means a condition of internal pressure which causes the water level in a well to rise above the aquifer used to supply water at the well location.

(g) "Bottled drinking water" means water which is ultimately sold, provided, or offered for human consumption in a closed container.

HISTORY: 1984 ACS 94, p. ___.

R 325.10103. Definitions; C.

Rule 103. As used in these rules:

(a) "Casing" means an impervious durable pipe placed in a well to prevent the soil from caving and to seal off surface drainage or undesirable water, gases, contaminants, or other fluids and prevent their entering the well and the aquifer supplying the well.

(b) "Casing vent" means an outlet at the upper terminal of a well casing to provide atmospheric pressure in the well and to allow the escape of gases when present.

(c) "Certificate" means a document which is issued by the department to a person meeting the qualification requirements for operation of a treatment system or for operation or maintenance of a distribution system, or a portion thereof.

(d) "Certified operator" means an operator who holds a certificate.

(e) "Check sample" means a sample collected and analyzed to confirm the results of routine monitoring and analysis.

(f) "Community supply" means a public water supply which provides year-round service to not less than 15 living units or which regularly provides year-round service to not less than 25 residents.

(g) "Complete treatment system" means a treatment system employing disinfection, coagulation, sedimentation, and filtration units which function collectively to effect control over water quality characteristics to produce a finished water meeting the state drinking water standards.

(h) "Construction" means the erection, installation, or alteration of a waterworks system, or any portion thereof, which affects flow, capacity, system service area, source, treatment, or reliability.

(i) "Contested cases" means matters of issue involving orders, exemptions, variances, stipulations, consent agreements, permits, licenses, or certificates issued by the director, the department, or the division pursuant to the act and these rules, and other matters which are within the definition of a contested case as set forth by subsection (3) of section 3 of Act No. 306 of the Public Acts of 1969, as amended, being §24.203 of the Michigan Compiled Laws.

(j) "Contested case hearing" means a hearing initiated by the department or a person pursuant to chapters 4, 5, and 6 of Act No. 306 of the Public Acts of 1969, as amended, being §§24.271 to 24.306 of the Michigan Compiled Laws.

(k) "Contaminant" means a physical, chemical, biological, or radiological substance or matter in water.

(l) "Contingency plan" means a plan for use by a supplier of water in the event of an emergency.

(m) "Cross connection" means a connection or arrangement of piping or appurtenances through which a backflow could occur.

HISTORY: 1984 ACS 14, p ___

R 325.10104. Definitions; D to E.

Rule 104. As used in these rules:

(a) "Department" means the department of public health or its authorized agent or representative.

(b) "Deviation" means an exception to a department rule establishing minimum standards or requirements issued in writing or as a condition to a permit to a supplier of water.

(c) "Director" means the director of public health or his authorized agent or representative.

(d) "Distribution system" means a system of piping, transmission or distribution mains, pumps, pumping stations, storage tanks, controls, and associated appurtenances through which water is distributed, and used or intended for use for drinking or household purposes.

(e) "Division" means the division of water supply of the bureau of environmental and occupational health of the department.

(f) "Drawdown" means the difference between the static water level and the pumping water level in a well, or for a flowing artesian well, the difference between an established datum above ground and the pumping water level.

(g) "Emergency" means a situation in a public water supply resulting in the contamination, loss of pressure, lack of adequate supply of water, or other condition which poses an imminent hazard or danger to the public health.

(h) "EPA" means the United States environmental protection agency.

(i) "Established ground surface" means the intended or actual finished grade or elevation of the surface of the ground at the site of a water supply facility.

(j) "Exemption" means an order, with appropriate conditions, time schedules, and compliance requirements issued by the director to a supplier of water permitting a public water supply to be in temporary noncompliance with a state drinking water standard, including a specified treatment technique.

HISTORY: 1984 ACS 94, p. ___.

R 325.10105. Definitions; F to L.

Rule 105. As used in these rules:

(a) "Federal act" means the safe drinking water act, 42 U.S.C. 300f, and 40 C.F.R., part 35, §35.600f; 40 C.F.R., part 141; and 40 C.F.R., part 142, promulgated by EPA pursuant thereto, or any subsequent revisions, modifications, or additions thereto.

(b) "Finished water" means water which is ready for distribution to the customers or users of a public water supply.

(c) "Firm capacity", as applied to wells, pumping stations, or units of treatment systems, means the production capability of each respective part of the waterworks system with the largest well, pump, or treatment unit out of service.

(d) "Gravity storage tank" means an elevated or ground level finished water storage reservoir which, during normal use, operates under atmospheric pressure.

(e) "Ground water" means the water in the zone of saturation in which all of the pore spaces of the subsurface material are filled with water.

(f) "Grout" means neat cement, concrete, or other sealing material approved by the department used to seal a well casing in a well.

(g) "Imminent hazard" means that in the judgment of the director, there is a violation, or a condition which may cause a violation of the state drinking water standards at a public water supply requiring immediate action to prevent endangering the health of the people.

(h) "License" means the license issued by the department to a water hauler, or for a water hauling tank, pursuant to section 18 of the act.

(i) "Living unit" means a house, apartment, or other domicile occupied or intended to be occupied on a day to day basis by an individual, family group, or equivalent.

HISTORY: 1984 ACS 94, p. ___.

R 325.10106. Definitions; M to O.

Rule 106. As used in these rules:

(a) "MCL" means the maximum contaminant level for a contaminant identified under the state drinking water standards permissible in water delivered to a free flowing outlet of the ultimate user of a public water supply. In the case of turbidity, the maximum permissible level is measured at the point of entry to a distribution system. An MCL does not apply to substances added to the water under circumstances controlled by the user. An MCL does apply to contaminants resulting from corrosion of piping and plumbing caused by water quality.

(b) "Monitoring requirement" means a schedule, frequency, and location for sampling and analysis of water required by part 7 of these rules to determine

whether a public water supply is in compliance with the state drinking water standards.

(c) "Noncommunity supply" means a public water supply which is not a community supply, but which has not less than 15 service connections or which serves not less than 25 individuals on an average daily basis for not less than 60 days out of the year.

(d) "One hundred year drought elevation" means the minimum projected water surface elevation which would occur at a location once in a period of 100 years.

(e) "One hundred year flood elevation" means the maximum projected water surface elevation which would occur at a location once in a period of 100 years.

(f) "Operator" means an individual who operates a treatment system or operates or maintains a distribution system, or portion thereof.

(g) "Operator in charge" means an individual designated by the owner of a public water supply as the responsible individual in overall charge of a treatment system or a distribution system.

HISTORY: 1984 ACS 84, p. ____

R 325.10107. Definitions; P to R.

Rule 107. As used in these rules:

(a) "Permit" means a public water supply construction permit issued to a supplier of water by the department pursuant to section 4 of the act.

(b) "Person" means an individual, partnership, copartnership, cooperative, firm, company, public or private association or corporation, political subdivision, agency of the state, agency of the federal government, trust, estate, joint structure company, or any other legal entity, or their legal representative, agent, or assigns.

(c) "Pitless adapter" means a device or assembly of parts which permits water to pass through the wall of a well casing or extension thereof, and which provides access to the well and to the parts of the water system within the well in a manner to prevent entrance of contaminants into the well and the water produced.

(d) "Plans and specifications" means drawings, data, and a true description or representation of an entire waterworks system, or parts thereof, as it exists or is to be constructed, and a statement on how a waterworks system is to be operated.

(e) "Political subdivision" means a city, village, township, charter township, county, district, authority, or portion or combination thereof.

(f) "Production well" means a well that has been approved for use for a public water supply in accordance with part 8 of these rules.

(g) "Public hearing" means a hearing conducted by the director or the department on matters relating to the functions and responsibilities of the division for which public input is sought or desired.

(h) "Public water supply" means a waterworks system which provides water for drinking or household purposes to persons other than the supplier of water, except those waterworks systems which supply water to only 1 living unit. Those waterworks systems serving 2 to 14 living units shall be subject to only those provisions of the act necessary to assure proper construction and operation such that the quality of water distributed meets the state drinking water standards; specifically, the provisions of sections 4 and 10 shall not apply to waterworks systems serving 2 to 14 living units.

(i) "Pumping water level" means the distance measured from an established datum at or above ground to the water surface in a well being pumped at a known rate for a known period of time.

(j) "Raw water" means water obtained from a source by a public water supply before a supplier of water provides any treatment, or distributes the water to its customers.

(k) "Regional administrator" means the EPA region V administrator.

(*l*) "Resident" means an individual who owns or occupies a living unit.

HISTORY: 1984 ACS 94, p. ___.

R 325.10108. Definitions; S.

Rule 108. As used in these rules:

(a) "Sanitary survey" means an evaluation, including an on-site review of a waterworks system, or a portion thereof, for existing or potential health hazards, including sampling, design, operation, and maintenance, for the purpose of determining the ability of the public water supply to produce, treat, and distribute adequate quantities of water meeting state drinking water standards.

(b) "Service connection" means a direct connection from a distribution watermain to a living unit or other facility for the purpose of providing water for drinking or household purposes. A service connection is not designed to be an integral part of the network of distribution watermains.

(c) "Shift operator" means an operator, other than the operator in charge, who is in charge of a work shift of a treatment system at a surface water supply.

(d) "Source" means the point of origin of raw water, or treated water which is purchased or obtained by a public water supply, by a water hauler, or by a person providing bottled water.

(e) "State drinking water standards" means quality standards setting limits for contaminant levels or establishing treatment techniques to meet standards necessary to protect the public health.

(f) "Static water level" means the distance measured from an established datum at or above ground to the water surface in a well not being pumped, not under the influence of pumping, nor flowing under artesian pressure.

(g) "Suction line" means a pipe or line connected to the inlet side of a pump or pumping equipment.

(h) "Supplier of water" or "supplier" means a person who owns or operates a public water supply, and includes a water hauler.

(i) "Surface water" means water that rests or flows on the surface of the ground.

HISTORY: 1984 ACS 94, p. ___.

R 325.10109. Definitions; T to Y.

Rule 109. As used in these rules:

(a) "Test well" means a well drilled on a site which has not been approved for use as a production well in accordance with part 8 of these rules.

(b) "Treatment system" means a facility or structure and associated appurtenances installed for the purpose of treating drinking water prior to delivery to a distribution system.

(c) "Treatment technique" means a minimum treatment requirement or a

necessary methodology or technology employed by a supplier of water for the control of the chemical, physical, biological, or radiological characteristics of the public water supply.

(d) "Variance" means an order, with appropriate conditions and compliance schedules and requirements, issued by the director to a supplier of water permitting a public water supply to be in noncompliance with a state drinking water standard, including a specified treatment technique.

(e) "Water hauler" means a person engaged in bulk vehicular transporation of water to other than the water hauler's own household which is intended for use or used for drinking or household purposes.

(f) "Water transportation tank" means a tank associated with an over-the-road vehicle used for bulk transport of drinking water.

(g) "Waterworks system" or "system" means a system of pipes and structures through which water is obtained and distributed, including, but not limited to, wells and well structures, intakes and cribs, pumping stations, treatment plants, storage tanks, pipelines and appurtenances, or a combination thereof, actually used or intended for use for the purpose of furnishing water for drinking or household purposes.

(h) "Year-round service" means the ability to provide drinking water by a supplier of water on a continuous basis to any living unit or facility.

HISTORY: 1984 ACS 84, p ___.

R 325.10110. Definitions; parts 6 and 7.

Rule 110. As used in part 6 and part 7 of these rules.

(a) "Dose equivalent" means the product of the absorbed dose from ionizing radiation and such factors as account for differences in biological effectiveness due to the type of radiation and its distribution in the body as specified by the ICRU.

(b) "Gross alpha particle activity" means the total radioactivity due to alpha particle emission as inferred from measurements on a dry sample.

(c) "Gross beta particle activity" means the total radioactivity due to beta particle emission as inferred from measurements on a dry sample.

(d) "ICRU" means the international commission on radiological units and measurements.

(e) "Man-made beta particle and photon emitters" means all radionuclides emitting beta particles or photons, or both, listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure", NBS Handbook 69, except the daughter product of thorium-232, uranium-235, and uranium-238.

(f) "Picocurie" or "pCi" means that quantity of radioactive material producing 2.22 nuclear transformations per minute.

(g) "Rem" means the unit of dose equivalent from ionizing radiation to the total body or any internal organ or organ system. A millirem is 1/1000 of a rem.

HISTORY: 1984 ACS 84, p ___.

R 325.10111. Authorized agents or representatives of department and director.

Rule 111. (1) The chief of the bureau of environmental and occupational health of the department, the division chief, the technical staff of the division, and

other persons specifically designated by the division chief are authorized agents or representatives of the department and the director for the purpose of implementing the act.

(2) For the purposes of implementing the act, the chief of the bureau of environmental and occupational health of the department is designated as the authorized agent or representative of the director to initiate contested cases and to appoint hearing officers pursuant to chapters 4 and 5 of Act No. 306 of the Public Acts of 1969, as amended, being §§24.271 to 24.292 of the Michigan Compiled Laws, and pursuant to part 2 of these rules. The director shall make the final department decision in all contested cases arising under the act.

(3) The chief of the bureau of environmental and occupational health of the department is designated by the director as his representative to seek the initiation of injunctive action or other action by the department of the attorney general to enforce the act, a condition or provision of an order, permit, license, certificate, variance, exemption or these rules.

HISTORY: 1954 ACS 94, p. ___.

R 325.10112. Adoption by reference.

Rule 112. The department incorporates by reference, and adopts as a part of these rules, the publication entitled "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air and Water for Occupational Exposure," NBS Handbook 69, as referred to in parts 1 and 6 of these rules. Copies of the adopted matter are available for inspection at the offices of the department in Escanaba and Lansing. Copies may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. at a cost of 35 cents and from the Department of Public Health, 3500 North Logan Street, P.O. Box 30035, Lansing, Michigan 48909, at no cost.

HISTORY: 1954 ACS 94, p. ___.

R 325.10113. Compliance with rules; guidance information.

Rule 113. Suppliers of water may use the information set forth in the following publications for general guidance in complying with the provisions of these rules:

(a) "Recommended Standards For Water Works," prepared by the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers, is available for inspection at the department offices in Lansing and Escanaba, and may be purchased at a cost of $1.50 from the Health Education Service, P.O. Box 7283, Albany, New York 12224.

(b) The American Water Works Association Manual M-19, Emergency Planning for Water Utility Management, 1973, as referred to in part 23, is available for inspection at the department offices in Lansing and Escanaba, and may be purchased at a cost of $8.00 from the American Water Works Assocation, 6666 West Quincy Avenue, Denver, Colorado 80235.

HISTORY: 1954 ACS 94, p. ___.

R 325.10114. Rescissions.

Rule 114. The following rules of the department are rescinded:

(a) Rules entitled "Municipal Water Supplies", being R 325.480 to R 325.491 of the Michigan Administrative Code, and appearing on pages 2283 to 2284 of the 1954 volume of the Code.

(b) Rules entitled "Regulations Providing Minimum Standards for the Location and Construction of Certain Water Supplies in the State of Michigan," being

R 325.1451 to R 325.1461 of the Michigan Administrative Code, and appearing on pages 3205 to 3210 of the 1984-85 Annual Supplements to the Code.

(c) Rules entitled "Operation of Plants Furnishing Water Supply," being R 325.371 to R 325.374 of the Michigan Administrative Code, and appearing on page 2253 of the 1954 volume of the Code.

(d) Rules entitled "Certification of Water Treatment Plant Personnel," being R 325.551 to R 325.572 of the Michigan Administrative Code, and appearing on pages 2278 to 2282 of the 1954 volume of the Code.

(e) Rules entitled "Water Supply Cross-Connections," being R 325.431 to R 325.440 of the Michigan Administrative Code, appearing on pages 6129 to 6131 of the 1972 Annual Supplement to the Code.

HISTORY: 1984 ACS 84, p. ___

R 325.10115. Remedies and penalties.

Rule 115. A person who violates any of the provisions of these rules shall be subject to the remedies and penalties as prescribed by sections 21 and 22 of the act.

HISTORY: 1984 ACS 84, p. ___

PART 2. HEARINGS AND CONTESTED CASES

R 325.10201. Public hearings; applicable law.

Rule 201. Public hearings conducted by the division pursuant to the act and these rules shall be in accordance with, and subject to, Act No. 306 of the Public Acts of 1969, as amended, being §§24.201 to 24.315 of the Michigan Compiled Laws.

HISTORY: 1984 ACS 84, p. ___

R 325.10202. Requests for public hearings.

Rule 202. (1) If a person requests the division to schedule a public hearing, the request shall be made in writing and shall include all of the following information:

(a) The name, address, and telephone number of the person requesting the public hearing.

(b) A brief statement of the reason for the request and the relationship of the person to the subject for which the public hearing is requested.

(c) A brief statement of the information that the person requesting the public hearing intends to submit at the public hearing.

(2) After receipt of the request for public hearing, the chief of the bureau of environmental and occupational health shall make a determination as to the need for a hearing. If the chief of the bureau grants the public hearing, it shall be scheduled and conducted in accordance with, and subject to, Act No. 306 of the Public Acts of 1969, as amended.

(3) If the chief of the bureau denies the public hearing, he shall notify the person requesting the public hearing in writing of his decision and shall state his reasons for denial of the hearing.

HISTORY: 1984 ACS 84, p. ___

R 325.10203. Contested cases; applicable law; appearances; service of notices and orders.

Rule 203. (1) Division administrative procedures in contested cases and

judicial review thereof shall be in accordance with, and subject to, chapters 4, 5 and 6 of Act No. 306 of the Public Acts of 1969, as amended, being §§24.271 to 24.306 of the Michigan Compiled Laws.

(2) Appearances at a contested case hearing shall be either in person or by duly authorized agent. Legal counsel may represent a person in a contested case.

(3) Service of notices, orders, and final orders shall be by personal service or by certified mail, or both, upon the parties named in the proceedings.

HISTORY: 1984 ACS 94, p. ___.

R 325.10204. Initiation of contested case hearing.

Rule 204. (1) Contested case hearings may be initiated by the chief of the bureau of environmental and occupational health. Except in the case of suspension or revocation of a license, permit, order, variance, or exemption, the chief of the bureau shall initiate a contested case hearing by notice mailed by certified mail not less than 21 days prior to the hearing.

(2) A person requesting a contested case hearing shall file a petition with the division in Lansing, Michigan. The petition shall state the legal authority under which the hearing is requested, a brief statement of the matters asserted, a statement of the relationship of the petitioner to the issue, and a statement of relief sought.

HISTORY: 1984 ACS 94, p. ___.

R 325.10205. Notice of contested case hearing.

Rule 205. When a contested case hearing is initiated, the division shall provide notice to those known persons who may be materially affected by the proceedings. The notice shall be by mail or by publication, or both, as may be necessary.

HISTORY: 1984 ACS 94, p. ___.

R 325.10206. Hearing officer; record of proceedings; proposal for decision.

Rule 206. That portion of a contested case hearing in which testimony and evidence is to be taken may be referred to a hearing officer who shall be designated and authorized by the director to preside at the hearing. The hearing officer shall hear the evidence and prepare a record of the proceedings and a proposal for decision, including findings of fact and conclusions of law. The record of the proceedings and proposal for decision shall be filed at the office of the director as soon as possible after completion of the hearing. A copy of the proposal for decision shall be served by certified mail on all other parties to the proceedings.

HISTORY: 1984 ACS 94, p. ___.

R 325.10207. Division files and records; availability; evidence.

Rule 207. The files and records of the division specified in notices of determination and hearing, except those materials exempted by section 13 of Act No. 442 of the Public Acts of 1976, being §15.243 of the Michigan Compiled Laws, shall be available before or at contested case hearings held by the director or by the hearing officer, and the whole, or a part thereof, may be offered at a hearing as evidence on behalf of the division.

