

COUGAR DAM

ADULT FISH COLLECTION FACILITY

OPERATION AND MAINTENANCE MANUAL



U.S. Army Corps of Engineers, Portland District
100% Back-Checked Draft – September 28, 2011

ARMY CORPS OF ENGINEERS

Facility Operations and Maintenance Manual

Cougar Adult Fish Collection Facility

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Facility Operations and Maintenance Manual

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ABBREVIATIONS AND ACRONYMS

AFCF	Adult Fish Collection Facility
ATS	Automatic Transfer Switch
AWS	Auxiliary Water Supply (Pumped water for entrance attraction flow)
CFM	Cubic Feet per Minute
CFS	Cubic Feet per Second
DDR	Design Document Report
FCF	Fish Collection Facility
FWS	Facility Water Supply (Pumped water for fish ladder, pre-sort pool, post-sort pools, false weir and other sorting uses)
IOP	Interim Operation Plan (Operation plan to facilitate the operation of AFCF during the 2010 season)
O&M	Operation and Maintenance
PAC	Post Authorization Change
PLC	Programmable Logic Control
PSI	Pounds per Square Inch
SCADA	Supervisory Control and Data Acquisition
VFD	Variable Frequency Drive
WTC	Water Temperature Control (Tower)

1. INTRODUCTION

In 2005, a new Water Temperature Control Tower (WTC) was commissioned at the Cougar Dam Project. The new temperature control system has delivered significant improvements to the downstream salmon habitat by removing a former thermal obstruction (caused by previous dam releases without temperature control) and by providing outflow water temperatures that more closely resemble the natural cycle before the dam was built. After the WTC project began operating, Spring Willamette Chinook began to return to the base of the powerhouse. A permanent adult salmon fish collection facility (AFCF) was authorized as the next step in a comprehensive program to improve the native salmon condition in the McKenzie River Basin.

The AFCF was designed to collect upstream migrating fish (salmon, bull trout and other resident fish) from the Cougar Dam tailrace and sort the fish (e.g. separate native and hatchery fish) so that selected fish may be transported above the Cougar Project. This project effectively expands spawning and rearing habitat, and will help restore biological connectivity between upstream and downstream habitats. The new AFCF was built during 2008-2010, and commissioned in July 2010. After a seven-day Endurance test and installation of a new programmable logic control (PLC), the AFCF was operated for fish collection and sorting purposes until Oct 15, 2010.

The Willamette Project is responsible for the operation and maintenance of this new system. Given the electrical, mechanical and structural complexity of the AFCF, the preparation of an Operation and Maintenance Manual (O&M) was mandated by the Portland District. This O&M manual will work in conjunction with the Contractor's Operation and Maintenance Manual—twelve volumes that will contain detailed product and maintenance information on the separate components of the system. The following O&M manual is intended to provide the overall framework and guidance on how to operate, maintain and trouble shoot the AFCF as a system.

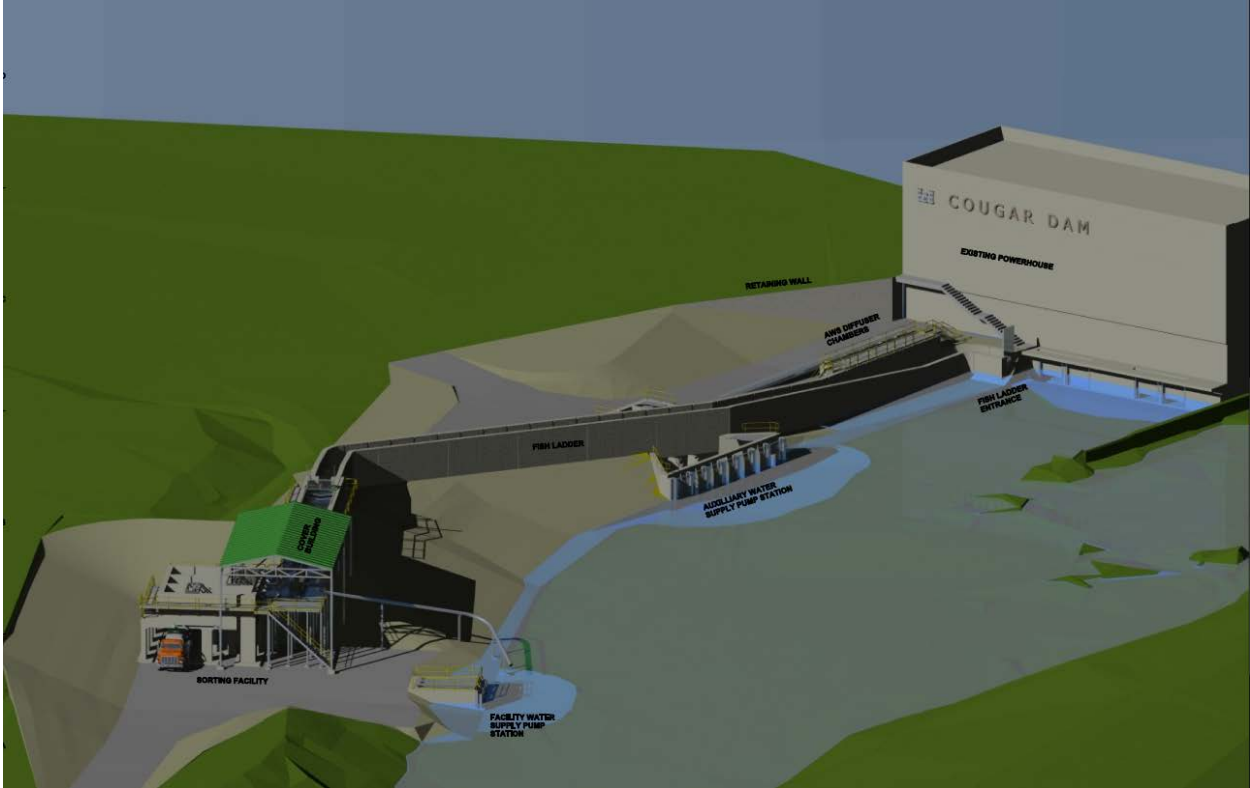


Figure 1 – Isometric Rendering of the Cougar AFCF (Excerpt from Cougar AFCF Plans Sheet G-004)

1.1. ORIGINAL AUTHORIZATION

The initiation of activity that led to the ultimate construction of the Cougar Adult Fish Collection Facility (AFCF) was launched from two Congressional resolutions which provide authority to the Corps of Engineers to conduct temperature control studies at the Blue River and Cougar lakes projects. In 1995, the Corps produced the Willamette River Temperature Control Final Feasibility Report and Environmental Impact Statement. This study evaluated the potential for modifying the Cougar and Blue River projects for water temperature control, investigating alternatives that would modify the temperature of downstream releases to replicate pre-project water temperatures to benefit anadromous and native fish species. These alternatives included operational changes, a curtain barrier, mixing devices, and a selective withdrawal system.

1.2. POST AUTHORIZATION CHANGES

As part of these two Congressional resolutions, a Post Authorization Change (PAC) Report was generated, which recommended the construction of a permanent Adult Fish Collection Facility (AFCF), to be located at Cougar Dam. The report recommends a specific plan for construction of the facility and provides justification for implementing this plan as part of the Willamette River Temperature Control Project. The specific recommendations were to (1) construct a permanent fish collection and transportation facility composed of electric pumps and a pool-and-weir fishway, (2) extend monitoring of Chinook salmon and bull trout, and (3) defer construction of Blue River.

1.3. PURPOSE & SCOPE

The Willamette Project will be responsible for the operation and maintenance of the new Cougar AFCF system. The new facility is a complex system with many interacting mechanical, electrical, and structural components. In addition, the hydraulic performance must be carefully controlled so that the system operation routinely meets NOAA Fisheries criteria and provides effective fish passage.

The Operation and Maintenance (O&M) Manual will be developed to provide the necessary guidance in the general system operation and to describe the specific operation and maintenance of each pertinent component in the system. Inspection cycles and maintenance procedures need to be identified, described and scheduled for all of the pertinent features and components of the new system. This O&M manual needs to provide easy reference to specific and relevant locations in the Contractors O&M manual, which contain detailed product O&M information for each item that was furnished. The O&M Manual should be detailed, comprehensive in scope and prepared in a manner that is accessible to the personnel that will be operating and maintaining this system in current and future decades.

1.4. PARTS OF MANUAL

There are three general parts:

1. Introduction, purpose and scope
2. Description of project features with photos
3. Operation and Maintenance of the system- This describes the general system operation (automatic or manual), general maintenance, and specific maintenance for the components.

Appendices include (A) Plates, (B) Location Information for Level Transmitters, (C) Hydraulic Data, (D) SCADA Alarms, (E) Operator Walkthrough PowerPoint, (F) DeviceNet Configuration and Equipment Parameters.

1.5. PROJECT DESCRIPTION

The Cougar Project is located 42 air miles east of Eugene, Oregon on the South Fork of the McKenzie River. The South Fork of the McKenzie River is 61 river miles upstream from the mouth of the McKenzie River, which is a tributary to the Willamette River.

On the downstream side of the Cougar dam, there are two separate primary outflow channels that merge together about 1000 feet downstream of the dam. The powerhouse (2 units, 1350 cfs combined maximum discharge, 25,000 Kilowatts Rated Power) releases into the north channel. The Reservoir Outlet (13-foot Tunnel, 12,050 cfs) discharges into a plunge pool in the south channel.

The Cougar AFCF is located on the north bank of the powerhouse (north) outlet channel. The less frequently used diversion tunnel (re-commissioned for the construction of the Water Temperature Tower) also discharges into the Powerhouse channel, south of the powerhouse.