HISTORY: 1984 ACS 94, p. ___.

R 325.10208. Stipulations and consent orders; final orders.

Rule 208. (1) A person cited to appear at a hearing noticed by the division, and who desires to dispose of the contested case by stipulation or consent order, may mail to the director not later than 10 days before the date set for hearing his written consent to the terms and conditions of the proposed order or other form of action as set forth in the notice of determination and hearing. Agreement between the parties on the terms and conditions of a stipulation or consent order shall constitute sufficient cause for the director to dispose of the contested case without further hearing.

(2) After the hearing officer has submitted his proposal for decision, the director shall issue a final order on the matter. A certified copy of the final order shall be prepared and served by certified mail on the contesting parties or their attorneys together with the director's finding containing a resume of the facts and grounds for decision.

HISTORY: 1984 ACS 84, p. ____

PART 3. VARIANCES AND EXEMPTIONS

R 325.10301. Purpose.

Rule 301. The purpose of this part is to prescribe procedures by which the department may grant or deny a variance or exemption from a state drinking water standard pursuant to the provisions of section 20 of the act and in accordance with the federal act.

HISTORY: 1984 ACS 84, p. ____

R 325.10302. Form.

Rule 302. If a variance or exemption is granted by the department to a supplier of water, it shall be in the form of an enforceable administrative order, approved as to form by the department of the attorney general. The order shall contain applicable conditions, specific compliance requirements, and time schedules for compliance.

HISTORY: 1984 ACS 84, p. ____

R 325.10303. Request for variance or exemption, generally.

Rule 303. (1) A supplier of water who wishes to request a variance or exemption shall make that request in writing to the department not less than 90 days prior to the date on which the supplier of water wishes the variance or exemption. The request shall be made in a manner prescribed by the department and shall contain all information required by this part and the federal act.

(2) Requests for variances or exemptions for more than 1 MCL or treatment technique shall be made separately.

HISTORY: 1984 ACS 84, p. ____

R 325.10304. Variance from MCL or treatment technique; required finding.

Rule 304. Variances from an MCL or treatment technique may be granted by the director only upon his specific finding that either of the following exist:

(a) The supplier of water demonstrates that the characteristics of the raw water source or sources which are reasonably available to the public water supply do not permit the public water supply to meet the maximum contaminant level specified in a state drinking water standard despite application of the best available

treatment technology, techniques, or other means which the department finds are generally available, taking costs into consideration, and that the granting of a variance will not result in an unreasonable risk to the health of persons served by the public water supply.

(b) The supplier of water demonstrates that a specific treatment technique is not necessary to protect the health of persons served by the public water supply, and that the granting of the variance will not result in an unreasonable risk to the health of persons served by the public water supply.

HISTORY: 1984 ACS 94, p. ____.

R 325.10305. Request for variance; included information.

Rule 305. A supplier of water who requests a variance from the department shall include on the request for variance the following information, where applicable:

(a) The nature and duration of the variance requested.

(b) Relevant water quality data of the public water supply, including the results of tests conducted pursuant to part 7 of these rules and the act.

(c) An explanation and evidence of the best available treatment technology and techniques, where applicable.

(d) Economic and legal factors relevant to the ability to comply with an MCL or treatment technique.

(e) Raw water quality data relevant to the variance requested.

(f) A proposed compliance schedule including the date by which each step toward compliance shall be achieved. A compliance schedule shall include, but not necessarily be limited to, all of the following:

(i) The date by which an arrangement for an alternative raw water source or improvement of the existing raw water source shall be completed.

(ii) The anticipated date of initiation of the connection to the alternative raw water source or the improved existing raw water source.

(g) A plan for interim control measures during the duration of the variance requested, including the provision of safe drinking water in the case of a rise in the contaminant level.

(h) A statement that the supplier of water shall perform monitoring and other reasonable requirements as may be prescribed by the director as a condition to a variance.

(i) Other information believed to be pertinent to the request for variance by the director or the supplier of water.

HISTORY: 1984 ACS 94, p. ____.

R 325.10306. Exemption from MCL or treatment technique; required finding.

Rule 306. Exemptions from an MCL or treatment technique may be granted by the director only upon his specific finding that all of the following exist:

(a) Due to compelling factors, including, but not limited to, economic factors, a public water supply is not able to comply with an MCL or treatment technique.

(b) A public water supply for which an exemption is requested was in operation on the effective date of the state drinking water standard.

(c) The supplier of water demonstrates that the granting of an exemption will not result in an unreasonable risk to the health of persons using the public water supply.

HISTORY: 1984 ACS 9, p. ___.

R 325.10307. Request for exemption; included information.

Rule 307. A supplier of water who requests an exemption from the department shall include on the request for an exemption all of the following information:

(a) The nature and duration of the exemption requested.

(b) Relevant water quality data of the public water supply, including the results of tests conducted pursuant to part 7 of these rules and the act.

(c) The date the public water supply was put into operation.

(d) A complete explanation of the compelling factors, including, but not limited to, time and economic factors which prevent the public water supply from achieving compliance.

(e) A proposed compliance schedule, including a date by which each step toward compliance shall be achieved.

(f) The date by which final compliance is to be achieved.

(g) Other information believed by the director or the supplier of water to be *pertinent to the request for exemption.*

HISTORY: 1984 ACS 9, p. ___.

R 325.10308. Review of request for variance or exemption.

Rule 308. In his review of a request for a variance or an exemption the director shall take at least the following into consideration:

(a) The availability and effectiveness of all methods which may be employed by the supplier of water to comply with the MCL or treatment technique for which the variance or exemption is requested.

(b) Cost and other economic considerations such as implementing treatment, improving the quality of the raw water source, using an alternative raw water source, or otherwise bringing the public water supply into compliance.

(c) The quality of the raw water source, including water quality data and pertinent sources of contamination.

(d) Source protection measures employed by the public water supply.

(e) *Construction or modification of treatment equipment or systems.*

(f) The time required to put into operation a new treatment system to replace an existing treatment system which is not in compliance, or other facilities or other means to bring the public water supply into compliance.

(g) Risk to the health of persons served by the public water supply.

HISTORY: 1984 ACS 9, p. ___.

R 325.10309. Disposition of requests for variances or exemptions; public notices and opportunity for public hearings.

Rule 309. (1) Prior to issuing an order granting a variance from an MCL, the director shall provide public notice of his intent and shall provide an opportunity for any person to request a public hearing on the proposed order and the proposed compliance schedule.

(2) Prior to finalizing a compliance schedule which is to be a part of an

exemption from an MCL or treatment technique or a variance from a specified treatment technique, the director shall provide public notice thereof and shall provide an opportunity for any person to request a public hearing on the compliance schedule.

(3) Public notices issued by the director pursuant to subrules (1) and (2) shall be circulated in a manner designed to inform interested persons of the proposed order or compliance schedule, or both.

(4) The public notice issued by the director pursuant to subrules (1) and (2) shall contain a summary of proposed conditions, compliance programs, compliance schedules, restrictions, and other information relating to the request for a variance or exemption.

(5) Notices issued and public hearings conducted pursuant to this rule may include more than 1 order or compliance schedule, or both.

(6) Public hearings conducted by the director pursuant to this rule shall be in accordance with, and subject to, R 325.10201 and R 325.10202.

HISTORY: 1984 ACS 84, p. ___.

R 325.10310. Order granting a variance or exemption or prescribing compliance schedule; denial of request.

Rule 310. After receipt of a request for a variance or exemption from a supplier of water, or following a public hearing conducted by the director pursuant to R 325.10309, the director shall issue an administrative order to the supplier of water granting a variance or exemption or prescribing a compliance schedule, or both, or shall deny the request.

HISTORY: 1984 ACS 84, p. ___.

R 325.10311. Term of exemption; reissuance.

Rule 311. An exemption granted by the director to a supplier of water shall have a fixed term not to exceed 5 years. A supplier of water who wishes to extend an exemption beyond the date specified in the administrative order shall submit a request for reissuance of an exemption pursuant to R 325.10307. Exemptions issued or reissued by the director pursuant to this part shall not be inconsistent in any manner with the provisions of the federal act.

HISTORY: 1984 ACS 84, p. ___.

R 325.10312. Remedies and penalties.

Rule 312. A supplier of water who submits false information in connection with a request for a variance or exemption, or who violates any of the provisions of an order issued by the director granting a variance or exemption, shall be subject to immediate revocation of the order and to the remedies and penalties specified by the act.

HISTORY: 1984 ACS 84, p. ___.

PART 4. PUBLIC NOTIFICATION

R 325.10401. Purpose.

Rule 401. The purpose of this part is to prescribe requirements of owners of public water supplies to provide public notification to customers or users of a public water supply when the public water supply fails to comply with an MCL; is granted a variance or exemption; or fails to comply with the requirements of a compliance schedule prescribed by a variance or exemption.

HISTORY: 1984 ACS 84, p. ___.

R 325.10402. Public notices, generally.

Rule 402. Public notices issued pursuant to this part shall be conspicuous, shall not use unduly technical language, unduly small print or other methods which frustrate the purpose of the notice.

HISTORY: 1984 ACS 94, p. ___

R 325.10403. Notice of variance or exemption from MCL granted to a type I public water supply.

Rule 403. (1) If a variance or exemption from an MCL is granted to a type I public water supply by the director pursuant to part 3 of these rules the owner of the public water supply shall provide notice thereof to all customers or users of that type I public water supply. The notice shall include, but not necessarily be limited to, the date the variance or exemption was granted by the director, the specific reasons for the variance or exemption, the specific MCL for which the variance or exemption was granted, the compliance schedule contained in the variance or exemption, and any preventive measures which shall be taken by users to protect the public health.

(2) Notification made by the owner of the type I supply pursuant to subrule (1) shall be made in water bills or by direct mail not later than 3 months from the date the variance or exemption was granted. The department may require such notification to be repeated at a frequency determined by the department.

HISTORY: 1984 ACS 94, p. ___

R 325.10404. Notice of variance or exemption from MCL granted to type II public water supply.

Rule 404. If a variance or exemption from an MCL is granted to a type II public water supply by the director pursuant to part 3 of these rules, the owner of the public water supply shall provide notice thereof by conspicuous posting of the notice in a location or locations where it can reasonably be expected to be observed by the customers or users of the type II public water supply. The notice shall be posted not later than 30 days after the date of granting the variance or exemption, and shall include, but not necessarily be limited to, the date the variance or exemption was granted by the director, the specific reasons for the variance or exemption, the specific MCL for which the variance or exemption was granted, the compliance schedule contained in the variance or exemption, and any preventive measures which shall be taken by the users to protect the public health.

HISTORY: 1984 ACS 94, p. ___

R 325.10405. Notice of failure of type I supply to comply with MCL or compliance schedule prescribed by variance or exemption.

Rule 405. (1) If a type I public water supply fails to comply with an MCL, or a compliance schedule prescribed by a variance or exemption, the public water supply shall provide notice thereof to all customers or users of that type I public water supply affected by the failure. Notification required by this rule shall include all material facts relating to the violation of the MCL or variance or exemption schedule, including the nature of the problem, a clear statement that an MCL or variance or exemption schedule has been violated, and the steps being taken to correct the violation. In addition, the notice shall explain the significance of the violation to the public health and any preventive or precautionary measures that shall be taken by the customers or users of the type I public water supply.

(2) Notification by the owner of the type I public water supply pursuant to subrule (1) shall be made in water bills or by direct mail not later than 3 months from the date of the violation. In the case of a violation of an MCL, such notice shall be repeated not less than once every 3 months so long as the violation continues. In the case of a violation of a variance or exemption schedule, the department may require such notification to be repeated at a frequency determined by the department.

(3) If a type I public water supply has failed to comply with an MCL and does not correct the failure promptly after discovery, the owner of that supply shall, in addition to the requirements of subrules (1) and (2), provide other general public notice of the failure in a manner as may be determined by the department. Additional notice as may be required by this subrule may consist of notice by newspaper advertisement, press release, or other appropriate means.

HISTORY: 1984 ACS 94, p. ___.

R 325.10406. Failure of owner of type II public water supply to comply with MCL; public notification.

Rule 406. Upon a determination that an owner of a type II public water supply has failed to comply with an MCL, or a compliance schedule prescribed by a variance or exemption, the owner of the public water supply shall provide public notification in a manner prescribed by R 325.10404.

HISTORY: 1984 ACS 94, p. ___.

R 325.10407. Notification of customers of public water supply that imminent hazard exists.

Rule 407. In situations where the director determines that an imminent hazard to the public health exists, the director may order the owner of a public water supply to make immediate notification to all customers or users of that public water supply. The notice shall contain the preventive or precautionary measures that should be taken by the customers or users of the public water supply to protect the public health.

HISTORY: 1984 ACS 94, p. ___.

R 325.10408. Periodic progress reports; correction of violations and notification of customers.

Rule 408. The department may require an owner of a public water supply to submit periodic reports on progress being made to correct a violation of an MCL, order, or a variance or exemption, and to notify the customers or users of the public water supply of that progress.

HISTORY: 1984 ACS 94, p. ___.

R 325.10409. Failure of owner to provide adequate public notice.

Rule 409. If deemed necessary by the department, when an owner of a public water supply fails to provide adequate public notice, the department may do so with costs incurred by the department charged to the owner of the public water supply. Action taken by the department pursuant to this rule shall not provide immunity to an owner of a public water supply from the remedies and penalties prescribed by the act.

HISTORY: 1984 ACS 94, p. ___.

PART 5. TYPES OF PUBLIC WATER SUPPLIES

R 325.10501. Purpose.

Rule 501. The purpose of this part is to implement section 8 of the act by establishing a basic classification system for public water supplies. The basic classification system established by this part may be modified in other parts of these rules, as applicable, to reflect the need for further breakdown due to specific criteria, requirements, or standards which may apply within a public water supply.

HISTORY: 1984 ACS 84, p. ___.

R 325.10502. Classification of public water supplies.

Rule 502. (1) For purposes of implementing the act, public water supplies are classified by the department into 3 types as follows:

(a) Type I: All community supplies are classified as type I public water supplies.

(b) Type II: All noncommunity supplies are classified as type II public water supplies.

(c) Type III: All water supplies which are not type I or type II public water supplies shall be classified as type III public water supplies.

(2) Type II public water supplies are further classified by the department as follows:

(a) Type IIa: Type IIa public water supplies are type II public water supplies with an average daily water production for the maximum month equal to or greater than 20,000 gallons per day.

(b) Type IIb: Type IIb public water supplies are type II public water supplies with an average daily water production for the maximum month of less than 20,000 gallons per day.

(3) When a supplier of water is unable to determine average daily water production, the department may use other criteria based on similar public water supplies to make a determination of classification for purposes of subrule (2).

HISTORY: 1984 ACS 84, p. ___.

R 325.10503. Two or more waterworks systems under same ownership or operation.

Rule 503. Two or more waterworks systems owned or operated by the same person at the same general location, not individually meeting the definition of a community supply or a noncommunity supply, but collectively meeting the definition of a community supply or a noncommunity supply, shall be considered by the department to be a single public water supply.

HISTORY: 1984 ACS 84, p. ___.

R 325.10504. General requirements of type I public water supplies.

Rule 504. Suppliers of water of type I public water supplies shall meet the following general requirements and other specific requirements as prescribed by the act and these rules:

(a) Certified operators of treatment systems and distribution systems are required.

(b) Suppliers of water shall monitor for contaminants at prescribed frequencies as required by part 7 of these rules.

(c) Suppliers of water shall submit waterworks system operation reports and shall maintain records.

(d) Except for those type I public water supplies serving facilities which are licensed annually by the department including, but not limited to, mobile home parks and health care facilities, suppliers of water shall comply with the provisions of part 14 of these rules, and suppliers of water of all type I public water supplies shall comply with all applicable state and local plumbing codes.

(e) Owners of type I public water supplies shall submit plans and specifications and obtain permits from the department in accordance with the provisions of the act and part 13 of these rules, except those type I public water supplies serving less than 15 living units.

HISTORY: 1984 ACS 84, p. ___.

R 325.10505. General requirements of type II public water supplies.

Rule 505. Suppliers of water of type II public water supplies shall meet the following general requirements and other specific requirements as prescribed by the act and these rules:

(a) Certified operators of treatment systems where treatment is employed to protect the public health are required.

(b) Suppliers of water shall monitor for contaminants at prescribed frequencies as required by part 7 of these rules.

(c) Suppliers of water shall submit waterworks system operation reports where treatment is employed to protect the public health, and shall maintain records as required by the department.

(d) Suppliers of water shall comply with all applicable state and local plumbing codes.

(e) Owners of type II public water supplies shall obtain permits from the department in accordance with the provisions of the act and part 13 of these rules.

HISTORY: 1984 ACS 84, p. ___.

R 325.10506. General requirements of type III public water supplies.

Rule 506. Suppliers of water of type III public water supplies shall meet the following general requirements and other specific requirements as prescribed by the act and these rules:

(a) Suppliers of water shall meet requirements for ground water sources and surface water sources in accordance with the provisions of the act and these rules, as those requirements pertain to type III public water supplies.

(b) If required by the department, suppliers of water shall monitor for contaminants at prescribed frequencies as required by part 7 of these rules.

(c) Suppliers of water shall comply with all applicable state and local plumbing codes.

HISTORY: 1984 ACS 84, p. ___.

PART 6. STATE DRINKING WATER STANDARDS AND ANALYTICAL TECHNIQUES

R 325.10601. Purpose.

Rule 601. Maximum contaminant levels for organic and inorganic chemicals, microbiological contaminants, and turbidity contained in the federal act are incorporated by reference in section 6 of the act. The purpose of this part is to establish certain MCL's for specific contaminants which are not adopted by reference by section 6 of the act or which are different than the MCL's contained in the federal act; and which shall be met by a supplier of water to assure protection of the public health; and to specify methods to be used in the analyses of water samples from public water supplies to determine compliance with the state drinking water standards.

HISTORY: 1984 ACS 84, p. ____

R 325.10602. MCL's for coliform bacteria.

Rule 602. Compliance with the MCL for coliform bacteria shall be determined in accordance with part 7 of these rules. The following are the MCL's for coliform bacteria applicable to all public water supplies:

(a) When the membrane filter technique is used, the number of coliform bacteria shall be less than 1 per 100 milliliters in any sample collected and analyzed.

(b) When the fermentation tube method and either 10 milliliter or 100 milliliter standard portions are used, coliform bacteria shall not be present in any portion of any sample collected and analyzed.

HISTORY: 1984 ACS 84, p. ____.

R 325.10603. MCL's for radium-226, radium-228, and gross alpha particle radioactivity in type I public water supplies.

Rule 603. The MCL's for radium-226, radium-228, and gross alpha particle radioactivity for type I public water supplies are as follows:

(a) Combined radium-226 and radium-228—5 pCi per liter.

(b) Gross alpha particle activity, including radium-226 but excluding radon and uranium—15 pCi per liter.

HISTORY: 1984 ACS 84, p. ____

R 325.10604. MCL's for beta particle and photon radioactivity from man-made radionuclides in type I public water supplies.

Rule 604. (1) The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water of type I public water supplies shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems per year.

(2) Except for the radionuclides listed in table 1, the concentration of man-made radionuclides in type I public water supplies causing 4 millirems total body or organ dose equivalents shall be calculated on the basis of a 2 liter per day drinking water intake using the 168-hour data listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure", NBS Handbook 69, as amended August, 1963, U.S. Department of Commerce. If 2 or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 millirem per year.

TABLE I

Average annual concentrations assumed to produce a total body or organ dose of 4 millirem per year.

Radionuclide	Critical Organ	pCi per liter
Tritium	Total body	20,000
Strontium-90	Bone marrow	8

HISTORY: 1954 ACS 94, p. ____.

R 325.10605. Analytical techniques for contaminants, turbidity, and radioactivity; incorporation by reference.

Rule 605. The analytical techniques for bacteriologic contaminants, inorganic chemical contaminants, organic chemical contaminants, turbidity, and radioactivity which are contained in the national interim primary drinking water regulations contained in 40 CFR Part 141, and which have been promulgated by EPA under authority of the federal act before the effective date of these rules are hereby incorporated by reference. Copies of the adopted material may be obtained from U. S. Environmental Protection Agency, Region V, Water Supply Branch, 230 South Dearborn Street, Chicago, Illinois, or from the Department of Public Health, 3500 North Logan Street, P.O. Box 30035, Lansing, Michigan 48909, at no cost.

HISTORY: 1954 ACS 94, p. ____.

R 325.10606. Alternative analytical techniques.

Rule 606. With the written permission of the department, and upon approval by EPA, an alternative analytical technique may be employed. The use of the alternative analytical technique shall not decrease the frequency of monitoring required by part 7.

HISTORY: 1954 ACS 94, p. ____.

R 325.10607. List of approved alternative analytical techniques; maintenance and availability.

Rule 607. A list of those alternative analytical techniques approved pursuant to R 325.10606 shall be maintained by the department and shall be available from the department offices in Lansing and Escanaba.

HISTORY: 1954 ACS 94, p. ____.

PART 7. SURVEILLANCE, INSPECTION, AND MONITORING

R 325.10701. Purpose.

Rule 701. The purpose of this part is to specify inspection and surveillance activities by the department to assure compliance by a public water supply with the act and these rules; to prescribe certain monitoring requirements and procedures for suppliers of water in accordance with the act and the federal act; and to establish a schedule of fees for the collection and analysis of water samples by the department as required by the act.

HISTORY: 1954 ACS 94, p. ____.

R 325.10702. Evaluation of adequacy and condition of public water supplies, generally.

Rule 702. In accordance with the provisions of section 3 of the act, the department shall make sanitary surveys, on-site inspections, surveillance obser-

vations, or special purpose investigations for the purpose of evaluating the adequacy and condition of public water supplies at a frequency which may be determined by the department.

HISTORY: 1954 ACS 84, p. ___.

R 325.10703. On-site inspections and surveillance observations.

Rule 703. On-site inspections and surveillance observations of public water supplies may include, but are not necessarily limited to, a review of all of the following:

(a) Waterworks system physical facilities and equipment.

(b) Administration and record keeping.

(c) Sampling techniques, and monitoring activities for water quality.

(d) The maintenance program for the waterworks system.

(e) The design and operation of the waterworks system.

(f) Compliance with operator certification requirements for treatment systems and distribution systems.

(g) A cross connection control program.

(h) The reliability of the waterworks system.

(i) Security measures provided to protect water quality and the operation of the waterworks system.

HISTORY: 1954 ACS 84, p. ___.

R 325.10704. Collection and analysis of samples for coliform bacteria, generally.

Rule 704. (1) Suppliers of water of type I and type II public water supplies shall collect samples and cause analyses to be made for coliform bacteria to determine compliance with the state drinking water standards.

(2) The department may require samples to be collected and analyzed for coliform bacteria for type III public water supplies at a frequency as may be deemed necessary by the department.

HISTORY: 1954 ACS 84, p. ___.

R 325.10705. Collection and analysis of samples for coliform bacteria; type I public water supply.

Rule 705. (1) A supplier of water of a type I public water supply shall collect samples of water from representative locations on a distribution system to be analyzed for the presence of coliform bacteria at regular time intervals and in numbers according to the population served by the system. The frequency of sampling shall be as set forth in table 1 in R 325.10737 or such other frequency as may be determined by the department and concurred in by the regional administrator.

(2) The department, based on a sanitary survey, may vary the frequency of sampling for a type I public water supply serving less than 1,000 persons, and supplied solely by a protected ground water source, but in no case shall the frequency be less than once per quarter.

HISTORY: 1954 ACS 84, p. ___.

R 325.10706. Collection and analysis of samples for coliform bacteria; type II public water supply.

Rule 706. (1) After June 24, 1979, a supplier of water of a type II public water supply shall collect samples of water and cause analyses to be made for the presence of coliform bacteria on a quarterly basis at such locations deemed appropriate by the department.

(2) The department, based on a sanitary survey of a type II public water supply with a protected ground water source, may vary the frequency of sampling.

HISTORY: 1954 ACS 94, p. ____

R 325.10707. Collection and analysis of check sample; reporting and notification.

Rule 707. (1) When a sample exceeds an MCL for coliform bacteria, 1 check sample shall be collected from the same sampling point and analyzed. If a subsequent sample has already been collected from the same sampling point, it shall be considered the check sample.

(2) When the analysis of the check sample required in subrule (1) shows the presence of coliform organisms, the supplier of water shall do both of the following:

(a) Report to the department within 48 hours.

(b) Initiate an investigation, including the collection and analysis of a check sample from the same point and other sampling points in the area, to define the extent of the problem.

(3) Following the investigation required in subrule (2) and if contamination is demonstrated by that investigation, the supplier of water shall notify the public in the area affected by the indicated contamination in accordance with the requirements contained in part 4 of these rules, unless the department determines that the positive samples resulted from sampling error.

(4) The department may, at its discretion, require check samples to be collected and analyzed at a specified frequency from the same sampling point and other sampling points in the area to identify and eliminate suspected public health hazards when a sample exceeds the maximum contaminant level set forth in the state drinking water standards, even if the check sample required in subrule (1) does not indicate the presence of coliform bacteria.

(5) When the cause of the indicated contamination has been determined and corrected, additional check samples shall be collected at a frequency as directed by the department.

(6) The location at which the check samples were taken pursuant to subrule (1) shall not be eliminated from future sampling without approval of the department.

HISTORY: 1954 ACS 94, p. ____

R 325.10708. Unreliable analysis results caused by factors beyond control of supplier; collection of additional samples.

Rule 708. The department may determine that unreliable analytical results for a sample collected in a discrete monitoring period pursuant to R 325.10705 and R 325.10706 were caused by factors beyond the control of the supplier of water. Those factors may include, but are not necessarily limited to, excessive transit time between collection and analysis of the sample, sample being broken in transit, or interference in test results when the membrane filter technique is used. If this is the case and the supplier of water does not learn of these results until the

following monitoring period, another sample collected immediately thereupon may be used in determining compliance with R 325.10705 and R 325.10706. However, a single sample may not be attributed to more than 1 monitoring period.

HISTORY: 1984 ACS 94, p. ____

R 325.10709. Nonroutine sampling.

Rule 709. Check samples, samples with unreliable analytical results, and special purpose samples such as those taken following water main placement, replacement, or repair shall not be used to determine compliance with R 325.10705 and R 325.10706, except as provided in R 325.10706.

HISTORY: 1984 ACS 94, p. ____

R 325.10710. Collection and analysis of samples for inorganic chemicals, generally.

Rule 710. (1) Suppliers of water of type I and type II public water supplies shall collect water samples and cause analyses to be made for inorganic chemicals to determine compliance with the state drinking water standards.

(2) The department may require samples to be collected and analyzed at a prescribed frequency for inorganic chemicals for type III public water supplies.

HISTORY: 1984 ACS 94, p. ____

R 325.10711. Collection and analysis of samples for inorganic chemicals; type I public water supply.

Rule 711. (1) For type I public water supplies utilizing surface water sources, samples shall be collected from the distribution system and analyses performed for the purpose of determining compliance with state drinking water standards for inorganic chemicals before June 24, 1978, and shall be repeated annually.

(2) For type I public water supplies utilizing only ground water sources, samples shall be collected from the distribution system and analyses performed for the purpose of determining compliance with state drinking water standards for inorganic chemicals before June 24, 1979, and shall be repeated at 3 year intervals.

HISTORY: 1984 ACS 94, p. ____

R 325.10712. Collection and analysis of samples for nitrate; type II and type III public water supplies.

Rule 712. (1) For type II public water supplies, whether supplied by surface or ground water sources, samples shall be collected from the waterworks system and analyses shall be performed for nitrate concentration before June 24, 1979, and at subsequent intervals as may be determined by the department.

(2) For type III public water supplies, the department may require samples to be collected and analyses performed for nitrate concentration as deemed necessary by the department.

HISTORY: 1984 ACS 94, p. ____

R 325.10713. Acceptability of existing data for inorganic chemical analyses.

Rule 713. For the initial analyses required by R 325.10711 and R 325.10712, data for type I and type II public water supplies utilizing surface water sources acquired after June 24, 1976, and for ground water sources acquired after June 24, 1974, shall be deemed acceptable by the department.

HISTORY: 1984 ACS 94, p. ____

R 325.10714. Inorganic chemicals; reporting and notification.

Rule 714. (1) If the result of an analysis made pursuant to R 325.10711 and R 325.10712 indicates that the concentration of any inorganic chemical contaminant exceeds the MCL, the supplier of water shall report to the division within 7 days and initiate 3 additional analyses at the same sampling point within 1 month.

(2) When the average of 4 analyses made pursuant to subrule (1) for the inorganic chemical in question exceeds the MCL, the supplier of water shall notify the division and shall give notice to the public pursuant to part 4 of these rules. Monitoring after public notification shall be at a frequency determined by the department and shall continue until the MCL has not been exceeded in 2 successive samples or until a monitoring schedule, as a condition to a variance, exemption, or enforcement action, becomes effective.

(3) For purposes of this rule, compliance with the MCL for nitrate shall be determined on the basis of the mean of 2 analyses.

HISTORY: 1984 ACS 94, p. ____.

R 325.10715. Nitrates; reporting and notification.

Rule 715. When a level exceeding the MCL for nitrate is found, a second analysis shall be initiated within 24 hours after being notified of the results and if the mean of the 2 analyses exceeds the MCL, the supplier of water shall report his findings to the division within 48 hours and shall make public notification as prescribed by part 4 of these rules.

HISTORY: 1984 ACS 94, p. ____.

R 325.10716. Collection and analysis of samples for organic chemicals; type I, type II, and type III public water supplies.

Rule 716. (1) Suppliers of water of type I public water supplies shall collect samples and cause analyses to be made for organic chemicals to determine compliance with the state drinking water standards.

(2) For type II and type III public water supplies, the department may require samples to be collected and analyzed at prescribed frequencies for organic chemicals.

HISTORY: 1984 ACS 94, p. ____.

R 325.10717. Collection and analysis of samples for organic chemicals; type I public water supplies.

Rule 717. (1) Samples shall be collected from the distribution system and analyses performed for the purpose of determining compliance with the MCL's for organic chemicals for type I public water supplies utilizing surface water sources before June 24, 1978. All analyses of water for organic chemicals shall be repeated at 3 year intervals, or more frequently if deemed necessary by the department.

(2) For type I public water supplies specified by the department utilizing only ground water sources, samples shall be collected from the distribution system and analyses performed at prescribed frequencies for the purpose of determining compliance with the MCL's for organic chemicals.

HISTORY: 1984 ACS 94, p. ____.

R 325.10718. Acceptability of existing data for organic chemical analyses.

Rule 718. For the initial analyses required by R 325.10717, data for public water supplies utilizing surface water sources acquired after June 24, 1976, and for public water supplies utilizing only ground water sources acquired after June 24, 1974, shall be deemed acceptable by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.10719. Organic chemicals; reporting and notification.

Rule 719. (1) If the result of an analysis made pursuant to R 325.10717 indicates that the concentration of any organic chemical contaminant exceeds the MCL, the supplier of water shall report to the division within 7 days and initiate 3 additional analyses at the same sampling point within 1 month.

(2) When the average of 4 analyses made pursuant to subrule (1) for the organic chemical in question exceeds the MCL, the supplier of water shall notify the division within 48 hours and shall give notice to the public pursuant to part 4 of these rules. Monitoring after public notification shall be at a frequency determined by the department and shall continue until the MCL has not been exceeded in 2 successive samples or until a monitoring schedule, as a condition to a variance, exemption, or enforcement action, becomes effective.

HISTORY: 1984 ACS 94, p. ___.

R 325.10720. Collection and measurement of samples for turbidity; type I and type II water supplies.

Rule 720. (1) Suppliers of water of all type I and type II public water supplies utilizing surface water sources shall collect samples and perform measurements for turbidity at a representative entry point to the water distribution system to determine compliance with the state drinking water standards.

(2) Suppliers of water of type I and type II water supplies utilizing surface water sources shall collect samples at least once daily, preferably more frequently, while the treatment system is in operation.

HISTORY: 1984 ACS 94, p. ___.

R 325.10721. Turbidity resampling; reporting and notification.

Rule 721. (1) If the result of a turbidity measurement pursuant to R 325.10720 indicates that the MCL has been exceeded, the sampling and measurement shall be confirmed by resampling as soon as possible, preferably within 1 hour. The repeat sample shall be the sample used for the purpose of calculating the daily average and the monthly average.

(2) Except as noted in subrule (1) of this rule, the daily average and monthly average shall be determined from the normally scheduled turbidity measurements and shall not include special purpose samples.

(3) If the daily average of turbidity measurements exceeds the MCL, the supplier of water shall notify the division within 48 hours. If the monthly average of the daily turbidity measurements exceeds the MCL or if the average of turbidity measurements taken on 2 consecutive days exceeds 5 turbidity units, a supplier of water shall report to the division within 48 hours and shall make public notification as prescribed by part 4 of these rules.

HISTORY: 1984 ACS 94, p. ___.

R 325.10722. Collection and analysis of samples for natural radionuclides.

Rule 722. (1) Suppliers of water of type I public water supplies shall collect samples of water and have analyses performed for natural radionuclides to determine compliance with the state drinking water standards.

(2) Suppliers of water of type I public water supplies shall initiate sampling to determine compliance with R 325.10603 of part 6 of these rules before June 24, 1979, and the analyses shall be completed before June 24, 1980. Compliance shall be based on the analysis of an annual composite of 4 consecutive quarterly samples or the average of the analyses of 4 samples obtained at quarterly intervals.

(3) A gross alpha particle activity measurement may be substituted for the required radium 226 and radium 228 analyses provided that the measured gross alpha particle activity does not exceed 5 pCi/l at a confidence level of 95%.

(4) In localities where radium 228 may be present in drinking water, the department may require radium 226 or radium 228 analyses, or both, when the gross alpha particle activity exceeds 2 pCi/l.

(5) When the gross alpha particle activity exceeds 5 pCi/l, the same or an equivalent sample shall be analyzed for radium 226. If the concentration of radium 226 exceeds 3 pCi/l, the same, or an equivalent sample, shall be analyzed for radium 228.

HISTORY: 1954 ACS 94, p. ____.

R 325.10724. Radiological monitoring; acceptability of existing data.

Rule 724. For the initial analysis required by R 325.10722, data acquired after June 24, 1976, shall be accepted by the department.

HISTORY: 1954 ACS 94, p. ____.

R 325.10725. Radiological monitoring; additional requirements.

Rule 725. (1) After the initial analysis required by R 325.10722, suppliers of water of type I public water supplies shall monitor for radiological contaminants at least once every 4 years following the procedures prescribed by R 325.10722. When an annual record taken pursuant to the procedures in R 325.10722 has established that the average annual concentration is less than half the MCL, an analysis of a single sample may be substituted for the quarterly sampling procedure at the discretion of the department.

(2) The department may require more frequent monitoring by suppliers of water in the vicinity of operations which may contribute alpha particle radioactivity to either surface or ground water sources of drinking water, or in the event of possible contamination or when changes in the distribution system or treatment processing occur which may increase the concentration of radioactivity in finished water. Annual monitoring may be required by the department of any public water supply in which the radium 226 concentration exceeds 3 pCi/l.

(3) A supplier of water of a type I public water supply which is new or which is introducing a new, completely different source shall monitor in conformance with R 325.10722 within 1 year of the introduction of the water source.

(4) A supplier of water of a type I public water supply using 2 or more sources of drinking water having different concentrations of radioactivity shall monitor source water in addition to water from a free flowing tap when determined necessary by the department to protect the public health.

(5) Monitoring for compliance with state drinking water standards after the initial period need not include radium 228 unless determined necessary by the department, provided that the average annual concentration of radium 228 has been assayed at least once using the quarterly sampling procedure required by subrule (1).

HISTORY: 1984 ACS 94, p. ___.

R 325.10726. Collection and analysis of samples for man-made radionuclides.

Rule 726. (1) Suppliers of water of type I public water supplies using surface water sources and serving more than 100,000 persons and such other type I public water supplies as may be designated by the department shall collect samples of water and have analyses performed for man-made radionuclides to determine compliance with the state drinking water standards.

(2) Suppliers of water of type I public water supplies utilizing surface water sources and serving more than 100,000 persons and such other type I public water supplies as may be designated by the department shall initiate sampling for beta particle and photon radioactivity from man-made radionuclides before June 24, 1979, and the analyses shall be completed before June 24, 1980. Compliance shall be based on the analysis of a composite of 4 consecutive quarterly samples or an average of the analysis of 4 quarterly samples. Compliance may be assumed without further analysis if the average annual concentration of beta activity is less than 50 pCi/l and if the average annual concentrations of tritium and strontium 90 are less than those listed in table 1 of this part, provided that if both radionuclides are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 millirems per year.

(3) If the gross beta particle activity exceeds 50 pCi/l, an analysis of the sample shall be required to identify the major radioactive constituents present and the appropriate organ and total body doses shall be calculated to determine compliance with the state drinking water standards.

(4) Suppliers of water utilizing only ground water sources may be required to monitor for man-made radioactivity as may be deemed necessary by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.10728. Acceptability of existing data and other data.

Rule 728. (1) For the initial analyses required by R 325.10726, data acquired after June 24, 1976, may be accepted by the department.

(2) The department may allow the substitution of environmental surveillance data taken in conjunction with a nuclear facility for direct monitoring of man-made radioactivity by a supplier of water where the department determines that data is applicable to a particular type I public water supply.

HISTORY: 1984 ACS 94, p. ___.

R 325.10729. Additional monitoring requirements for man-made radioactivity.

Rule 729. (1) After the initial analysis, suppliers of water shall monitor at least every 4 years following the procedures prescribed by R 325.10726.

(2) Prior to June 24, 1979, suppliers of water of any type I public water supply designated by the state as using waters contaminated by effluents from nuclear facilities shall initiate quarterly monitoring for gross beta particle and iodine 131 radioactivity and annual monitoring for strontium 90 and tritium.

(3) Quarterly monitoring for gross beta particle activity shall be based on the analysis of monthly samples or the analysis of the composite of 3 monthly samples. If the gross beta particle activity in a sample exceeds 15 pCi/1, the same or an equivalent sample shall be analyzed for strontium 89 and cesium 134. If the gross beta particle activity exceeds 50 pCi/1, an analysis of the sample shall be required to identify the major radioactive constituents present and the appropriate organ and total body doses shall be calculated to determine compliance with the state drinking water standards.

(4) For iodine 131, a composite of 5 consecutive daily samples shall be analyzed once each quarter. As ordered by the department, more frequent monitoring shall be conducted by a supplier of water when iodine 131 is identified in the finished water.

(5) Annual monitoring for strontium 90 and tritium shall be conducted by means of an analysis of a composite of 4 consecutive quarterly samples or the average of the analysis of 4 quarterly samples.

HISTORY: 1954 ACS 84, p. ——.

R 325.10730. Radioactivity; reporting requirements.

Rule 730. (1) If the average annual MCL for gross alpha particle activity or total radium as set forth in part 6 is exceeded, the supplier of water shall notify the division within 48 hours and shall notify the public pursuant to part 4 of these rules. Monitoring at quarterly intervals shall be continued until the annual average concentration no longer exceeds the state drinking water standard.