The Cougar AFCF includes the following general features:

1. Two pump stations each equipped with VFDs and airburst screen cleaners:
 - a. Facility Water Supply (FWS) supplies water to the Presort and upper fish ladder, holding, sorting, and transporting facility (3 pumps);
 - b. Auxiliary Water Supply (AWS) delivers attraction water to the fish ladder entrance (3 pumps);
2. Sorting Facility including:
 - a. Pre-sort pool with Crowder, finger weir and false weir;
 - b. 3 post-sort pools, and a loading hopper to load trucks for fish transport;
 - c. Anesthetizing tank; and
 - d. Recovery tank and return to river flume.
3. Fish Ladder System with:
 - a. Pools separated by weirs and orifices;
 - b. Diffusers in lower pools supplied by the AWS pumps; and
 - c. Fish Ladder Entrance with entrance gate and fish exclusion screen
4. Transport Truck Access Roadway and a new Access Road to the Powerhouse.
5. Station Service Upgrades at the Powerhouse to support increased power requirements of the fish collection facility.
6. Emergency backup power generator
7. Fish Transport Truck

2. PROJECT FEATURES

A specific description of each pertinent project feature is provided in this section.

2.1. PUMP STATIONS

There are two pump stations that supply the Cougar AFCF:

- Facility Water Supply (FWS)
- Auxiliary Water Supply (AWS)

These pump stations are described in detail in the following sections.

2.1.1. FWS Pump Station



Update picture after follow on to show hoods on the combination valves

The FWS pump station is located downstream of the fish ladder and is constructed of reinforced concrete. The FWS supplies water to the sorting facility and the upper end of the fish ladder. The FWS pumps are the most critical to the operation of the facility. Without the operation of two FWS pumps, fish will not be able to ascend the ladder, enter the pre-sort pool, pass over the false weir, and enter the rest of the sorting facility.

2.1.1.1. FWS Pumps

There are three, variable frequency drive (VFD) controlled, pumps at the FWS pump station, two of which are normally running. The three pumps are KSB's Amacan S 650-404/656UAG2. Each pump is rated for a maximum 72.6 Hp and a maximum output of 5162 GPM. The FWS pumps supply river water to the sorting facility post-sort and pre-sort pools. The pre-sort pool supply flows into the ladder and is

the only water supply to keep the ladder watered up. In the event of a power outage the generator only powers one FWS pump.