(2) If the average annual MCL for man-made radioactivity as prescribed in part 6 is exceeded, the supplier of water shall notify the division within 48 hours and shall provide notice to the public pursuant to part 4 of these rules. Monitoring at monthly intervals shall be continued until the concentration no longer exceeds the state drinking water standard.

HISTORY: 1954 ACS 84, p. ——.

R 325.10731. Sample analyses; approved laboratories and personnel.

Rule 731. For the purpose of determining compliance with the monitoring requirements prescribed by this part, samples shall be considered valid only if they have been analyzed by a laboratory approved by the department, except that measurements for turbidity may be performed by personnel acceptable to the department.

HISTORY: 1954 ACS 84, p. ——.

R 325.10732. Specific testing frequencies; sample locations and parameters.

Rule 732. (1) The department may require a supplier of water to monitor raw water, water during stages in the treatment system if treatment is employed, and water from the distribution system at frequencies and for parameters as specified by the department.

(2) Parameters required by subrule (1) may include other constituents than the MCL's including, but not limited to, chlorine residual.

HISTORY: 1954 ACS 84, p. ——.

R 325.10733. Modification of monitoring requirements for type I public water supplies which supply water to additional public water supplies.

Rule 733. When a type I public water supply supplies water to 1 or more other public water supplies, the department may modify the monitoring requirements prescribed by this part to the extent that the interconnection of the public water supplies justifies treating them as a single water supply for monitoring purposes. Modified monitoring shall be conducted pursuant to a schedule specified by the department and concurred in by the regional administrator.

HISTORY: 1954 ACS 84, p. ___.

R 325.10734. Reporting to the division; general requirements.

Rule 734. (1) Except where a shorter reporting period is specified in this part, a supplier of water shall report to the division the results of that measurement or analysis within 40 days following a measurement or analysis required by this part.

(2) Unless otherwise specified in this part, a supplier of water shall report to the division within 48 hours of a failure to comply with an MCL including failure to comply with a monitoring requirement as prescribed by this part.

(3) A supplier of water shall not be required to report analytical results to the division in cases where the department laboratory performs the analysis and reports the results to the division.

HISTORY: 1954 ACS 84, p. ___.

R 325.10735. Vigilance of threats or hazards; notification to division.

Rule 735. (1) A supplier of water shall maintain continued vigilance of activities posing threats or hazards of undue contamination to the source of water.

(2) In the event of a threat of contamination of a public water supply source, a supplier of water shall immediately notify the division.

HISTORY: 1954 ACS 84, p. ___.

R 325.10736. Schedule of fees.

Rule 736. The supplier of water shall collect and analyze water samples or have them collected and analyzed as specified in this part. If the supplier of water fails to meet this responsibility, the department shall collect and analyze the water samples routinely as specified in this part and charge the supplier for these services according to the fee schedule established in table 2 in R 325.10738.

HISTORY: 1954 ACS 84, p. ___.

R 325.10737. Table 1.

Rule 737. Table 1 reads as follows:

Population served	Minimum number of samples per month	Population served	Minimum number of samples per month
25 to 1,000	1	6,701 to 7,600	8
1,001 to 2,500	2	7,601 to 8,500	9
2,501 to 3,300	3	8,501 to 9,400	10
3,301 to 4,100	4	9,401 to 10,300	11
4,101 to 4,900	5	10,301 to 11,100	12
4,901 to 5,800	6	11,101 to 12,000	13
5,801 to 6,700	7	12,001 to 12,900	14

Population served	Minimum number of samples per month
12,901 to 13,700	15
13,701 to 14,600	16
14,601 to 15,500	17
15,501 to 16,300	18
16,301 to 17,200	19
17,201 to 18,100	20
18,101 to 18,900	21
18,901 to 19,800	22
19,801 to 20,700	23
20,701 to 21,500	24
21,501 to 22,300	25
22,301 to 23,200	26
23,201 to 24,000	27
24,001 to 24,900	28
24,901 to 25,000	29
25,001 to 28,000	30
28,001 to 33,000	35
33,001 to 37,000	40
37,001 to 41,000	45
41,001 to 46,000	50
46,001 to 50,000	55
50,001 to 54,000	60
54,001 to 59,000	65
59,001 to 64,000	70
64,001 to 70,000	75
70,001 to 76,000	80
76,001 to 83,000	85
83,001 to 90,000	90
90,001 to 96,000	95
96,001 to 111,000	100
111,001 to 130,000	110
130,001 to 160,000	120
160,001 to 190,000	130
190,001 to 220,000	140
220,001 to 250,000	150
250,001 to 290,000	160
290,001 to 320,000	170
320,001 to 360,000	180
360,001 to 410,000	190
410,001 to 450,000	200
450,001 to 500,000	210
500,001 to 550,000	220
550,001 to 600,000	230
600,001 to 660,000	240
660,001 to 720,000	250
720,001 to 780,000	260
780,001 to 840,000	270
840,001 to 910,000	280
910,001 to 970,000	290
970,001 to 1,050,000	300
1,050,001 to 1,140,000	310
1,140,001 to 1,230,000	320
1,230,001 to 1,320,000	330
1,320,001 to 1,420,000	340
1,420,001 to 1,520,000	350
1,520,001 to 1,630,000	360
1,630,001 to 1,730,000	370
1,730,001 to 1,850,000	380
1,850,001 to 1,970,000	390
1,970,001 to 2,080,000	400
2,080,001 to 2,270,000	410
2,270,001 to 2,510,000	420
2,510,001 to 2,750,000	430
2,750,001 to 3,020,000	440
3,020,001 to 3,320,000	450
3,320,001 to 3,620,000	460
3,620,001 to 3,980,000	470
3,980,001 to 4,310,000	480
4,310,001 to 4,690,000	490
4,690,001 or more	500

HISTORY: 1954 ACS 94, p. —

R 325.10738. Table 2.

Rule 738. Table 2 reads as follows:

Type of sample collected and analyzed or measured	Fee per sample when collected by the department
Bacteriologic	$35.00
Turbidity	$35.00
Others	No fee

HISTORY: 1954 ACS 94, p. —

PART 8. GROUND WATER SOURCES

R 325.10801. Purpose.

Rule 801. The purpose of this part is to establish certain requirements and objectives for the isolation and construction of wells which shall be met by public water supplies to provide a continuous, adequate quantity of water meeting the state drinking water standards.

HISTORY: 1984 ACS 94, p. —.

R 325.10802. Applicability; approval of deviation from minimum standards and requirements.

Rule 802. (1) The provisions of this part apply to wells used to supply ground water for a public water supply. These rules are minimum standards and requirements which shall be considered by the department in the issuance of permits or approvals for waterworks systems.

(2) Deviations from the minimum standards and requirements prescribed by this part may be approved by the department upon a showing by an owner of a public water supply that a deviation will not adversely affect the public health. Deviations from this part shall be by permit condition for type I or type II public water supplies, and in writing by the department for type III public water supplies.

HISTORY: 1984 ACS 94, p. —.

R 325.10804. Type III public water supplies; applicability of other rules.

Rule 804. Suppliers of water of type III public water supplies shall comply with the applicable provisions of rules of the department promulgated pursuant to Act No. 294 of the Public Acts of 1965, as amended, being §§325.221 to 325.240 of the Michigan Compiled Laws, and entitled, "Part 1. Well Construction Code," being R 325.1601 to R 325.1676 of the Michigan Administrative Code, except where specific requirements for type III public water supplies prescribed by this part are more restrictive.

HISTORY: 1984 ACS 94, p. —.

R 325.10805. Retroactivity of rules; significant changes or major repairs made to existing well; utilization of well not in compliance with this part.

Rule 805. (1) This part is not retroactive for individual well installations constructed before the effective date of these rules except:

(a) When water quality from the well does not meet the state drinking water standards.

(b) Upon a determination by the department that continued use of a well represents a health hazard, or

(c) When a well is found to be in violation of previous rules of the department which were in effect at the time of construction.

(2) Significant changes or major repairs made to an existing well after the effective date of these rules shall conform to the provisions of this part. Those changes shall include, but are not necessarily limited to, replacing the casing, modifying the depth of a well, installing new pumping equipment of a different type or of higher capacity, or modifying the pump setting. In general, a significant change or major repair shall be considered to have occurred if the pumping

capacity is increased above the original capacity as a result of the work. A significant change or major repair shall not include routine maintenance or incidental repairs.

(3) A supplier of water proposing to utilize water from a well or well field not in compliance with this part may be required to provide continuous treatment of the water in a manner acceptable to the department and shall obtain written approval from the department before utilizing that well or well field as part of a public water supply.

(4) A supplier of water employing a complete treatment system to treat a ground water source may be granted special consideration by the department for the location and construction of wells used as a raw water source prior to treatment.

HISTORY: 1954 ACS 94, p. ——

R 325.10806. Change in classification of public water supply.

Rule 806. Requirements or criteria prescribed by this part for the various types of public water supplies shall be based on the facilities which the public water supply is intended to serve. If the volume of water used or the type of facilities or number of units served by a public water supply changes in such a way as to cause a change in the classification of a public water supply, the supplier of water shall meet requirements applicable to the new classification.

HISTORY: 1954 ACS 94, p. ——

R 325.10807. Location of well.

Rule 807. A well shall be located with due consideration given to the extent of the property, the contour of the land, elevation of the site, the depth to the water table, other geological characteristics, local ground water conditions, and other factors necessary to provide a safe and reliable public water supply. A well shall meet all of the following requirements:

(a) Located so the well and its surrounding area is controlled and protected from potential sources of contamination.

(b) Adequate in size, design, and development for the intended use.

(c) Constructed to maintain existing natural protection against contamination of water bearing formations and to prevent all known sources of contamination from entering the well.

(d) Protected against the entry of surface water.

HISTORY: 1954 ACS 94, p. ——

R 325.10808. Standard isolation area, generally.

Rule 808. The standard isolation areas from any existing or potential sources of contamination including, but not limited to, storm and sanitary sewers, pipelines, septic tanks, drain fields, dry wells, cesspools, seepage pits, leeching beds, barnyards, or any surface water, other area or facility from which contamination of the ground water may occur, are established for public water supplies as follows:

(a) For type I and type IIa public water supplies, the standard isolation area is an area measured with a radius of 200 feet in all directions from the well.

(b) For type IIb and type III public water supplies, the standard isolation area is an area measured with a radius of 75 feet in all directions from the well.

HISTORY: 1954 ACS 94, p. ——

R 325.10809. Standard isolation area; modification; approval.

Rule 809. (1) Modifications of the standard isolation area, if any, shall be determined for a site based on a study of hydrogeological conditions provided to the department by a supplier of water pursuant to R 325.10813 and R 325.10814.

(2) The department may require an increase or approve a decrease in the standard isolation area of a well.

(3) Approval of the isolation area shall be obtained from the department before construction of a production well used for drinking or household purposes as part of a public water supply.

HISTORY: 1984 ACS 84, p. —.

R 325.10810. Standard isolation area for type I public water supplies; ownership or control.

Rule 810. (1) A supplier of water of a type I public water supply shall be required to own the approved isolation area except as provided by subrule (2) to prevent use of the property which could result in contamination of the public water supply.

(2) If a supplier of water of a type I public water supply adequately demonstrates to the department that ownership of the isolation area is not possible, adequate control of the isolation area shall be required. Adequate control may be a long term lease or easement including provisions to prevent use of the isolation area which could result in contamination of the well.

HISTORY: 1984 ACS 84, p. —.

R 325.10811. Sewers within approved isolation area.

Rule 811. (1) A storm or sanitary sewer shall not be located within the approved isolation area of a well for a type I or type IIa public water supply.

(2) A buried sewer, located within the approved isolation area for a type IIb or type III public water supply, shall be constructed with materials and joints as approved in writing by the department.

HISTORY: 1984 ACS 84, p. —.

R 325.10812. Location of wells with respect to major sources of contamination.

Rule 812. Wells serving type I and type IIa public water supplies shall be located a minimum distance of 2,000 feet, and wells serving type IIb and type III public water supplies shall be located a minimum distance of 800 feet, from known major sources of contamination including, but not limited to, large scale waste disposal sites, land application of sanitary wastewater or sludges, sanitary landfills, and chemical or waste chemical storage or disposal facilities. Based on hydrogeological studies, the department may require an increase or approve a decrease in the 2,000 foot distance for type I or type IIa public water supplies or the 800 foot distance for type IIb or type III public water supplies.

HISTORY: 1984 ACS 84, p. —.

R 325.10813. Study of hydrogeological conditions by supplier of water of type I and type IIa public water supplies.

Rule 813. (1) A supplier of water of a type I or type IIa public water supply shall prepare a study of hydrogeological conditions for determination of an isolation area and the acceptability of a proposed location of a well. The study shall be provided to the department and approval obtained.

(2) Previous studies of hydrogeological conditions shall be considered by the department in determining the scope of or need for a study required by this rule.

(3) A study of hydrogeological conditions shall mean investigations and a compilation and evaluation of data necessary to determine the isolation area, acceptability of a well location and construction, and the availability of water at that location. The study of hydrogeological conditions may include the following:

(a) The type of public water supply.

(b) The proposed well capacity.

(c) The proposed well depth and well construction features.

(d) Identification of geological formations including the thickness and characteristics of the aquifer, the number and thicknesses of protective layers, and if deemed necessary by the department, the areal extent of the protective formations.

(e) Location of the well relative to sources of contamination.

(f) Susceptibility of the area to flooding.

(g) Depth to the water table from the established ground surface.

(h) Proximity of the well to surface water.

(i) A yield test of the well in accordance with R 325.10830.

(j) Water quality analyses.

(4) The scope of the hydrogeological study may vary depending upon the capacity of the proposed well in relation to the aquifer capacity, the need for a modification of a standard isolation area, or other factors; and may include additional determinations required by the department, such as the general aquifer characteristics and interference relative to other wells in proximity to the well site.

HISTORY: 1954 ACS 84, p. ___.

R 325.10814. Studies of suppliers of water of type IIb and type III public water supplies.

Rule 814. If a modification of the standard isolation area is requested by a supplier of water of a type IIb or type III public water supply, the supplier shall submit to the department and obtain approval for a study of hydrogeological conditions consistent with the capacity of the well and the capacity of the aquifer.

HISTORY: 1954 ACS 84, p. ___.

R 325.10815. Procedures for department approval of a proposed well for type I and type II public water supplies.

Rule 815. (1) In reviewing the location and acceptability of a proposed well for a type I or type II public water supply, the department shall determine whether the following procedures have been followed by a supplier of water:

(a) Approval has been obtained from the department for each proposed land parcel on which a test well is to be located.

(b) For type I public water supplies, ownership or adequate control as required by R 325.10810 or an option for ownership or adequate control of the required isolation area has been secured.

(c) Where required, a study of hydrogeological conditions has been approved by the department.

(d) Satisfactory yield tests have been completed on the test well or the well capacity has been established to the satisfaction of the department.

(e) Water quality analyses show results meeting the state drinking water standards.

(2) When the department finds that a proposed well, its location, and its construction features meet the requirements of this part, the department shall authorize construction of a production well or conversion of a test well to a production well.

HISTORY: 1984 ACS 94, p. —.

R 325.10816. Location of well in area subject to flooding.

Rule 816. (1) A well shall not be located in an area subject to flooding unless the well is protected as approved in writing by the department. The ground surface immediately adjacent to a well casing shall be graded so that surface water is diverted away from the casing. Surface flooding shall not be allowed closer than 25 feet from the well.

(2) The top of a well casing, any other opening into the well casing, well appurtenances, and controls shall be not less than 2 feet above the greater of the following:

(a) One hundred year flood elevation.

(b) The maximum recorded flood elevation.

HISTORY: 1984 ACS 94, p. —.

R 325.10817. Top of well casing; elevation.

Rule 817. The top of a well casing shall terminate not less than 12 inches above the established ground surface, or the floor of a pump room, well room, or well house. In addition, for type IIb and type III public water supplies the top of a well casing may terminate not less than 12 inches above the floor of an approved basement offset.

HISTORY: 1984 ACS 94, p. —.

R 325.10818. Minimum well casing depth.

Rule 818. Casings for all wells serving public water supplies shall extend not less than 25 feet below the established ground surface.

HISTORY: 1984 ACS 94, p. —.

R 325.10819. Well casing in rock formation.

Rule 819. (1) In an area where a well is to be developed in fractured, jointed, or cavernous rock, the well shall not be approved as a production well unless all of the following conditions exist:

(a) Adequate protective material above the aquifer.

(b) No evidence of aquifer contamination.

(c) No direct flow from surface or near surface sources to the rock aquifer.

(2) The department may also approve a well developed in fractured, jointed, or cavernous rock based on special well construction features and a hydrogeologic study.

HISTORY: 1984 ACS 94, p. —.

R 325.10820. Water suction lines.

Rule 820. (1) A casing shall not be used as a suction line unless protected by a permanent outer casing.

(2) For type I and type IIa public water supplies, a buried water suction line extending outside the well casing is prohibited.

(3) For type IIb and type III public water supplies, a buried water suction line extending outside the well may be used if protected in a manner approved by the department.

(4) Any buried pump discharge line shall be under positive pressure at all times.

HISTORY: 1954 ACS 94, p. ___.

R 325.10821. Casing materials.

Rule 821. All casings used for wells serving a public water supply shall be of materials approved in writing by the department.

HISTORY: 1954 ACS 94, p. ___.

R 325.10822. Grouting.

Rule 822. (1) Grouting may be required by a method approved by the department to obtain a tight bond between the well casing and the undisturbed natural earth formations, thus preventing the entrance of any surface water or near surface contaminants to the ground water source.

(2) Grouting may be required to protect the well casing from corrosion, where necessary.

(3) Grouting may be required by the department where a reduction in the standard isolation area of a well is proposed.

HISTORY: 1954 ACS 94, p. ___.

R 325.10823. Flowing artesian wells; well construction.

Rule 823. In areas where flowing artesian wells are commonly encountered, the well construction methods proposed by a supplier of water to protect a flowing artesian aquifer and confining strata shall be submitted to the department by the supplier of water and approval obtained prior to the start of construction.

HISTORY: 1954 ACS 94, p. ___.

R 325.10824. Flowing artesian wells; flow control.

Rule 824. For flowing artesian wells, a direct connection between a discharge pipe for flow control and a sewer or other source of contamination is prohibited.

HISTORY: 1954 ACS 94, p. ___.

R 325.10825. Elevation of discharge from well casing; location of connection to well casing.

Rule 825. (1) For type I and type IIa public water supplies, a discharge from a well casing at an elevation less than 12 inches above the established ground surface is prohibited, except where an installation with an approved pitless adapter is permitted by the department.

(2) For type IIb and type III public water supplies, a connection to a well casing may be at least 12 inches above the floor of an approved basement offset, pump room, or well room, or the requirements of subrule (1) shall be met.

HISTORY: 1954 ACS 94, p. ___.

R 325.10826. Construction and location of room housing pumping equipment or room housing top of well casing.

Rule 826. (1) For type I and type IIa public water supplies, a room housing pumping equipment or a room housing the top of a well casing, where used, shall be constructed above the established ground surface allowing access to the pump for maintenance or repair.

(2) For type IIb and type III public water supplies, a room housing pumping equipment may be located below the established ground surface if it is located in or attached to an approved basement or is drained to the ground surface by gravity.

HISTORY: 1984 ACS 94, p. ____.

R 325.10827. Tail pipe or pump suction pipe; termination.

Rule 827. In screened wells, the bottom of a tail pipe or pump suction pipe shall terminate not less than 5 feet above the top of the screen.

HISTORY: 1984 ACS 94, p. ____.

R 325.10828. Casing vents; sampling tap; relief valves.

Rule 828. (1) Casing vents shall be:

(a) Provided on all wells and constructed to prevent the entrance of contaminants into the well.

(b) Extended to the outside atmosphere above the roof level if toxic or flammable gases are present.