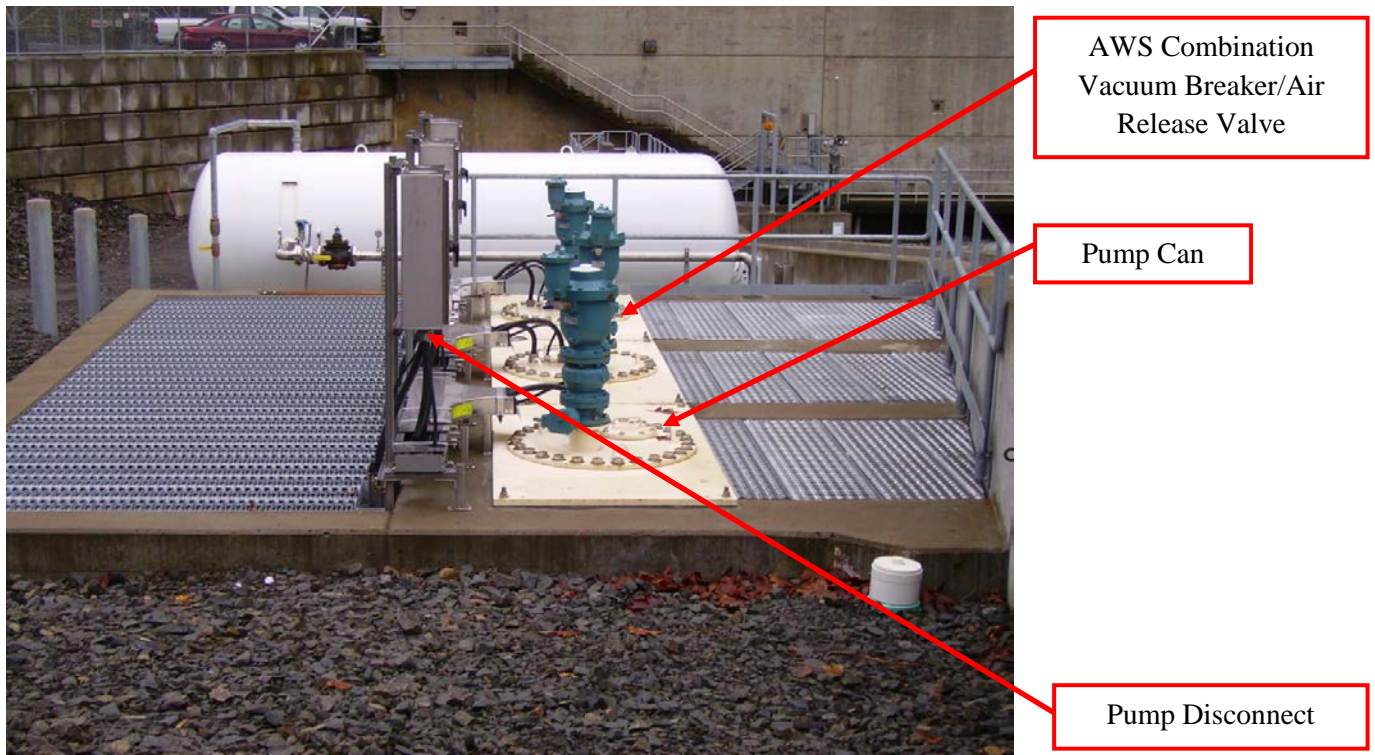
2.1.1.2. FWS Piping

The FWS pipe is painted carbon steel (inside and outside), with a diameter of 24” and a wall thickness of 0.375”. Internal system pressure can be observed by gauge readings near the check valves at the pump cans. The piping must be drained during the winter because the water in the pipe will not flow back into the river. **A ball valve is located at the bottom of the pipe manifold near the pump cans for draining.** The piping routes water to the pre-sort pool, post-sort pools, and false weir. This water is the primary source of flow for ladder operation.

2.1.1.3. FWS Check Valves

The FWS pump check valves are located approximately four feet downstream of the pump cans. Each check valve is a 24” diameter APCO 9000 with a cast iron body, ductile iron doors with nickel facing, stainless steel spring, Buna-N seat material and stainless steel hinge pin. Each check valve weighs approximately 700 pounds. The check valves are needed to prevent backflow through any pump that is not operating or has failed.

2.1.2. AWS Pump Station



Update picture after hoods have been put on the valves

The AWS pump station is located near the midpoint of the fish ladder and is constructed of reinforced concrete. Water from the AWS pumps provides attraction flow at the ladder entrance under varying powerhouse operations. The AWS pump operation has been configured to discharge 39 – 80 cfs with two

operating pumps and 27 - 38 cfs with one pump. AWS pump operation is 50 – 80 cfs for normal tailwater levels (at least one powerhouse unit operating at minimum 300 cfs).

2.1.2.1. AWS Pumps

There are three submerged, variable frequency drive (VFD) controlled, pumps at the AWS pump station, two of which are normally running, except at very low tailwater levels. The three pumps are KSB's Amacan PA-540/1008UTG1. Each unit is rated for a maximum 127 Hp and a maximum output near 40 cfs. The AWS pumps supply river water to the first 4 ladder pools through a series of butterfly valves. The AWS water supply provides additional flow to attract fish; that flow is determined by tailrace conditions.

2.1.2.2. AWS Piping



The AWS piping consists of a variety of different diameter pipes. The main conveyance line is a 4-foot diameter pipeline. Refer to as-built drawings for specific sizes and lengths. The piping is unique as it operates with a vacuum when the combination air release/air vacuum breaker valves are open. During pumping operations the pipe must be filled with water to avoid excess cavitations at the pumps. The pumping system will self-sweep excess air from the system once the combination valves are closed and the pumps are running. If excess noise is heard at the pumps refer to air removal operation in Section 3.6. The piping provides flow from the AWS pumps to ladder pools 1-4; the flow can be regulated by pump speed and five diversion valves.

2.1.2.3. AWS Flow Meter



The Accusonic Model 798 is a clamp-on permanent ultrasonic flow meter that measures flow through the main AWS pipeline near the AWS compressed air receiver. This measured flow is sent as feedback to the PLC which then adjusted the flow based on ladder criteria. **WARNING:** This flow meter will only measure flow in a full pipe; air entrainment will provide false readings to the PLC and the system will not adjust AWS flow correctly.