(2) Provisions shall be made for collection of water samples by installation of a proper sampling tap in a convenient location as close to each well as possible.

(3) Air-vacuum relief valves, where used, shall be constructed to prevent entrance of contaminants into the well.

HISTORY: 1984 ACS 94, p. ____.

R 325.10829. Well appurtenances; type I public water supplies.

Rule 829. (1) The following is required of each well serving type I public water supplies:

(a) Each well shall be equipped with a meter or other acceptable means to measure the volume of water produced.

(b) Each well shall be provided with an electrical outlet energized with the pump motor, chemical injection taps, and space necessary for the addition of chemicals so that treatment equipment can be readily connected to the well discharge line in the event the department requires chemical treatment to protect the public health.

(c) Each well shall be equipped to allow pumping to waste without interrupting normal service in the distribution system.

(d) Each well shall be equipped with a means to measure the water level.

(2) Subdivisions (a) and (b) of subrule (1) do not apply to individual wells which are a part of a multiple well field serving a type I public water supply if the multiple well field is equipped in accordance with the provisions of subdivisions (a) and (b) or where a well is a raw water source for a treatment system when the treatment system is equipped with a meter or other acceptable means to measure the volume of water produced.

HISTORY: 1984 ACS 94, p. ____.

R 325.10830. Yield or performance testing requirements.

Rule 830. (1) Each well constructed to serve a public water supply shall be tested for yield or performance, by a method approved by the department, after installation of a production well and prior to use of a well to supply water to a waterworks system.

(2) For type I and type IIa public water supplies, yield tests or performance tests shall be performed on the test well or production well. The tests may be required to:

(a) Determine the adequacy of well depth and development.

(b) Secure water samples for quality analyses.

(c) Determine well capacity and production on a long term basis.

(d) Determine drawdown.

(e) Select permanent pumping equipment.

(f) Evaluate well efficiency.

(g) Assure proper utilization and protection of ground water aquifers.

(3) For type IIb and type III public water supplies, yield tests or performance tests of wells shall demonstrate that water can be safely withdrawn from an aquifer in sufficient quantity to provide water for drinking and household purposes and of a quality meeting the state drinking water standards.

HISTORY: 1984 ACS 84, p. ___.

R 325.10831. New or reconditioned well; disinfection; water samples.

Rule 831. (1) A new or reconditioned well or pump installation or well facility which is opened for maintenance or inspection shall be pumped to waste until the water is as clear as reasonably possible. Thereafter the well and pumping equipment shall be properly disinfected.

(2) Prior to placing a new or reconditioned well or a well facility which is opened for maintenance or inspection into service, not less than 2 consecutive water samples for bacteriological analyses shall be collected from the installation and each analysis shall show results meeting state drinking water standards. Analyses for other contaminants may be required by the department.

HISTORY: 1984 ACS 84, p. ___.

R 325.10832. Abandoned wells.

Rule 832. An abandoned well shall be properly filled and sealed to prevent it from becoming a hazard or serving as a channel for contamination of the ground water or the escape of subterranean gas.

HISTORY: 1984 ACS 84, p. ___.

R 325.10833. Sanitary protection of ground water sources.

Rule 833. Water from ground water sources with limited or no sanitary protection including springs, shall not be used as a water source for a public water supply, unless followed by complete treatment prior to distribution.

HISTORY: 1984 ACS 84, p. ___.

PART 9. SURFACE WATER SOURCES

R 325.10901. Purpose.

Rule 901. The purpose of this part is to establish certain requirements for the location and use of raw water intakes in surface water sources to assure a continuously adequate quantity of the best quality raw water available for treatment and distribution to the public.

HISTORY: 1954 ACS 94, p. ___

R 325.10902. Applicability; approval of deviations from minimum standards and requirements.

Rule 902. (1) The provisions of this part apply to all public water supplies utilizing surface water sources. These rules are minimum standards and requirements which shall be considered by the department in the issuance of permits or approvals for waterworks systems or portions thereof.

(2) Deviations from the minimum standards and requirements prescribed by this part may be approved by the department upon a showing by an owner of a public water supply that a deviation will not adversely affect the public health. Deviations from this part shall be by permit condition for type I and type II public water supplies, and in writing by the department for type III public water supplies.

HISTORY: 1954 ACS 94, p. ___

R 325.10904. Retroactivity of rules.

Rule 904. This part is not retroactive for intakes in surface water sources constructed before the effective date of these rules, except upon a determination by the department that continued use of the intake or surface water source poses a health hazard.

HISTORY: 1954 ACS 94, p. ___

R 325.10905. Sanitary survey of proposed surface water source.

Rule 905. (1) A sanitary survey of a proposed surface water source shall be performed by the owner of a public water supply. The scope or need for the sanitary survey shall be established in advance by the department after consultation with the owner.

(2) All of the following shall be determined for each alternate location of a surface water intake:

(a) The normal water quality.

(b) Any significant variations in water quality.

(c) Any existing or potential hazards to public health.

(d) The suitability of the water for treatment.

(e) The availability of an adequate and dependable source.

(3) Previous sanitary surveys of the same surface water source may be considered by the department in determining the scope or need for a sanitary survey required by subrule (1).

(4) The results of the sanitary survey shall be submitted to the department for review, and approval shall be obtained prior to the issuance of a permit for the construction or use of an intake in a surface water source.

(5) Where the water quality of the proposed surface water source is unknown, the department may require sampling and analyses by the supplier of water for a period not to exceed 1 year to determine water quality and suitability of the water for treatment.

HISTORY: 1984 ACS 94, p. ___.

R 325.10906. Intake from surface water source; design capacity.

Rule 906. An intake from a surface water source shall be designed to withdraw raw water in no greater quantity than the available yield at the 100 year drought elevation or flow.

HISTORY: 1984 ACS 94, p. ___.

R 325.10907. Intake inlet and pipeline.

Rule 907. (1) The intake inlet shall be submerged so that hazards of the source waters, including physical hazards, icing hazards, and shipping hazards are minimized.

(2) Approval of the intake inlet configuration and construction materials shall be based on protection of the structure and control of the inlet velocity.

(3) The intake pipeline shall be constructed to reasonably protect against physical hazards associated with the surface water source.

HISTORY: 1984 ACS 94, p. ___.

R 325.10908. Approval of intake materials.

Rule 908. Classes and types of materials used for intake pipelines, joints, and intake inlets shall be as approved by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.10909. Pressure testing required.

Rule 909. Pressure testing is required and the intake line shall meet the requirements of the pressure test prior to placing a new intake line into service.

HISTORY: 1984 ACS 94, p. ___.

PART 10. TREATMENT SYSTEMS AND PUMPING FACILITIES

R 325.11001. Purpose.

Rule 1001. The purpose of this part is to establish requirements to be met by suppliers of water providing treatment of surface water sources or other sources of water requiring treatment, and to establish requirements for water pumping facilities operated by suppliers of water to provide a continuously adequate quantity of water meeting the state drinking water standards.

HISTORY: 1984 ACS 94, p. ___.

R 325.11002. Applicability; approval of deviations from minimum standards and requirements.

Rule 1002. (1) The provisions of this part apply to all public water supplies using surface water sources, to all complete treatment systems, and to certain other treatment systems; and to all water pumping facilities. These rules are minimum standards and requirements which shall be considered by the department for issuance of permits or approvals for waterworks systems.

(2) Deviations from the minimum standards and requirements prescribed by this part may be approved by the department upon a showing by an owner of a public water supply that the deviation will not adversely affect public health. Deviations shall be by permit condition for type I and type II public water supplies, and in writing by the department for type III public water supplies.

HISTORY: 1984 ACS 94, p. ___

R 325.11004. Treatment requirements for surface water sources and other sources.

Rule 1004. (1) Exceptions to this rule, except as provided by subrule (4), shall be by variance or exemption only.

(2) A complete treatment system shall be provided for all public water supplies using a surface water source.

(3) A complete treatment system may be required for certain other sources of water which, in the judgement of the department, cannot be continuously protected against contamination.

(4) The department may grant a deviation from subrules (2) or (3) where a treatment system which includes filtration is demonstrated to be capable of producing finished water meeting the state drinking water standards.

(5) All treatment systems for public water supplies using a surface water source or any source of water requiring complete treatment shall provide sufficient disinfectant contact time at the rated treatment capacity before entry of the water to the distribution system to assure adequate disinfection.

(6) Equipment provided for disinfection required under subrule (5) shall be capable of treating at the rated treatment capacity with the largest unit removed from service.

(7) Disinfection shall be provided for public water supplies employing phosphate treatment systems or certain iron removal treatment systems.

HISTORY: 1984 ACS 94, p. ___

R 325.11005. Treatment system; measurement of volume and rate of finished water flow.

Rule 1005. Each treatment system shall be provided with a means to measure the volume and rate of finished water produced.

HISTORY: 1984 ACS 94, p. ___

R 325.11006. Rated capacity of a complete treatment system.

Rule 1006. (1) The department shall establish the rated capacity of new or existing complete treatment systems.

(2) The department shall notify the supplier of water of its determination of rated capacity within 1 year from the effective date of these rules or on the permit for a new complete treatment system or on the permit for an existing complete treatment system which undergoes alterations which affect rated capacity.

(3) The rated capacity of the complete treatment system is the smallest of the following rated capacities for each element or unit of the system:

(a) Intake—The rated capacity of the intake is the lesser of the intake capacity at the 100 year drought elevation or the intake capacity at the time of the lowest recorded elevation of surface water at the point of intake.

(b) Raw water supply—The rated capacity of the raw water supply is the firm capacity of raw water pumping units or the total flow from a system supplying raw water by gravity under minimum source water elevation conditions.

(c) Treatment processes—The rated capacity of treatment processes including coagulation, precipitation, sedimentation, and filtration is the established maximum allowable treatment rate. Where less than 4 filters are provided, the rated capacity of the filters is the maximum allowable treatment rate with the largest filter removed from service.

(d) Finished water supply—The rated capacity of the finished water supply to the distribution system or storage is the firm capacity of pumping systems or the total flow from a system supplying finished water by gravity under the limiting head condition.

HISTORY: 1984 ACS 94, p. ___.

R 325.11007. Retroactivity of rules.

Rule 1007. R 325.11008 is not retroactive for existing complete treatment systems except upon a determination by the department that continued use of the existing system represents a health hazard.

HISTORY: 1984 ACS 94, p. ___.

R 325.11008. Complete treatment system; requirements.

Rule 1008. (1) A minimum of 2 units shall be provided for each treatment process for coagulation, sedimentation, and filtration.

(2) Firm filter backwash capacity at the approved backwash rate is required.

(3) Essential chemical systems for application of disinfectants, primary coagulants, and other chemicals, as required by the department, shall be equipped to provide service at the maximum allowable treatment rate with the largest unit removed from service.

(4) Storage of essential chemicals shall be provided to assure continuity of supply for treatment process requirements.

(5) Application points for disinfection shall be provided, or be available, at all of the following:

(a) Before coagulation.

(b) Immediately preceding filtration.

(c) Immediately following filtration.

(d) Immediately before entry of finished water into the distribution system.

(6) Each unit or element of a complete treatment system shall be provided with a means to remove it from service without interrupting the treatment process. However a complete bypass of the coagulation, sedimentation, or filtration processes is prohibited.

(7) Each unit or element of a complete treatment system shall be provided with a means to drain and with overflow control sufficient to prevent flooding of the facility.

(8) There shall be no common walls between finished water and water of lesser quality.

(9) Each complete treatment system shall be provided with a means to measure the volume and rate of raw water supplied and finished water produced.

(10) A complete treatment system shall be protected from the highest recorded flood elevation or the 100 year flood elevation, whichever is greater.

(11) Components of a complete treatment system essential for protection of public health and required for production of drinking water on a continuous basis shall be protected from flooding.

HISTORY: 1984 ACS 94, p. ___.

R 325.11009. Treatment system operator.

Rule 1009. An operator certified in accordance with part 19 of these rules shall be present at all times during operation of the treatment processes at a complete treatment system or other treatment system using a surface water source.

HISTORY: 1984 ACS 94, p. ___.

R 325.11010. Applicability of pumping facility.

Rule 1010. R 325.11011 and R 325.11012 apply to all raw water, finished water, and distribution system pumping installations in type I and type IIa public water supplies, except distribution system pumping facilities where service is provided to less than 50 service connections or to less than 200 individuals.

HISTORY: 1984 ACS 94, p. ___.

R 325.11011. Pumping facility; capacity.

Rule 1011. (1) A pumping facility shall have sufficient capacity to meet the service area demands with the largest unit removed from service.

(2) Compliance with this rule for public water supplies in operation on the effective date of these rules shall be achieved by January 1, 1985.

HISTORY: 1984 ACS 94, p. ___.

R 325.11012. Pumping facility; servicing.

Rule 1012. Each unit of a pumping facility shall be provided with a means to remove it from service without interrupting service to the distribution system.

HISTORY: 1984 ACS 94, p. ___.

R 325.11013. Pumping facility; storage and demand.

Rule 1013. All pumping facilities operating with hydropneumatic storage systems or with less than adequate gravity storage systems shall have capacity equal to, or greater than, peak instantaneous demands. This rule shall apply to all public water supplies.

HISTORY: 1984 ACS 94, p. ___.

R 325.11014. Pumping facility; protection from flooding.

Rule 1014. (1) A pumping facility shall be protected from the highest recorded flood elevation or the 100 year flood elevation, whichever is greater.

(2) Components of a pumping facility essential for protection of public health and required for pumping water on a continuous basis shall be protected from flooding.

HISTORY: 1984 ACS 94, p. ___.

R 325.11015. Pumping facility; pressure.

Rule 1015. (1) All finished water pumping facilities shall be designed to maintain a minimum pressure of 5 p.s.i. gauge in all buried suction piping and suction piping subject to flooding.

(2) For finished water pumping facilities taking direct suction from a distribution system, an adequate pressure shall be maintained in the distribution system on the low pressure side of the facility.

HISTORY: 1954 ACS 94, p. ___.

R 325.11016. Protection of treatment systems and pumping facilities.

Rule 1016. Suppliers of water shall take reasonable precautions to protect treatment systems and pumping facilities from trespassers and to prevent introduction of contaminants into the waterworks system.

HISTORY: 1954 ACS 94, p. ___.

PART 11. DISTRIBUTION SYSTEMS AND STORAGE TANKS

R 325.11101. Purpose.

Rule 1101. The purpose of this part is to establish certain requirements for distribution systems and water storage tanks to assure a continuously adequate quantity and quality of water for drinking and household purposes.

HISTORY: 1954 ACS 94, p. ___.

R 325.11102. Applicability; approval of deviations from minimum standards and requirements.

Rule 1102. (1) The provisions of this part apply to all public water supplies. These rules are minimum standards and requirements which shall be considered by the department in the issuance of permits or approvals for waterworks systems.

(2) Deviations from the minimum standards and requirements prescribed by this part may be approved by the department upon a showing by an owner of a public water supply that a deviation will not adversely affect the public health. Deviations from this part shall be by permit condition for type I public water supplies, and in writing by the department for type II and type III public water supplies.

HISTORY: 1954 ACS 94, p. ___.

R 325.11104. Retroactivity of rules.

Rule 1104. This part is not retroactive for existing distribution systems and water storage tanks except upon a determination by the department that continued use of a distribution system or storage tank poses a health hazard.

HISTORY: 1954 ACS 94, p. ___.

R 325.11105. Capacity of distribution system; fire hydrants; inadequately sized watermains.

Rule 1105. (1) Distribution systems shall have sufficient capacity to meet peak demands, including fire flow demands where fire protection is provided, while continuously maintaining positive pressure adequate for service.

(2) The department may prohibit installation of fire hydrants where watermain capacity, system source capacity, storage capacity, or pressure is inadequate to sustain fire flow demands in addition to normal user demands.

(3) Replacement of inadequately sized watermains with watermains of the same size is prohibited.

HISTORY: 1954 ACS 94, p. ___.

R 325.11106. Watermain and joint materials.

Rule 1106. Classes and types of materials used for watermains and joints shall be as approved in writing by the department.

HISTORY: 1954 ACS 94, p. ___

R 325.11107. Isolation of watermains from sources of contamination.

Rule 1107. All public water supplies shall maintain adequate vertical and horizontal isolation of watermains from sources of contamination.

HISTORY: 1954 ACS 94, p. ___

R 325.11108. Distribution system valves.

Rule 1108. (1) Sufficient valves shall be provided on distribution systems to minimize interruptions in service and minimize sanitary hazards during construction or repairs.

(2) Automatic air relief and automatic vacuum relief valves, if provided on the distribution system, shall be installed and maintained to prevent contaminants from entering the distribution system.

(3) Buried stop-and-waste valves on service lines and the installation of other valves with openings subject to flooding are prohibited.

HISTORY: 1954 ACS 94, p. ___

R 325.11109. Type I public water supplies; pressure testing of new watermains.

Rule 1109. For type I public water supplies, pressure testing is required for new watermains, and the requirements of the pressure test shall be met prior to placing a new watermain in service.

HISTORY: 1954 ACS 94, p. ___

R 325.11110. Distribution systems; flushing, disinfection, and water analysis.

Rule 1110. (1) Proper techniques shall be followed during construction to keep watermains clean and dry. New watermains shall be flushed thoroughly prior to disinfection.

(2) Disinfection of new watermains is required.

(3) Prior to placing a new watermain in service, not less than 2 consecutive water samples for bacteriological analysis shall be collected and each analysis shall show results meeting state drinking water standards. Analyses for other contaminants may be required by the department.

(4) Those public water supplies in which all or part of a distribution system is not in year-round service shall disinfect the distribution system before resuming use. Bacteriological sampling and analysis shall be performed and shall show results meeting the state drinking water standards before resuming use.

HISTORY: 1954 ACS 94, p. ___

R 325.11111. Distribution system records.

Rule 1111. A supplier of water shall maintain adequate records on the operation of the water distribution system, on the location and type of maintenance performed, and on the type of materials and appurtenances used.

HISTORY: 1954 ACS 94, p. ___

R 325.11112. Storage tanks, generally.

Rule 1112. All storage tanks including hydropneumatic or gravity storage tanks which are used for the storage of finished water shall meet all of the following requirements:

(a) Be watertight below the maximum water level elevation.

(b) Be constructed with materials and coatings approved by the department pursuant to part 21 of these rules.

(c) Have no unprotected openings.

(d) Be provided with access to the inside of the tank for inspection or repair.

(e) Be capable of being isolated from the distribution system and drained without interrupting service to users or customers.

(f) Prevent sediment or debris which may collect in the tank from entering the distribution system.

HISTORY: 1984 ACS 94, p. ___.

R 325.11113. Gravity storage tanks.

Rule 1113. All gravity storage tanks shall be provided with all of the following:

(a) A watertight and properly drained roof.

(b) A vent of sufficient size.

(c) An overflow line of sufficient size.

(d) A high and low level warning device.

HISTORY: 1984 ACS 94, p. ___.

R 325.11114. Ground level gravity storage tanks.

Rule 1114. (1) The bottom of a ground level gravity storage tank shall be above the highest ground water level.

(2) The bottom of a ground level gravity storage tank shall be located at least 1 foot above the 100 year flood elevation or the maximum recorded flood elevation, whichever is greater.

(3) The site of a ground level gravity storage tank shall be graded to direct surface drainage away from the tank.

HISTORY: 1984 ACS 94, p. ___.

R 325.11115. Hydropneumatic storage tanks.

Rule 1115. (1) For type I and type IIa public water supplies, a hydropneumatic tank shall be located above the established ground surface and installed in a wellhouse, except it shall be acceptable to expose 1 end of the hydropneumatic tank and the controls in a wellhouse and mound earth cover material over the remainder of the tank.

(2) For type IIb and type III public water supplies, a hydropneumatic tank may be partially buried if controls are located in an approved basement or in a room or pit drained by gravity to the ground surface. A totally buried hydropneumatic tank may be used if manufactured and installed as approved by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11116. Type I public water supplies; pressure testing of new storage tanks.

Rule 1116. For type I public water supplies, hydrostatic pressure testing is required for new storage tanks, and the requirements of the pressure test shall be met prior to placing a new storage tank into service.

HISTORY: 1984 ACS 94, p. ___.

R 325.11117. Storage tanks; disinfection and water analysis.

Rule 1117. (1) Proper techniques shall be followed during construction to keep storage tanks clean and dry.

(2) A finished water storage tank shall be disinfected prior to initial use and after any internal maintenance or repair activity.

(3) After construction, repair, or maintenance of a storage tank, not less than 2 consecutive water samples for bacteriological analysis shall be collected and each analysis shall show results meeting state drinking water standards. Analyses for other contaminants may be required by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11118. Protection of storage tanks.

Rule 1118. Suppliers of water shall take reasonable precautions to protect storage tanks from trespassers and to prevent introduction of contaminants into the distribution system or storage tanks.

HISTORY: 1984 ACS 94, p. ___.

PART 12. RELIABILITY

R 325.11201. Purpose.

Rule 1201. The purpose of this part is to establish certain requirements for maintaining the reliability of public water supply systems to assure a continuous supply of water for drinking and household purposes.

HISTORY: 1984 ACS 94, p. ___.

R 325.11202. Applicability; approval of deviations from minimum requirements.

Rule 1202. (1) The provisions of this part apply to all type I public water supplies and are minimum requirements of the department.

(2) Deviations from the minimum requirements prescribed by this part may be approved in writing by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11203. Study of water supply requirements for type I public water supply; proposal for compliance.

Rule 1203. (1) The owner of a type I public water supply shall conduct a study to determine the quantity of water supply needed for the waterworks system and shall propose a method of compliance in accordance with R 325.11204.

(2) The study required by subrule (1) shall be based upon 10 year projections of water use by the public water supply. The study shall be updated every 5 years unless this requirement is waived by the department.

(3) As a minimum, the information presented in this study shall include all of the following:

(a) The present and projected average daily demand.

(b) The present and projected maximum daily demand.

(c) The present and projected maximum hourly demand.

(d) The present and projected peak instantaneous demand for systems using hydropneumatic storage.

(e) The present and projected fire flow demand.

(f) The basis of demand projections.

(4) The initial study to determine the quantity of water supply needed, as required by subrule (1), shall be submitted to the department by January 1, 1981, or at the time a new finished water source is proposed.

(5) If the owner of a type I public water supply fails to provide an adequate study of water supply requirements, the department may determine the quantity of water supply needed for that public water supply and notify the owner of its determination. A permit shall not be issued by the department to a public water supply unless an approved study of water supply quantity requirements is available or unless a determination is made by the department pursuant to this subrule.

HISTORY: 1954 ACS 94, p. ___.

R 325.11204. Required capacity of waterworks system; compliance date; applicability.

Rule 1204. (1) A supplier of water of a type I public water supply shall provide sufficient capacity in the waterworks system to meet the approved finished water supply requirements. That capacity may be 1, or any combination of, the following:

(a) Rated capacity from an approved surface water supply or complete treatment system.

(b) Firm capacity from an approved ground water supply where firm capacity equals the flow with the largest producing well out of service.

(c) The available capacity obtained under contract and capable of delivery from another approved public water supply.

(d) Finished water storage capacity in excess of the established normal waterworks system requirements.

(2) Compliance with this rule by type I public water supplies in operation on the effective date of these rules is required by January 1, 1985. If compliance is achieved prior to January 1, 1985, the requirements of this rule shall be met thereafter.

(3) Compliance with this rule may be required by the department prior to January 1, 1985, pursuant to an administrative order issued by the director.

HISTORY: 1954 ACS 94, p. ___.

R 325.11205. Minimum number of wells; compliance date.

Rule 1205. (1) For type I public water supplies where ground water is the sole source of water supply, a minimum of 2 wells, with separate pumping units as required, shall be provided.

(2) Compliance with this rule for public water supplies in operation on the effective date of these rules is required within 5 years from the effective date of these rules.

HISTORY: 1984 ACS 94, p. ___.

R 325.11206. Interruption of power service; applicability; compliance date.

Rule 1206. (1) For a type I public water supply, a means shall be provided to continuously supply finished water to the entire distribution system during periods when the normal power service is interrupted.

(2) This rule does not apply to type I public water supplies serving less than 50 service connections or serving less than 200 individuals, or to those public water supplies serving facilities which are licensed annually by the department including, but not limited to, mobile home parks and health care facilities.

(3) Compliance with this rule is required by January 1, 1985.

HISTORY: 1984 ACS 94, p. ___.

R 325.11207. Interruption in water service to distribution system.

Rule 1207. If an interruption in water service to the distribution system occurs due to a failure in the source of supply, the water shall be disinfected in a manner approved by the department and compliance with the state drinking water standards shall be demonstrated by additional bacteriological monitoring. The department may require the supplier of water to provide notice to customers or users of the public water supply in accordance with the provisions of part 4.

HISTORY: 1984 ACS 94, p. ___.

PART 13. CONSTRUCTION PLANS AND SPECIFICATIONS AND PERMITS

R 325.11301. Purpose.

Rule 1301. The purpose of this part is to prescribe requirements of suppliers of water of type I and type II public water supplies regarding the submission of plans and specifications or other pertinent information for the construction or alteration of a waterworks system, or a portion thereof, and the procedures for issuance of permits by the department for that construction or alteration.

HISTORY: 1984 ACS 94, p. ___.

R 325.11302. Submission of plans and specifications for construction or alteration of waterworks system; guidance material.

Rule 1302. (1) For type I public water supplies, before the construction or alteration of any waterworks system, or a portion thereof, plans and specifications shall be submitted to the department by a supplier of water or his designated agent for review, approval, and issuance of a permit, unless otherwise excepted by subrule (2) of R 325.11304.

(2) A transmittal letter shall be submitted with the plans and specifications, shall identify and summarize plans or projects, and, if applicable, shall indicate the authorization of the designated agent for the supplier of water.

(3) A supplier of water shall use the materials set forth in the "Recommended Standards for Water Works", prepared by the Great Lakes-Upper Mississippi board of state sanitary engineers, whenever applicable, as guidance when preparing plans and specifications for submission to the department for a waterworks system, or portion thereof.

HISTORY: 1984 ACS 94, p. ___.

R 325.11303. Engineering report or basis of design; approval.

Rule 1303. (1) If requested by the department, a supplier of water shall submit an engineering report for a significant project or a basis of design, or both, for approval by the department, before plans and specifications are submitted for the construction or alteration of any portion of a waterworks system.

(2) The department may reject or return any plans and specifications submitted by a supplier of water for the construction or alteration of a waterworks system, or any portion thereof, unless an engineering report or basis of design, or both, as requested by the department, have been approved.

HISTORY: 1954 ACS 94, p. ___.

R 325.11304. Type I and type II public water supplies; construction details and sketch of proposed waterworks system; replacement of watermains and appurtenances; permit.

Rule 1304. (1) Suppliers of water of type II public water supplies shall submit construction details and an acceptable scaled drawing properly dimensioned showing important aspects of the general layout of a proposed waterworks system, or portion thereof, and shall obtain a permit for the construction or alteration of all source facilities and any treatment facilities which are to be employed for public health purposes prior to construction.

(2) Suppliers of water of type I public water supplies are not required to submit plans and specifications or to obtain a permit for the replacement of an adequately sized watermain or other appurtenance on a distribution system which does not affect flow or capacity.

HISTORY: 1954 ACS 94, p. ___.

R 325.11305. Review of plans and specifications by department.

Rule 1305. (1) Upon receipt of plans and specifications or other pertinent information for the construction or alteration of a waterworks system, or any portion thereof, the department shall review them as soon as practicable to determine their completeness with regard to the minimum requirements specified by these rules, and to determine their adequacy. In making its review, the department shall not approve the plans and specifications unless it determines that the waterworks system, or portion thereof, is designed to protect the public health.

(2) If the department determines that plans and specifications or other pertinent information are incomplete or inadequate, it shall notify the supplier of water or authorized agent and may request the submission of revised plans and specifications or other pertinent information with appropriate corrections or additions. The department shall not grant an approval of these submittals or issue a permit until the plans and specifications or other pertinent information are complete and are judged to be adequate.

(3) The department may designate an agent or representative, including a local health department, for the purposes of reviewing information submitted and issuing permits for type II public water supplies, where appropriate.

HISTORY: 1954 ACS 94, p. ___.

R 325.11306. Approval of plans and specifications; permit.

Rule 1306. (1) Upon a determination by the department that the plans and specifications or other pertinent information for the construction or alteration of a

waterworks system, or portion thereof, are complete and adequate, the department shall mark the plans or scaled drawing showing approval and shall issue a permit to the supplier of water.

(2) A permit issued pursuant to the act and these rules shall expire unless construction or alteration commences within 2 years from the date of issuance. A supplier of water may apply for a permit extension in accordance with these rules prior to expiration of a permit. A request for a permit extension shall be submitted in writing identifying the project and the number on the permit issued by the department for which the extension is requested, and the reason for requesting the extension.

HISTORY: 1954 ACS 94, p. ___.

R 325.11307. Denial of permit.

Rule 1307. The department may deny a permit request when it determines that a public water supply cannot provide a continuous and adequate supply of water meeting the state drinking water standards.

HISTORY: 1954 ACS 94, p. ___.

R 325.11308. Permit terms and conditions.

Rule 1308. The department may attach any term or condition to a permit issued pursuant to the act and these rules to a supplier of water that it deems necessary to assure proper construction, alteration, and operation of a waterworks system, or a portion thereof, to protect the public health.

HISTORY: 1954 ACS 94, p. ___.

R 325.11309. Revision of approved plans and specifications.

Rule 1309. (1) Changes from approved plans or specifications or other pertinent information which would affect the well or watermain isolation or capacity, flow, treatment, or operation of the waterworks system, or portion thereof, shall be submitted to the department and approval obtained before construction of the changes. Changes from approved proposals shall be submitted in advance of any construction work which will be affected by the changes to allow sufficient time for review and approval by the department.

(2) Revisions or minor changes not affecting isolation, capacity, flows, treatment, or operation may be allowed during construction without the approval of the department.

(3) As built plans, clearly showing the work as constructed, shall be submitted to the department upon request.

HISTORY: 1954 ACS 94, p. ___.

R 325.11310. Construction program minimizing operational interference with existing waterworks system.

Rule 1310. The department may request a supplier of water to submit for approval a program for construction which minimizes operational interference with an existing waterworks system, and which allows the supplier of water to maintain continuous service of water to customers or users of that waterworks system in a safe and reliable manner. If requested, the program shall be submitted before commencing construction or an alteration of a waterworks system.

HISTORY: 1954 ACS 94, p. ___.

R 325.11311. Revocation of permit.

Rule 1311. The department may revoke a permit if it determines that a supplier of water or a designated agent thereof is not constructing or making an alteration to a waterworks system in accordance with approved plans and specifications, other approved information, or the act. The department shall notify the supplier of water prior to revocation of the permit and afford him the opportunity to take any corrective action as may be required. The department shall revoke the permit and simultaneously order the supplier of water to halt any construction authorized by that permit if the supplier of water does not effect the corrections within a reasonable period of time.

HISTORY: 1954 ACS 94, p. ___.

PART 14. CROSS-CONNECTIONS

R 325.11401. Definitions.

Rule 1401. As used in this part:

(a) "Backflow" means water of questionable quality, wastes, or other contaminants entering a public water supply system due to a reversal of flow.

(b) "Safe air gap" means the minimum distance of a water inlet or opening above the maximum high water level or overflow rim in a fixture, device, or container to which public water is furnished which shall be not less than 2 times the inside diameter of the water inlet pipe, but shall not be less than 1 inch and need not be more than 12 inches.

(c) "Secondary water supply" means a water supply system maintained in addition to a public water supply, including, but not limited to, water systems from ground or surface sources not meeting the requirements of Act No. 399 of the Public Acts of 1976, being §§325.1001 to 325.1023 of the Michigan Compiled Laws, or water from a public water supply which in any way has been treated, processed, or exposed to any possible contaminant or stored in other than an approved storage facility.

(d) "Submerged inlet" means a water pipe or extension thereto from a public water supply terminating in a tank, vessel, fixture, or appliance which may contain water of questionable quality, waste or other contaminant, and which is unprotected against backflow.

(e) "Water utility" means a governmental unit, municipal or private corporation, association, partnership, or individual engaged in furnishing water to the public for household or drinking purposes.

HISTORY: 1954 ACS 94, p. ___.

R 325.11402. Compliance with regulations and local codes.

Rule 1402. A connection with a public water supply system shall comply with existing laws, ordinances, and rules including:

(a) Act No. 288 of the Public Acts of 1929, as amended, being §§338.901 to 338.917 of the Michigan Compiled Laws.

(b) Local ordinances or rules providing acceptable protection against cross-connections.

HISTORY: 1954 ACS 94, p. ___.

R 325.11403. Cross-connections prohibited.

Rule 1403. (1) A cross-connection shall not be made between a public water supply system and a secondary water supply.

(2) A cross-connection shall not be made by submerged inlet.

(3) A cross-connection shall not be made between a public water supply and piping which may contain sanitary waste or a chemical contaminant.

(4) A cross-connection shall not be made between a public water supply system and piping immersed in a tank or vessel which may contain a contaminant.

HISTORY: 1984 ACS 94, p. ___.

R 325.11404. Local cross-connection control programs.

Rule 1404. (1) A water utility shall develop a comprehensive control program for the elimination and prevention of all cross-connections. The plan for the program shall be submitted to the department of public health for review and approval within 1 year after the effective date of these rules. When the plan is approved, the water utility shall implement the program for removal of all existing cross-connections and prevention of all future cross-connections.

(2) The program shall include but not be limited to all of the following:

(a) A complete description of the method of administering the program, including the designation of inspection and enforcement agency or agencies. The local authority for implementation of the program shall be indicated, preferably by ordinance.

(b) A time schedule for inspection and reinspection of all water utility customers' premises for possible cross-connections. The periodic reinspection shall be used to ascertain whether or not safe air gaps or required protective devices are in place and in working order.

(c) A description of the methods and devices, as approved by the department of public health, used to protect the public water supply.

HISTORY: 1984 ACS 94, p. ___.

R 325.11405. Corrections and protective devices.

Rule 1405. (1) A user of public water shall obtain written approval by the water utility or authorized inspection agency of any proposed corrective action or protective device before using or installing it.

(2) The total time allowed for completion of the necessary corrections shall be contingent upon the degree of hazard involved and include the time required to obtain and install equipment. If the cross-connection has not been removed, after a reasonable period of time, the water utility shall physically separate the public water supply from the onsite piping system in such a manner that the 2 systems cannot again be connected by any unauthorized person.

(3) A water utility shall report annually to the department of public health on the status of the cross-connection control program on a form provided by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11406. Piping identification.

Rule 1406. When a secondary water source is used in addition to a public water supply system, exposed public water and secondary water piping shall be identified by distinguishing colors or tags and so maintained that each pipe may

be traced readily in its entirety. If piping is so installed that it is impossible to trace it in its entirety, it will be necessary to protect the public water supply at the service connection in a manner acceptable to the department of public health.

HISTORY: 1954 ACS 94, p. ___.

R 325.11407. Private water storage tanks.

Rule 1407. A private water storage tank supplied from a public water supply system shall be deemed a secondary water supply unless it is designed and approved for potable water usage.

HISTORY: 1954 ACS 94, p. ___.

PART 15. OPERATION REPORTS AND RECORDKEEPING

R 325.11501. Purpose.

Rule 1501. The purpose of this part is to establish requirements of certain suppliers of water for the periodic submission of operation reports and for the retention of certain records as required by the provisions of the act and the federal act.

HISTORY: 1954 ACS 94, p. ___.

R 325.11502. Monthly operation reports required from suppliers of water employing treatment.

Rule 1502. (1) A supplier of water of a type I public water supply where treatment is employed, or of a type II public water supply where treatment is employed for public health purposes, shall prepare an operation report on a form provided by the department for each month of operation. The report shall include, but not necessarily be limited to, all of the following:

(a) General operation data.

(b) A summary of samples analyzed, including distribution system sampling and chlorine residual sampling.

(c) Information on daily treatment system pumpage.

(d) Information on chemical application.

(e) Analyses of general parameters relating to the quality of the treated drinking water.

(2) The operation report shall be submitted to the division during the month following the month for which the operation report was prepared, except that results of bacteriological analyses and turbidity measurements shall be submitted as required by R 325.11503.

(3) The department may waive specific type I public water supplies from submitting a monthly operation report.

HISTORY: 1954 ACS 94, p. ___.

R 325.11503. Submission of results of sample analyses or measurements.

Rule 1503. (1) Suppliers of water of all public water supplies which monitor for bacteriological contamination or turbidity, or both, shall prepare and submit to the department the results of sample analyses or measurements on a form provided by the department as required by part 7 of these rules. In no case shall sample results be sumitted to the department later than 40 days from the date of analysis or measurement of the sample.

(2) Sample results of all contaminants not meeting the MCL's shall be reported to the department in accordance with the provisions of part 7 of these rules.

HISTORY: 1984 ACS 94, p. ——

R 325.11504. Annual reports.

Rule 1504. (1) At the end of the first calendar year after the effective date of these rules and each subsequent year, each type I public water supply which does not submit a monthly operation report shall submit an annual report on a form provided by the department. The department may require certain type II public water supplies to submit annual reports. The report shall include, but not necessarily be limited to, a summary of water pumpage and water use.

(2) The supplier of water shall submit the annual report to the division on or before March 31 following the year for which the report is prepared.

HISTORY: 1984 ACS 94, p. ——

R 325.11505. Additional reports required by department.

Rule 1505. (1) The department may require a supplier of water to submit reports required pursuant to this part on a more frequent basis if the department finds that discrepancies, violations, or other problems are or may be occurring based on the department's review of a monthly or annual operation report or based on a sanitary survey, on-site inspection, surveillance observation, or special investigation conducted by the department.

(2) The department may require a supplier of water to submit other reports as it deems necessary to evaluate the adequacy of the public water supply.

HISTORY: 1984 ACS 94, p. ——

R 325.11506. Retention of records.

Rule 1506. (1) A supplier of water of a type I or type II public water supply shall retain on its premises, or at a convenient location near its premises, all of the following records:

(a) Records of bacteriological analyses required pursuant to part 7 of these rules shall be kept for not less than 5 years.

(b) Records of chemical analyses required pursuant to part 7 of these rules shall be kept for not less than 10 years.

(c) Records of turbidity analyses required pursuant to part 7 of these rules shall be kept for not less than 5 years.

(d) Records of radiological analyses required pursuant to part 7 of these rules shall be kept for not less than 10 years.

(2) Actual laboratory reports for chemical, bacteriological, turbidity, and radiological analyses shall be kept, or the data thereon may be transferred to tabular summaries, if all of the following information is included:

(a) The date, place, and time of sampling and the name of the person who collected the sample.

(b) Identification of the sample as a routine distribution system sample, check sample, raw or treated water sample, or other special purpose sample.

(c) The date of the analysis.

(d) The laboratory and the person responsible for performing the analysis.

(e) The analytical technique or method used.

(f) The results of the analysis.

(3) Records of action taken by a public water supply to correct violations of the state drinking water standards shall be kept for not less than 3 years after the last action taken with respect to the particular violation.

(4) Copies of any written reports, summaries, or communications relating to sanitary surveys of the public water supply conducted by the public water supply itself, by a private consultant, by the division, or by any local, state, or federal agency shall be kept for not less than 10 years after completion of the sanitary survey involved.