2.1.2.4. AWS Check Valves

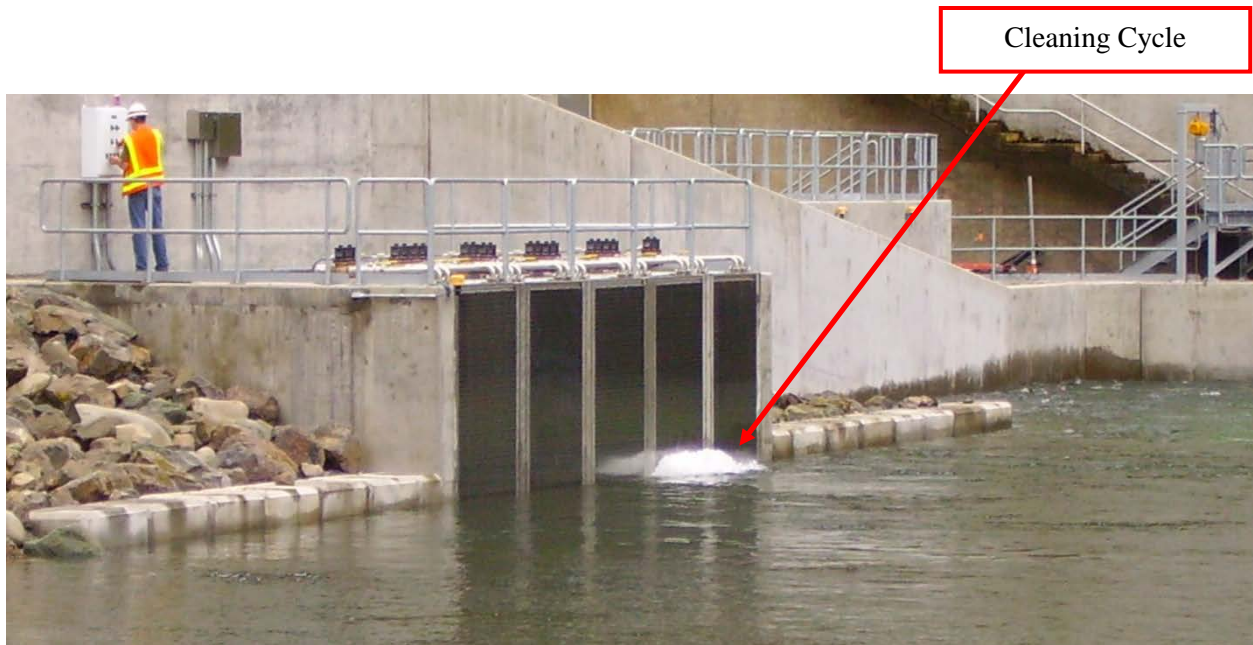


Check Valve

Expansion Sleeve

The AWS pump check valves are located in the pit behind the AWS pumps. Each check valve is a 30" diameter APCO 9000 with a cast iron body, ductile iron doors with nickel facing, stainless steel spring, Buna-N seat material and stainless steel hinge pin. Each check valve weighs approximately 1100 pounds. The check valves are needed to prevent backflow through any pump that is not operating or has failed.

2.1.3. Pump Intake Structure



AWS Pump Intake Structure

The purpose of the intake screens is to prevent the entrainment of juvenile salmonid fish and other small resident fish into the sump, pumps and discharge pipe system. The intake screens also prevent debris from entering the intake structure that may damage the pumps or other equipment in the system. Both the AWS and FWS pump intake structures are fabricated from 304L stainless steel vertical profile bars. The gaps between the bars are 1.75 mm, sized for juvenile fish per NOAA Fisheries Criteria. Each screen is 6 ft wide, framed with hollow structural sections, and with structural supports between sections. The FWS has two (2) 11-foot tall intake screens. The AWS has five (5) 16.5-foot tall intake screens. For the FWS, normal screen water velocity is limited to 0.4 fps. For the AWS, normal screen water velocity is limited to 0.2 fps.

2.1.4. Pump Intake Screens

The pump intake screens need to remain free from debris to minimize the pressure differential across the screens (and reduce likelihood of velocity hot spots); this maximizes the suction head for the pumps, keeping pump operation as efficient as possible. The cleaning is done by pressurized air released from a series of nozzles. The air jets release debris from the screens and the river flow provides a sweeping velocity to move the debris downstream. **The FWS airburst system will clean the screens at least six times a day and anytime the water elevation differential exceeds 0.6 feet between the tailwater and the pump sump behind the screen. The AWS airburst system will clean its screens twice a day and anytime the water elevation differential across the screen reaches 0.6 feet.**

2.1.5. Air Burst Manifolds



Airburst Solenoids



Manifold and Nozzles

Label solenoids and sensor

Each airburst manifolds consist of a series of nozzles and compressed air pipe that sit behind the pump intake screens. Each manifold is pressurized by the actuation of an electric air solenoid valve. The AWS pumps have five pump intake screens and the FWS pumps have two screens. The screens have four separate zones that activate based on water elevation on the screen. A cleaning airburst will only happen for zones that have at least two-thirds water coverage. Each system has a receiver acting as a reservoir if the supply air is interrupted. The AWS receiver has a 3000 gal capacity and the FWS receiver has a 1000 gal capacity; each is sized to allow one cleaning cycle if there is a problem with the air supply from the **powerhouse**.

2.1.6. Porosity Plates

The porosity plates for both the AWS and FWS are fabricated from 304L stainless steel. The purpose of the porosity plates is to make the flow pass through the screens more uniformly and prevent the occurrence of velocity hot-spots on the fish screen that could endanger juvenile fish. This is accomplished by having the porosity plate create much more hydraulic resistance than the fish screens. The AWS and FWS perforated plates have 12.8% open area through the plate. Each frame is 6 ft wide, framed with hollow structural sections, and with structural supports between sections. The FWS porosity plates are 11 ft tall. The AWS porosity plates are 16.5 ft tall. The FWS has 2 porosity plates. The AWS has 5 porosity plates.

2.1.7. Air Compressor

Will Change for follow on contract

Compressed air for the screen cleaning system is supplied by an air compressor located in the powerhouse. The AFCF currently shares its air supply with the powerhouse. The air compressor can supply 137 CFM@125 PSI. Currently the powerhouse air supply cannot be separated from the facility air supply. This will create a problem if an air burst solenoid is stuck open. SCADA alarms are in place that will warn of low pressure at the powerhouse receivers.

2.1.8. Dewatering Bulkheads

There are 5 bulkheads that can be used to dewater the FWS and the AWS. The bulkheads are 6.6 ft wide and 15.5 ft tall. The bulkheads are fabricated from 0.5 in plate and WT 4x14, painted carbon steel, sections. The bulkheads will be stored in the horizontal position on cribbing.

2.2. FISH LADDER FEATURES

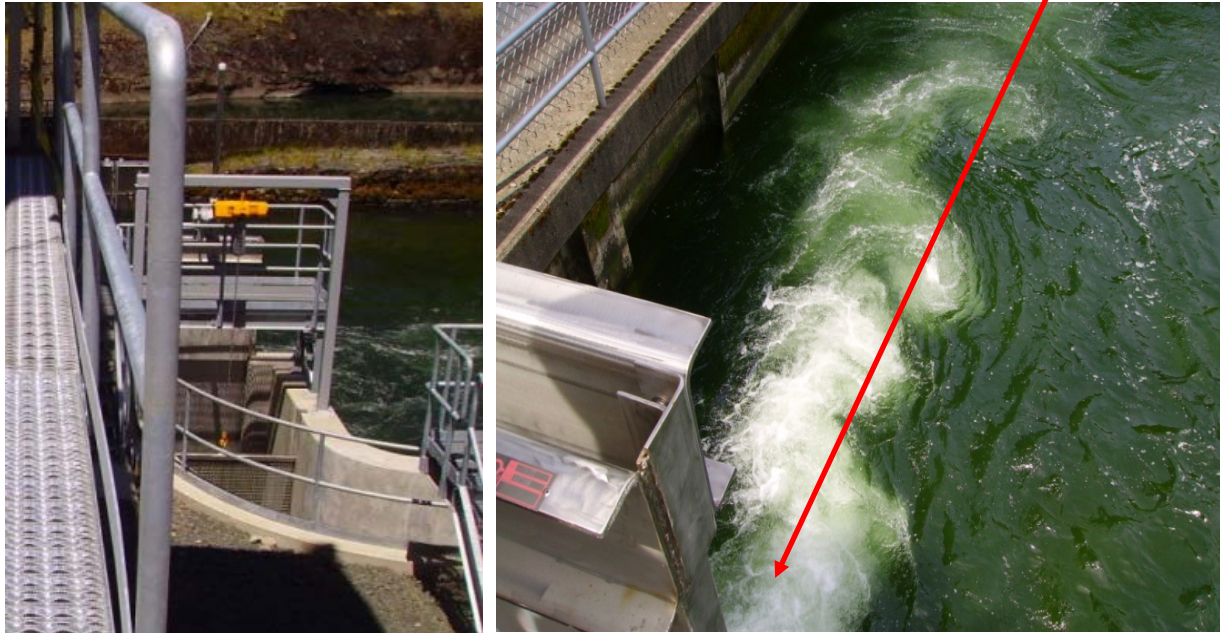


The fish ladder guides fish from the powerhouse tailrace to the AFCF presort pool. This fish ladder consists of 31 pools separated by 31 ladder weirs. The ladder is approximately 311 feet long and the invert is sloped at 1 on 9 feet, rising 30 feet from Pool 1 to the Presort Pool. Discharge down the ladder starts at the top from the Presort Pool and steps down from Pool 31 to Pool 1 and releases out the entrance to the tailrace. The FWS pumps supply the Presort pool and upper ladder flow (about 18 cfs). There are

four diffusers in the lower four pools that provide AWS attraction flow for the entrance discharge. The AWS pumps provide 50-80 cfs to the diffuser system.