(5) Records concerning a variance or an exemption granted to a public water supply shall be kept for not less than 5 years following the expiration date of the variance or exemption.

(6) Records concerning any emergency or public notification regarding a public water supply shall be kept for not less than 3 years after the emergency or public notification.

HISTORY: 1984 ACS 94, p. ___.

PART 16. GENERAL PLANS

R 325.11601. Purpose.

Rule 1601. It is the purpose of this part to establish requirements of certain suppliers of water for the submission and updating of waterworks system general plans to satisfy the requirements of subsection (1) of section 4 of the act.

HISTORY: 1984 ACS 94, p. ___.

R 325.11602. Type I and type II public water supplies; submission of general plans to department.

Rule 1602. (1) General plans for type I public water supplies shall be submitted to the department within 2 years after the effective date of these rules, except that this subrule shall not apply to those type I public water supplies serving less than 50 service connections or less than 200 persons and those serving facilities which are licensed annually by the department including, but not limited to, mobile home parks and health care facilities.

(2) The department, by written notice, may require suppliers of water of specific type II public water supplies to provide a copy of a general plan of a waterworks system. A supplier of water so notified shall provide a copy of a general plan to the department within 1 year after receipt of the written notice.

HISTORY: 1984 ACS 94, p. ___.

R 325.11603. Acceptability of previous general plans; updating requirements.

Rule 1603. (1) Suppliers of water having previously provided a general plan to the department meet the requirements of this part unless the department determines that the plans previously submitted are inadequate.

(2) The department may require the updating of a waterworks system general plan required pursuant to this part on a periodic basis by providing written notice to the supplier of water. The supplier of water so notified shall provide an updated general plan to the department within 6 months after receipt of the written notice.

HISTORY: 1984 ACS 94, p. ___.

R 325.11604. Contents of general plans.

Rule 1604. (1) The required general plan for a waterworks system shall contain, at a minimum, all of the following information, where pertinent:

(a) The general layout of the entire waterworks system, including treatment systems and distribution systems, and the location of valves, hydrants, storage tanks, watermains, and their size, pumps, wells, and pumping facilities.

(b) An identification of locations in the distribution system where the pressure may be less than 20 p.s.i. during peak flow.

(c) An identification of the entire area served or proposed to be served by the public water supply.

(d) Rated capacity of the waterworks system, including capacity of the developed water source, treatment system, storage tanks, pumping facilities, and equipment to maintain system reliability.

(2) A supplier of water may include with the general plan additional information including, but not necessarily limited to, the number of service connections, fire fighting capabilities, location of access roads, chemical delivery features, standby power, laboratory facilities, location of sampling stations, and a description of the meter system.

HISTORY: 1954 ACS 94, p. ___.

PART 17. OWNERSHIP OF PUBLIC WATER SUPPLIES

R 325.11701. Purpose.

Rule 1701. The purpose of this part is to prescribe certain requirements and procedures in accordance with section 10 of the act for private ownership of certain type I public water supplies when public ownership cannot be achieved.

HISTORY: 1954 ACS 94, p. ___.

R 325.11702. Intent.

Rule 1702. Regulatory jurisdiction over public water supplies in this state is for the declared purpose of protecting the public health and to assure that public water supplies and waterworks systems are properly planned, constructed, maintained, and operated. It is a well established principle in this state that type I public water supplies be operated and maintained in an effective manner at all times and that adequate provision be made for a continuing administrative authority to accomplish this objective. Department procedures which have been in effect have strongly encouraged public ownership of all type I public water supplies. Accordingly, it is the department's belief that all avenues must be thoroughly explored with local governmental units to achieve public ownership of those public water supplies. If it is determined by the department that a local unit of government will not accept responsibility for ownership and operation of a type I public water supply, specific procedures must be established prior to issuance of a permit for construction of waterworks systems associated therewith.

HISTORY: 1954 ACS 94, p. ___.

R 325.11703. Applicability.

Rule 1703. (1) After January 4, 1979, these rules shall apply to all privately-owned type I public water supplies except those serving facilities which are licensed annually by the department including, but not limited to, mobile home parks and health care facilities.

(2) This part applies to all type I public water supplies which are proposed to be constructed after the effective date of these rules, and to any proposed substantial additions or modifications to a type I public water supply which is privately-owned on the effective date of these rules, if the department determines that the operation of that public water supply does not meet the requirements of the act or these rules.

HISTORY: 1984 ACS 94, p. ___.

R 325.11704. Delegation of acceptance of ownership and operational responsibility of water supply by city, village, or township.

Rule 1704. A city, village, or township may delegate to a county, authority, district, or other public entity the acceptance of ownership and operational responsibility of any water supply within its jurisdiction. This delegation may be considered by the department to be adequate public ownership to meet the requirements of the act and these rules.

HISTORY: 1984 ACS 94, p. ___.

R 325.11705. Private ownership of type I public water supply permitted; proof of refusal to accept ownership or operational responsibility by governmental entity.

Rule 1705. (1) If the division determines that ownership and operation of a type I public water supply by a local governmental agency is not practical for a particular public water supply, private ownership shall be allowed with adequate provisions to assure a continuous operation of the public water supply which meets the requirements of the act and these rules.

(2) The department shall not accept plans and specifications from, nor shall a permit be issued to, an owner of a proposed type I public water supply which is to be privately-owned unless proof of refusal to accept ownership or operational responsibility of that public water supply is submitted in a formal resolution of the governing body of a city, county, village, township, or other governmental entity under whose jurisdiction the public water supply is included, or where proof of refusal is established to the satisfaction of the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11706. Stipulations by owner of privately-owned type I public water supply.

Rule 1706. (1) At the time an owner of a type I public water supply which is, or is proposed to be, privately-owned submits plans and specifications to the department, the owner shall stipulate that the public water supply shall be operated in such a manner as to assure the customers or users thereof a sufficient quantity of water under adequate pressure and a quality of water meeting the state drinking water standards.

(2) The owner of a type I public water supply, which is proposed to be privately-owned, shall stipulate to transfer the ownership and operation of the entire public water supply to a governing body of a city, village, or township, or its designated public entity, by an acceptable agreement between the parties, and with prior approval by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11707. Escrow fund.

Rule 1707. (1) In accordance with section 10 of the act, the owner of a type I public water supply, which is proposed to be privately-owned, shall establish a continuing cash escrow fund prior to the issuance of a permit, which fund shall be available to the department for immediate repair or maintenance of the public water supply if the owner fails to meet the responsibilities under the act and these rules.

(2) The amount of the escrow fund required shall be calculated on the basis of $100 per living unit proposed to be served by the public water supply, but in no case shall the escrow fund amount be less than $5,000, or exceed $50,000.

(3) Upon establishment of a written agreement between the owner of a privately-owned public water supply and the governing body of a city, village, or township which establishes a date certain by which the privately-owned public water supply ownership shall be transferred to that governing body, the department may reduce the amount of the required escrow fund.

(4) When the ownership of a privately-owned public water supply is transferred to the governing body of a city, village, or township, the department shall authorize return of the escrow fund and accrued interest to the owner of the privately-owned waterworks system.

HISTORY: 1984 ACS 94, p. ____.

R 325.11708. Removal of funds from escrow account.

Rule 1708. (1) Upon a determination by the department that removal of funds from an escrow account is required, only the director or his designated agent may remove funds from the escrow account to make the necessary corrections.

(2) It is the responsibility of the owner of a privately-owned waterworks system to replace all funds removed from the account by the director or his designated agent as required for needed improvements or corrections to the waterworks system within 90 days after removal of the funds to maintain the account at the original level.

HISTORY: 1984 ACS 94, p. ____.

R 325.11709. Privately-owned public water supply; easements; isolation area for wells; abandonment of wells.

Rule 1709. (1) The owner of a public water supply which is proposed to be privately-owned shall provide or obtain all necessary easements for any portion of the waterworks system which is not located in the public right-of-way.

(2) The isolation area for wells serving a public water supply which is, or is proposed to be, privately-owned shall be defined in the plans and specifications submitted to the department pursuant to the act and part 13 of these rules and shall be considered to be a part of the waterworks system.

(3) If the wells associated with a privately-owned waterworks system are abandoned, ownership or easements shall be retained as may be necessary for the operation of the remainder of the waterworks system. The procedures for abandonment of wells shall be in accordance with the requirements of the act and part 8 of these rules.

HISTORY: 1984 ACS 94, p. ____.

R 325.11710. Privately-owned waterworks system; additional service connections.

Rule 1710. The owner of a privately-owned waterworks system shall not provide additional service connections to other living units or facilities in excess of the total number specified on, and approved by issuance of, a permit by the department. If an owner of a privately-owned waterworks system wishes to provide service to additional living units or facilities, a permit shall be obtained from the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11711. Transfer of ownership of a privately-owned waterworks system.

Rule 1711. If ownership of a privately-owned waterworks system is transferred to another private owner, the former owner shall notify and receive approval from the department not less than 90 days prior to the change in ownership. The escrow fund established for that waterworks system shall be maintained by the new owner.

HISTORY: 1984 ACS 94, p. ___.

R 325.11712. Filing names of operation personnel.

Rule 1712. The owner of a privately-owned waterworks system shall file with the department the name, address, and telephone number of not less than 2 persons having direct responsibility for the daily operation and maintenance of the waterworks system who can be contacted in the event of any emergency or requirement relative to its operation.

HISTORY: 1984 ACS 94, p. ___.

R 325.11713. Approval of a privately-owned public water supply.

Rule 1713. The department shall approve a privately-owned public water supply only by issuance of a permit, and in addition, shall stipulate with the owner for entry of a consent order outlining the specific operation and maintenance requirements of that waterworks system and the amount of the escrow fund required. If the owner of the privately-owned waterworks system refuses to stipulate to the entry of a consent order, the department shall not issue a permit for the privately-owned waterworks system.

HISTORY: 1984 ACS 94, p. ___.

PART 19. EXAMINATION AND CERTIFICATION OF OPERATORS

R 325.11901. Classification of treatment systems.

Rule 1901. (1) Complete treatment systems are classified in 4 classes based on population served by the public water supply or designed treatment capacity of the treatment system as follows:

(a) Class F-1: Complete treatment systems for type I public water supplies serving a population greater than 20,000, or with a designed treatment capacity greater than 5.0 million gallons of water per day.

(b) Class F-2: Complete treatment systems for type I public water supplies serving a population from 4,000 to 20,000, or with a designed treatment capacity from 2.0 to 5.0 million gallons of water per day.

(c) Class F-3: Complete treatment systems for type I public water supplies serving a population from 1,000 to 4,000, or with a designed treatment capacity from 0.5 to 2.0 million gallons of water per day.

(d) Class F-4: Complete treatment systems for type I public water supplies serving a population of less than 1,000, or with a designed treatment capacity less than 0.5 million gallons of water per day.

(2) Those treatment systems including, but not limited to, disinfection, fluoridation, iron removal, zeolite softening, phosphate application, or filtration other than complete treatment, are classified in 4 classes based on population served by the public water supply or designed treatment capacity of the treatment system; and a limited class as follows:

(a) Class D-1: Treatment systems for type I public water supplies serving a population greater than 20,000, or with a designed treatment capacity greater than 5.0 million gallons of water per day.

(b) Class D-2: Treatment systems for type I public water supplies serving a population from 4,000 to 20,000, or with a designed treatment capacity from 2.0 to 5.0 million gallons of water per day.

(c) Class D-3: Treatment systems for type I public water supplies serving a population from 1,000 to 4,000, or with a designed treatment capacity from 0.5 to 2.0 million gallons of water per day.

(d) Class D-4: Treatment systems of type I public water supplies serving a population of less than 1,000, or with a designed treatment capacity less than 0.5 million gallons of water per day.

(e) Class D-SL: A limited classification, and a special limited certificate for an operator of a treatment system for a specific type II public water supply where treatment is employed for health related purposes and where it is determined by the department that the public health will be adequately protected if an oral examination is given and an on-site evaluation of the operator's skill is conducted by the division. An operator with a D-SL certificate shall not be certified to operate a treatment system at another public water supply.

HISTORY: 1984 ACS 94, p. ——.

R 325.11902. Classification of distribution systems.

Rule 1902. The following 4 classifications are assigned to distribution systems for type I public water supplies:

(a) Class S-1: Distribution systems for type I public water supplies serving a population greater than 20,000.

(b) Class S-2: Distribution systems for type I public water supplies serving a population from 4,000 to 20,000.

(c) Class S-3: Distribution systems for type I public water supplies serving a population from 1,000 to 4,000.

(d) Class S-4: Distribution systems for type I public water supplies serving a population of less than 1,000.

HISTORY: 1984 ACS 94, p. ——.

R 325.11903. Change in classification of treatment system or distribution system.

Rule 1903. For purposes of this part, treatment systems and distribution systems in any classification established by R 325.11901 and R 325.11902 may be

placed in a different classification by the department by reason of incorporation in the treatment system of special features of design, making operation different from usual, by reason of a particularly difficult type of raw water, upon a finding that the population served has changed or for other reasons deemed necessary by the department.

HISTORY: 1954 ACS 94, p. ___.

R 325.11904. Notification of change in classification.

Rule 1904. (1) A supplier of water of a public water supply affected by a change in classification shall be notified by the department by mail not less than 6 months prior to the next operator certification examination. A change in classification by the department shall be effective 6 months after the date of the next applicable examination.

(2) The classification of a newly constructed F-1, F-2, F-3, or F-4 treatment system shall be effective at the time of initial operation.

HISTORY: 1954 ACS 94, p. ___.

R 325.11905. Certification of operators.

Rule 1905. (1) An operator in charge of a treatment system or a distribution system at a type I public water supply, or of a treatment system at a type II public water supply where treatment is employed for health related purposes, shall hold certification in an assigned classification established by R 325.11901 or R 325.11902, unless a deviation is authorized by the department or a waiver is authorized by the department pursuant to R 325.11906. Certified operators holding an F certificate meet the qualifications to operate a D treatment system.

(2) Where treatment is employed at a type II public water supply the department may require the owner or operator thereof to take a written examination in 1 of the classes established by R 325.11901.

(3) A certified shift operator shall be in charge of operation during each work shift at a type I public water supply where a treatment system in the F classification is routinely operated when the certified operator in charge is absent. In the case of treatment systems at type I public water supplies in the D classification, certified shift operators are required where water from a surface source is treated.

(4) Shift operators at treatment systems in the F classification are required to hold a certificate in the F classification, except that shift operators at complete treatment systems treating more than 100 million gallons of water per day shall hold a F-3 or higher classification. Shift operators at surface water treatment systems in the D classification are required to hold a certificate in either a D or F classification, regardless of the population served or the amount of water treated by the public water supply.

(5) For purposes of training a shift operator to occupy a vacant position, the department may authorize a deviation from the requirements of subrule (3) by granting a provisional certification for a period of time not to exceed 2 years. A person occupying a position pursuant to this subrule shall otherwise be qualified to become certified by examination during this time and shall be titled an operator trainee.

HISTORY: 1954 ACS 94, p. ___.

R 325.11906. Waiver of operator certification requirements.

Rule 1906. The requirements of R 325.11905 relating to treatment system and distribution system operator certification may be waived by the department for certain type I public water supplies if the treatment employed is used only for the control of hardness, iron, or other characteristics primarily of an aesthetic concern; if the treated water is limited in distribution; or if the distribution system is limited in extent, such as at an apartment building, condominium, or other similar residential facility.

HISTORY: 1984 ACS 94, p. ____.

R 325.11907. Advisory board; terms of office.

Rule 1907. The members of the advisory board shall be appointed by the director pursuant to section 9 of the act for terms of 3 years each. Of the members of the advisory board first appointed by the director, 3 shall be appointed for 1-year terms, 3 shall be appointed for 2-year terms and 3 shall be appointed for 3-year terms. Thereafter, 3 shall be appointed each year for a 3-year term. Vacancies in an unexpired term shall be filled in the same manner as original appointments.

HISTORY: 1984 ACS 94, p. ____.

R 325.11908. Advisory board; powers and duties.

Rule 1908. (1) The advisory board shall meet not less than twice each year at designated times and places. The advisory board shall assist the department in examining all persons making application for certification who meet the minimum requirements established by the department pursuant to R 325.11911. The advisory board shall schedule at least 1 annual examination for treatment system operators and at least 1 annual examination for distribution system operators, and shall provide public notice of the date, time, and place for each examination not less than 90 days before the date set for the examination.

(2) After review of the application and the results of the examination, the advisory board shall recommend that the department issue or deny an applicant a certificate in the appropriate treatment system or distribution system classification.

HISTORY: 1984 ACS 94, p. ____.

R 325.11909. Advisory board; election of chairman; quorum; expenses and compensation.

Rule 1909. The members of the advisory board, as soon as appointed, shall organize and at the first meeting in each year thereafter elect from their number a chairman. Five members of the advisory board constitute a quorum. Members of the advisory board shall not be compensated but shall be entitled to all actual and necessary expenses incurred in the performance of their official duties in accordance with the rates established by the latest edition of the standard travel regulations of this state.

HISTORY: 1984 ACS 94, p. ____.

R 325.11910. Application for examination.

Rule 1910. (1) An individual who desires to be certified for the operation of a treatment system or a distribution system shall submit to the department, not less than 45 days before the announced examination date, an application for examination on a form provided by the department. The information contained

on the application shall be evaluated by the department and by the advisory board and shall constitute a part of the examination. The department may require verification of education and experience of an applicant for an examination.

(2) Not less than 15 days before the examination, the department shall notify all applicants of its findings, and shall notify those applicants accepted for examination of the date, time, and place of the examination.

HISTORY: 1984 ACS 94, p. ___.

R 325.11911. Applicant for certification; references; grading.

Rule 1911. (1) An applicant for a certificate shall submit as part of an application the names of 4 persons, other than relatives, who may be used as references.

(2) Applicants for certification shall be graded in 3 major divisions as follows:

(a) Educational qualifications of the applicant.

(b) Experience qualifications of the applicant.

(c) The written examination.

(3) Applicants shall satisfy the minimum criteria established by the department for educational qualifications prior to admission to the written examination.

(4) Criteria used for grading shall be determined by the division subject to the approval of the advisory board, and shall be made available by the department.

HISTORY: 1984 ACS 94, p. ___.

R 325.11912. Examination.

Rule 1912. (1) A written examination shall be prepared by the division with the concurrence of the advisory board for each of the distribution system classifications, and for each of the treatment system classifications, except the D-SL classification.

(2) Examinations shall be administered by the division staff, subject to review by the advisory board.

HISTORY: 1984 ACS 94, p. ___.

R 325.11913. Equivalent certificate; D-M certificate; limited certificate.

Rule 1913. (1) The division shall prepare an application form to be used by persons desiring an equivalent certificate. Treatment system operators holding certificates which were issued pursuant to R 325.551 to R 325.572 of the Michigan Administrative Code who submit a complete application for an equivalent certificate within 1 year after the application form becomes available from the department shall be issued certificates in the new treatment system classifications in accordance with table 1 in subrule (3).

(2) A special D-M certificate shall be issued to those certified operators previously holding M certificates and who do not also hold D-1 or D-2 certificates issued pursuant to previous rules of the department. The special D-M certificate is acceptable for operation of a treatment system where disinfection is not employed and the treatment is limited to that for which the operator was previously certified. The special D-M certificate shall designate the treatment for which the operator is certified.