2.2.1. Ladder Entrance

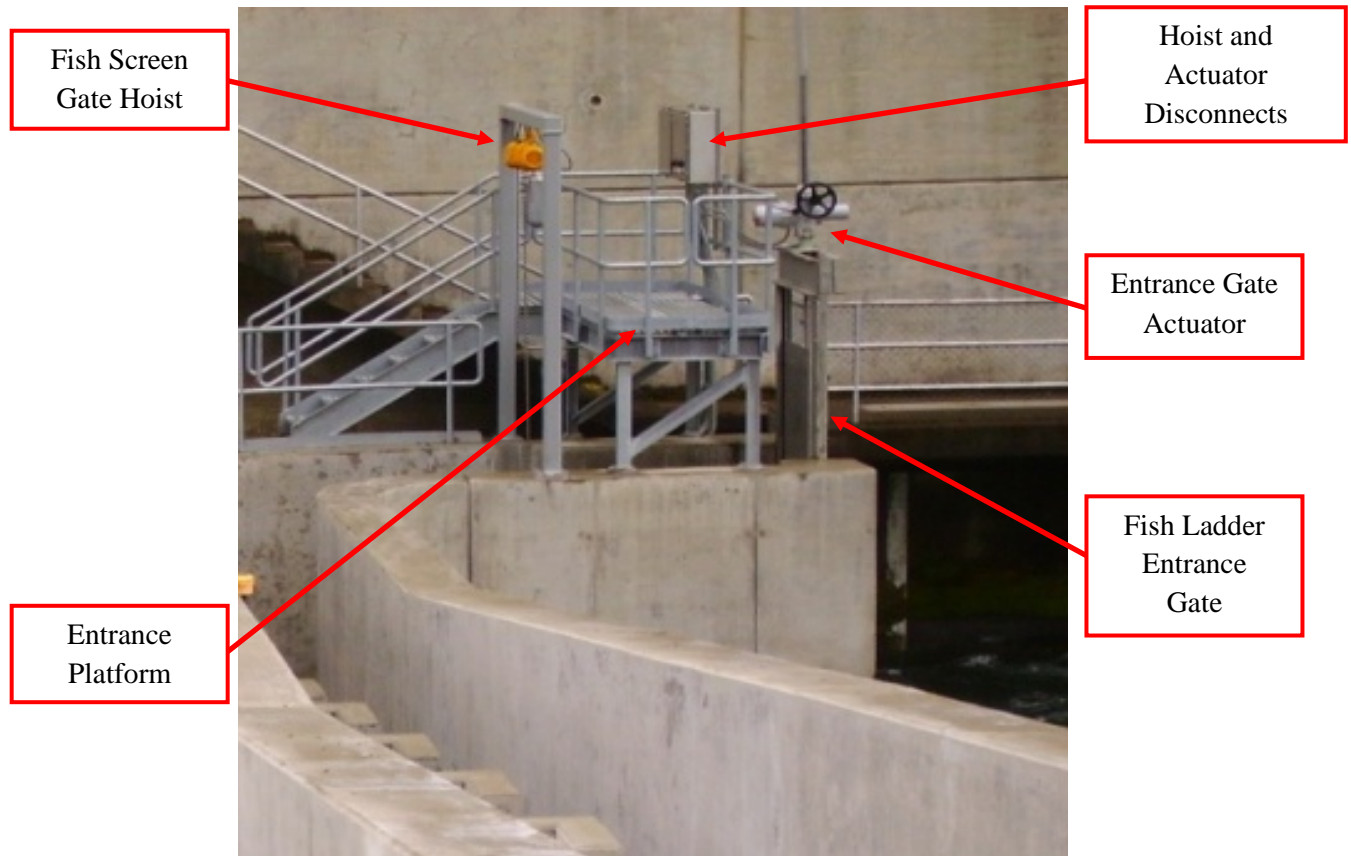
Ladder Entrance
Discharge Jet



Insert a new picture from a better angle

The fish ladder has one entrance located adjacent to the northeast corner of the Powerhouse. The ladder entrance has a concrete ramp leading up to the entrance to assist lamprey in entering the ladder. There is a four-foot wide entrance gate located at the entrance to the fish ladder. A fish screen gate is located behind (or upstream of) the entrance gate. Both gates close from the top downward. A work platform is located over the fish ladder entrance. The platform allows worker access to the fish ladder entrance gate and the fish screen gate.

2.2.1.1. Entrance Gate



An entrance gate is located at the entrance to the fish ladder. The Entrance gate is a slide plate that is moved by jack screw and actuator. The gate's primary function is to keep the ladder water elevation approximately 1.5 feet higher than the tail water elevation while maintaining a pool 1 water level of approximately 5 feet. The opening varies from nine to sixty inches (5 feet) and its position is normally regulated by the PLC; the gate is programmed to respond to changing output flow and tailrace elevation to keep the ladder entrance water level within criteria.

2.2.1.2. Fish Screen Gate



The fish screen gate is used to keep fish from entering the fish ladder during start up and shut down operations. The 6.5 ft wide by 9.5 ft tall gate is fabricated from 304L stainless steel grating, framed by a hollow structural section. The gate is raised and lowered by a manual hoist mounted to a lifting frame.