(3) Distribution system operators who hold certificates issued under the former division program governing the voluntary certification of operators of distribution systems, and who submit a complete application for an equivalent certificate within 1 year after the application form becomes available from the department, shall be issued equivalent certificates in the new distribution system classifications in accordance with table 1:

TABLE 1

EQUIVALENT CERTIFICATION

Previous Certification	New Certification
F-1	F-1
F-2	F-2
F-3	F-3
D-1	D-1
D-2	D-3
M	Class D-M
T	None
S-1	S-1
S-2	S-2
S-3	S-3

(4) An individual presently in charge of a distribution system and not entitled to a distribution system operator certificate pursuant to this rule may be issued a limited certificate to operate the distribution system for which the individual is presently in charge. An operator with a limited certificate is not certified to operate a distribution system at a different public water supply. Application for a limited certificate shall be made by the owner of the distribution system on behalf of the individual on a form provided by the department and shall be made within 1 year of the date on which application forms are made available by the department.

(5) An individual presently in charge of a shift at an F treatment system or D treatment system using a surface water source who is not otherwise entitled to a certificate satisfying the requirements of subrule (3) of R 325.11905 may be issued a certificate to operate a shift at that treatment system. Application for a limited certificate shall be made by the owner of the treatment system on behalf of the individual on a form provided by the department, and shall be made within 1 year after the date on which application forms are made available by the department.

HISTORY: 1954 ACS 94, p. ___.

R 325.11914. Reciprocity.

Rule 1914. A treatment system or distribution system operator certificate in a comparable classification may be issued by the department, without examination, to an individual who holds a similar operator certificate in another state, a territory or possession of the United States, or another country, if the requirements for certification of operators under which the certificate was issued are comparable to the requirements prescribed by this part.

HISTORY: 1954 ACS 94, p. ___.

R 325.11915. Term of certification.

Rule 1915. Certificates issued pursuant to the act and these rules shall automatically become inactive after 5 years during which the holder is not

employed by, or working with, public water supplies. A certificate shall not become inactive while a person is in military service. A certificate shall be considered inactive if the mailing address of the holder remains unknown to the department for a period of 2 years. Inactive certificates may be made active by the department provided sufficient proof of competency is presented to the advisory board by the holder of the certificate.

HISTORY: 1954 ACS 94, p. —.

R 325.11916. Additional educational or training requirements.

Rule 1916. The department, with the concurrence of the advisory board, may require certified operators of treatment systems or distribution systems in any classification to obtain additional education or training as a condition for maintaining certification.

HISTORY: 1954 ACS 94, p. —.

R 325.11917. Suspension or revocation of certificates.

Rule 1917. The director may suspend or revoke a certificate of an operator who, after a hearing before the advisory board, is judged incompetent or unable to properly perform the duties of a treatment system or distribution system operator or who has, with respect to water supply, committed fraud or has falsified an application, report, or record or who has been negligent in the discharge of properly assigned duties or responsibilities. Notice of suspension or revocation shall be provided in writing to the operator and to the owner of the public water supply where the operator is employed.

HISTORY: 1954 ACS 94, p. —.

R 325.11918. Appeals.

Rule 1918. An individual who feels aggrieved by an action of the department pursuant to the act or this part, or who wishes to appeal any other action of the department with respect to certification may request a hearing pursuant to Act No. 306 of the Public Acts of 1969, as amended, being §§24.201 to 24.315 of the Michigan Compiled Laws, and part 2 of these rules.

HISTORY: 1954 ACS 94, p. —.

PART 21. APPROVAL OF CHEMICALS AND OTHER MATERIALS

R 325.12101. Purpose.

Rule 2101. The purpose of this part is to prescribe certain requirements for the approval of chemicals, materials, coatings, additives, or other substances proposed to be used in the treatment or during the distribution of drinking water, or which are proposed to be used in contact with drinking water prior to, or during, distribution to the customer or user of a public water supply; and to prohibit a person from using unapproved chemicals or materials which may come into contact with, or serve as an additive to, drinking water.

HISTORY: 1954 ACS 94, p. —.

R 325.12102. Approval of chemicals and other materials.

Rule 2102. (1) Approval by the department is required for all chemicals, coatings or paints, proprietary products, and similar materials of whatever description, that are used or are proposed for use in, or in contact with, drinking water at any point in the waterworks system from the source to the ultimate point of distribution of the water.

(2) The supplier of water is responsible for determining that approval for a chemical or material has been granted by the department and determining the special conditions or limitations under which that approval was granted.

HISTORY: 1954 ACS 94, p. ___

R 325.12103. Approval criteria.

Rule 2103. Approval by the department of chemicals and other materials shall be based on a determination that the chemical or material and its component parts singly or together will not be detrimental to public health. It is the responsibility of the manufacturer or distributor to provide the data upon which a determination may be made by the department.

HISTORY: 1954 ACS 94, p. ___

R 325.12104. Change in product designation or composition.

Rule 2104. (1) Written approval by the department for a product, material, or chemical shall not extend to a change in composition or designation thereof. It is the responsibility of the manufacturer or distributor to make application to the department for approval of a product with a changed composition or designation.

(2) The department may contact a manufacturer or distributor to determine the status of a chemical or material previously approved. If contact with the manufacturer or distributor cannot be made, previous approval of a chemical or material manufactured or distributed by that manufacturer or distributor may be suspended.

HISTORY: 1954 ACS 94, p. ___

R 325.12105. Generic approval.

Rule 2105. The department may grant approval to specified chemicals or materials commonly used in the treatment or distribution of drinking water. Generic approvals may reference nationally recognized specifications such as those of the American water works association, the American society for testing materials, and others.

HISTORY: 1954 ACS 94, p. ___

R 325.12106. Specific approval of proprietary products.

Rule 2106. Specific approval is required by the department for the use of proprietary products. Approval shall include the complete name or other manufacturer's designation of the product, the purpose and condition of use, and, if applicable, the maximum acceptable dose to be applied to drinking water.

HISTORY: 1954 ACS 94, p. ___

R 325.12107. Form of approval.

Rule 2107. Approval given by the department for a chemical or material shall be by letter or a form describing the product, its intended use, and any special conditions or limitations attached to the written approval. Approval by the department shall not be an endorsement of any material, chemical, or product but shall be based on its toxicity with regard to public health.

HISTORY: 1954 ACS 94, p. ___

R 325.12108. Rescission or suspension of approval.

Rule 2108. Upon finding that a manufacturer or distributor of a chemical or a material which may come into contact with drinking water has submitted false

information regarding that chemical or material, or upon finding that a chemical or material previously approved has changed in composition, or upon finding at a later date that a chemical or material or constituent thereof may pose a hazard to the public health, the department shall rescind or suspend approval of that chemical or material for use in a waterworks system.

HISTORY: 1954 ACS 94, p. ___.

R 325.12109. Introduction of chemical or material into waterworks system by unauthorized person prohibited.

Rule 2109. No person, except the supplier of water, his duly authorized agent, or the department, shall introduce, or cause to be introduced, any chemical or material into a waterworks system, or a portion thereof, regardless of whether that chemical or material has been previously approved by the department pursuant to this part.

HISTORY: 1954 ACS 94, p. ___.

R 325.12110. Effect of approval.

Rule 2110. Approval of a chemical or material by the department does not imply that a chemical or material may be used in a waterworks system without submitting necessary plans and specifications for approval by the department and for the issuance of a permit pursuant to part 13 of these rules.

HISTORY: 1954 ACS 94, p. ___.

PART 23. CONTINGENCY PLANS

R 325.12301. Purpose.

Rule 2301. The purpose of this part is to establish requirements of suppliers of water of type I public water supplies and certain type II public water supplies to prepare contingency plans for implementation in the event of emergencies.

HISTORY: 1954 ACS 94, p. ___.

R 325.12302. Preparation; timetable; exceptions.

Rule 2302. (1) Unless specifically waived by the department, suppliers of water of type I public water supplies, including suppliers of water purchasing water from another supplier of water, shall prepare, or cause to be prepared, contingency plans for waterworks systems within 2 years after the effective date of these rules.

This subrule shall not apply to type I public water supplies serving less than 50 service connections or less than 200 individuals or those type I public water supplies serving facilities which are licensed annually by the department including, but not limited to, mobile home parks and health care facilities.

(2) The department may require suppliers of water of certain type II public water supplies to prepare contingency plans in accordance with the requirements of this part.

(3) If a supplier of water has an existing contingency plan, it may be updated to include any requirements specified by this part, and upon updating, shall be deemed to meet the requirements of this part.

HISTORY: 1954 ACS 94, p. ___.

R 325.12303. Contents.

Rule 2303. (1) A contingency plan prepared by a supplier of water shall, as a minimum, outline a program for rapid correction or mitigation of emergencies. The contingency plan may contain an inventory of necessary standby personnel, equipment, chemicals, and other materials readily available for correction of problems, including emergency treatment measures in the event of contamination, a plan for interconnection with adjacent public water supplies or agreements with water haulers in the event of waterworks system failures or loss of pressure, and appropriate means for notification of customers or users of a public water supply affected by an emergency. Public notification shall include a description of precautions or measures to be taken to protect the health of those customers or users.

(2) A contingency plan prepared by a supplier of water pursuant to this part shall include the general plan of the public water supply owned or operated by the supplier of water as required pursuant to subsection (1) of section 4 of the act.

(3) A supplier of water shall identify in a contingency plan the type, number, and capacity of standby power sources to operate a waterworks system in the event of a power outage or other situation requiring the use of other power sources.

(4) The contingency plan shall outline duty assignments for waterworks personnel and shall contain a schedule for updating the plan.

(5) The contingency plan shall include a listing of critical customers or users for whom the provision of a continuous supply of safe drinking water is most urgent.

(6) Contingency plans prepared pursuant to this part shall be located and distributed as necessary to assure effective use thereof by all necessary waterworks system personnel.

(7) For purposes of consistency in developing contingency plans, suppliers of water may use the American water works association manual M-19, "Emergency Planning for Water Utility Management, 1973", as guidance material.

HISTORY: 1954 ACS 98, p. —

R 325.12304. Emergency procedure.

Rule 2304. (1) When an emergency affecting a public water supply is discovered, the supplier of water shall immediately notify the division by telephone of that emergency. The supplier of water shall indicate in that notification the type of emergency, its discovery, the cause, the corrective actions planned to meet the emergency, and plans for notification to customers or users of the public water supply affected.

(2) A supplier of water shall, within 90 days after an emergency, file a written report with the department outlining in detail its discovery, the cause, the corrective actions taken by the supplier of water to meet the emergency, and the procedures by which its customers or users were notified. The report shall outline in detail the area of the waterworks system affected by the emergency, its duration, and the ability of the supplier of water to cope with the emergency by providing an adequate supply of safe drinking water.

HISTORY: 1954 ACS 98, p. —

PART 24. WATER HAULING EQUIPMENT STANDARDS

R 325.12401. Purpose.

Rule 2401. The purpose of this part is to prescribe standards for tanks and equipment used by water haulers to transport drinking water which shall serve as criteria by which a water hauler may obtain a license for a water transportation tank pursuant to part 25 of these rules.

HISTORY: 1984 ACS 94, p. ___.

R 325.12402. Water transportation tank materials and coatings.

Rule 2402. Materials or coatings on a water transportation tank or its appurtenances which come into contact with drinking water shall be of approved steel, stainless steel, fiberglass, metal, plastic, rubber, or other nontoxic materials given written approval by the department. Materials used in the construction of, or transported by, a water transportation tank shall not impart any substances to the water which may result in a violation of the state drinking water standards, or impart other undesirable physical properties to the water.

HISTORY: 1984 ACS 94, p. ___.

R 325.12403. Water transportation tank; outlets.

Rule 2403. The outlet from a water transportation tank shall be located to provide complete drainage of the tank or any compartment thereof. Outlet valves shall be of sanitary construction and readily cleanable. Valve outlets, unless equipped with a permanent hose, shall be provided with a sanitary cap.

HISTORY: 1984 ACS 94, p. ___.

R 325.12404. Manhole covers and openings.

Rule 2404. (1) Manhole covers and openings shall be constructed to allow reasonable access for cleaning purposes and to protect the sanitary quality of the water.

(2) Manholes and other openings in the top of the tank shall be higher than the surrounding area and shall be designed to prevent drainage from entering the opening.

HISTORY: 1984 ACS 94, p. ___.

R 325.12405. Fill connections.

Rule 2405. If used, a fill connection shall be constructed in a manner to prevent contamination and shall be capped at all times when not in use.

HISTORY: 1984 ACS 94, p. ___.

R 325.12406. Baffles.

Rule 2406. If used, baffles shall not interfere with free drainage of the water transportation tank. Baffles shall be constructed to allow accessibility to all areas for inspection and cleaning purposes.

HISTORY: 1984 ACS 94, p. ___.

R 325.12407. Pumps.

Rule 2407. If used, pumps shall be operated in a sanitary manner, and all couplings or connections shall be capped or otherwise protected from contamination when not in use.

HISTORY: 1984 ACS 94, p. ___.

R 325.12406. Transfer hose and piping.

Rule 2406. (1) Connections between the pump and the water transportation tank may be made with flexible tubing. Hose connectors shall be attached to the hose to allow easy removal for cleaning.

(2) Transfer hose or piping shall be constructed of nontoxic materials, maintained in a sanitary condition, and used in such manner to prevent contamination of the water and to prevent cross connections.

(3) If 2 or more lengths of flexible transfer hose are used, they shall be connected either by the use of sanitary couplings or a piece of sanitary tubing with clamps. Sanitary caps shall be furnished for each end of the hose, the pump, and the outlet valve.

(4) A hose carrier bracket shall be provided to adequately support the hose and a means shall be provided to support the loose end of the hose to prevent contamination.

HISTORY: 1984 ACS 94, p. ___

PART 25. LICENSING OF WATER HAULERS

R 325.12501. Purpose.

Rule 2501. The purpose of this part is to implement section 18 of the act by specifying certain criteria and requirements for licensing of water haulers and for their containers, equipment, and operation.

HISTORY: 1984 ACS 94, p. ___

R 325.12502. License.

Rule 2502. A person shall not engage in, or carry on the business of, hauling bulk water for drinking or household purposes, except for his own household use, without a license issued pursuant to the act and these rules. Compliance with this rule may be waived in emergency situations upon approval by the department.

HISTORY: 1984 ACS 94, p. ___

R 325.12503. Application for license.

Rule 2503. Within 2 years after the effective date of these rules, a person engaged in the business of hauling water for drinking or household purposes shall apply for a license using a license application form provided by the department.

HISTORY: 1984 ACS 94, p. ___

R 325.12504. Issuance of license.

Rule 2504. If the department, after such investigations as it deems necessary, is satisfied that a water hauler has the qualifications and equipment to perform water hauling services in a manner consistent with these rules, it shall issue a license to the water hauler. A license issued pursuant to this rule is not transferable.

HISTORY: 1984 ACS 94, p. ___

R 325.12505. Source and quality of water; chlorine; storage tanks.

Rule 2505. (1) All water hauled by a water hauler shall meet state drinking water standards and shall be from a public water supply or other source approved by the department.

(2) A water hauler shall add chlorine, in an amount specified by the department, when receiving water from a source and upon delivery of the water after hauling. The amount of chlorine to be added in each instance shall be specified on the license issued by the department for the water transportation tank. The department may require chlorine residual tests of the water hauled upon receipt of the water from the source, after addition of chlorine, and at delivery of the water. At the point of delivery of the water, a free chlorine residual of 1.0 mg/l is required. The department may approve an alternate means of disinfection upon written request by a water hauler.

(3) When transporting water to a public water supply, a water hauler shall deliver water only to tanks or facilities approved by the department.

HISTORY: 1954 ACS 94, p. ___

R 325.12506. Licensing of water hauler's water transportation tanks.

Rule 2506. (1) All tanks used to transport or to carry water shall be licensed annually by the department.

(2) At the same time a water hauler applies for a water hauling license pursuant to R 325.12503, an application for a license for each water transportation tank used for the bulk transport of water for drinking or household purposes shall also be made on an application form provided by the department.

(3) If the department, after such investigations as it deems necessary, determines that the water transportation tank and appurtenances are in compliance with part 24 of these rules, it shall issue a license for the tank to be used for hauling water.

(4) The license issued by the department shall be kept available in the water hauling vehicle for inspection.

(5) The license is not transferable from 1 water transportation tank to another. In addition to the license issued by the department, there shall be displayed on both sides of the tank, in letters not less than 2 inches high, the words "Licensed Water Hauling Tank". Directly adjacent to the words shall be affixed a seal furnished by the department which shall designate the calendar year of the license.

HISTORY: 1954 ACS 94, p. ___.

R 325.12507. Expiration and renewal of licenses.

Rule 2507. All licenses issued under the provisions of this part expire on the last day of June of each year. Application for renewal of a license may be made after March 31 of each year.

HISTORY: 1954 ACS 94, p. ___

R 325.12508. Trip records.

Rule 2508. A water hauler licensed by the department shall maintain trip records of all water hauled. The water hauler shall retain trip records for 2 years.

HISTORY: 1954 ACS 94, p. ___.

R 325.12509. Denial of license.

Rule 2509. If the department finds that water hauling equipment is not in compliance with part 24 of these rules, the department shall not issue or renew a license for the water transportation tank. If the department finds that a water hauler is not in compliance with the provisions of this part, the department shall

not issue or renew the license for the water hauler. In each case, the water hauler shall be notified in writing of the license denial and the reasons for denial by the department. The water hauler may request a hearing before the department if aggrieved by the department's decision, pursuant to the provisions of Act No. 306 of the Public Acts of 1969, as amended, and part 2 of these rules.

HISTORY: 1984 ACS 84, p. —

R 325.12510. Suspension or revocation of license.

Rule 2510. If the department determines that a water hauler licensed under the provisions of the act and these rules is not operating in an approved manner, is hauling water that does not meet state drinking water standards, or is operating a business or vehicles under conditions which may cause a hazard to the public health, the department shall notify the licensee and shall provide an opportunity for the water hauler to take corrective action as may be required. If the licensee does not effect the corrections within a reasonable time, the department shall suspend or revoke the license of the water hauler.

HISTORY: 1984 ACS 84, p. —

PART 26. BOTTLED WATER

R 325.12601. Applicability.

Rule 2601. The provisions of this part apply to all persons providing bottled drinking water for drinking or household purposes.

HISTORY: 1984 ACS 84, p. —

R 325.12602. Application for approval of source.

Rule 2602. (1) A person providing bottled drinking water shall submit an application to the department requesting approval of the source of water being used or planned to be used for bottled water. A person may request approval of more than 1 source of water on a single application.

(2) After receipt of the application, the department may approve the source or sources of water upon a finding that the source or sources meet the state drinking water standards and the requirements of the act and these rules.

(3) A person shall not use a source of water for bottled water unless prior approval from the department has been obtained.

HISTORY: 1984 ACS 84, p. —

R 325.12603. Sources of water; monitoring.

Rule 2603. If water is obtained from a source other than a type I or type II public water supply, the department may require a person providing bottled water to sample the source of water from time to time and submit records of that sampling to the department.

HISTORY: 1984 ACS 84, p. —

R 325.12604. Out of state sources.

Rule 2604. (1) A person providing bottled drinking water and utilizing an out of state source of water shall submit an application to the department as required by R 325.12602. The application shall show proof of approval of the source from the state agency with jurisdiction.

(2) After consultation with the state agency having jurisdiction, the department shall approve the source for bottled water if the other state's inspection, surveillance, and approval procedures are acceptable to the department, and the source meets the state drinking water standards.

HISTORY: 1984 ACS 94, p. ___.

R 325.12605. Maintenance of records.

Rule 2605. A person providing bottled drinking water shall maintain records of all sources from which water is purchased or obtained for bottled water and shall submit those records to the department on an annual basis.

HISTORY: 1984 ACS 94, p. ___.

R 325.12606. Rescission or suspension of approval.

Rule 2606. Upon its finding that a person has submitted false information on an application submitted to the department for approval of a source for bottled water pursuant to R 325.12602, or if a source for bottled water does not meet the state drinking water standards, or if a person has violated the provisions of the act or this part, the department may rescind or suspend approval of the source for bottled water.

HISTORY: 1984 ACS 94, p. ___.