2.2.2. Ladder Weirs and Orifices



The fish ladder channel is 6 feet wide. There are 31 pools separated by ladder weirs. Each ladder weir has a 4-foot long non-overflow weir and a 2-foot long overflow weir located between the fishway pools. A 12 inch wide by 15 inch tall orifice is located on the floor under the 2-foot overflow section. The weir and orifice are constructed of reinforced concrete. The orifice opening is rounded to assist lamprey passage. The crest of the overflow weir is 5 feet above the invert and the non-overflow crest is 2 feet above the overflow crest. The weirs are spaced at 9-foot centers from pool to pool and the ladder invert is sloped at 1 vertical to 9 horizontal. The elevation difference between the crest of the weirs up the ladder is 1 foot. The FWS pumps must discharge a combined discharge of 18 cfs to maintain one foot ladder head (design criteria).

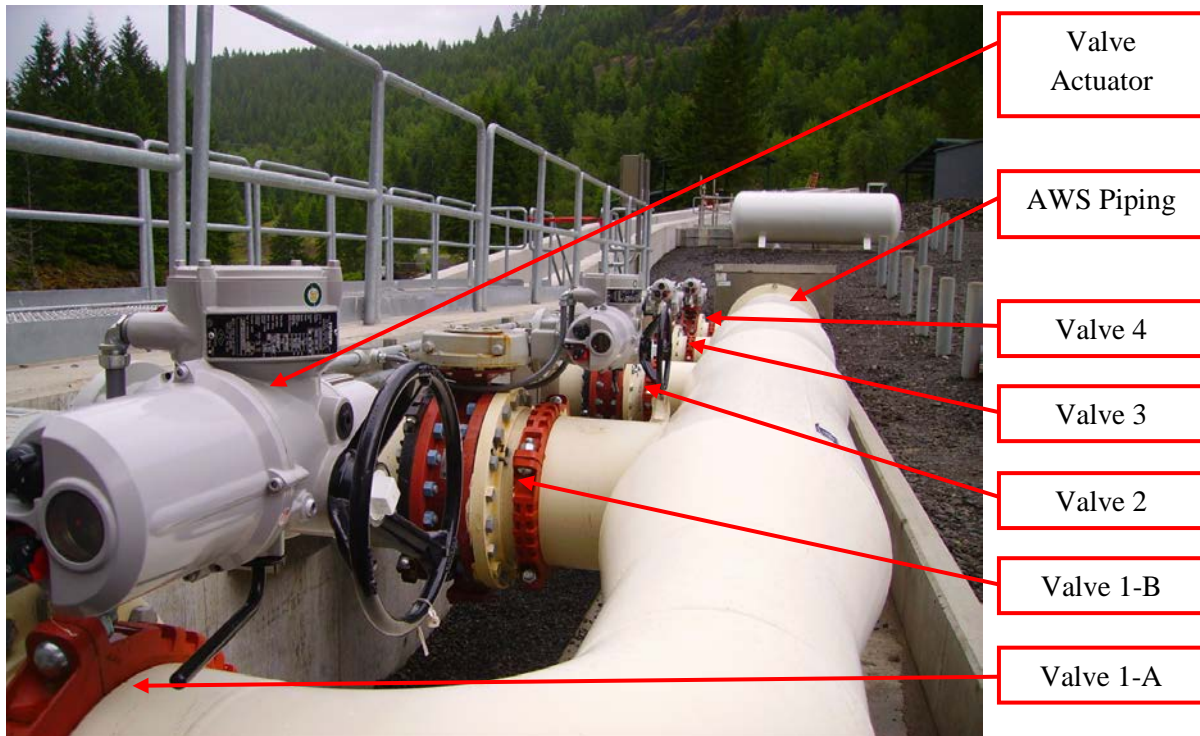
2.2.3. Diffusers

There are five diffusers through which the AWS flow is discharged in the lower four ladder pools. Each diffuser includes an on/off diffuser valve, diffusion basin, porosity plate and diffuser screen.

- Diffuser Valves 1-A and 1-B discharge to two diffuser screens in Pool 1, and share a common diffusion basin
- Diffuser valves 2, 3 and 4 each discharge to single diffuser screens in Pool 2, 3 and 4, respectively.

FIND PICTURES FOR THIS

2.2.3.1. Diffuser Valves



The diffuser valves are butterfly valves used to control water height in ladder pools one through four. Pool 1 is regulated by two 20-inch diameter valves (1-A and 1-B); each providing approximately 50 CFS of water to the pool. Pools 2, 3, and 4 each have a valve (2, 3, and 4, respectively) that is 16 inch diameter and provides approximately 10 CFS of flow to each pool. Tailrace water elevation determines which valves should be open. As the tailrace water elevation increases, the ladder flow must also increase to provide necessary head differential at the ladder entrance. This operation must concurrently adjust to keep Pool 1 water depth near 5 ft. Valves will open in succession based on the flow generated by the AWS pumps. The diffuser valves are not throttled; they are either fully open or fully closed.

2.2.3.2. Diffusion Basins with Diffuser Screens and Porosity Plates

The four AWS diffusion basins receive discharge from the AWS diffuser pipes and release the flow by means of wall diffuser screens to adjacent fish ladder Pools 1 – 4. These basins dissipate the concentrated flow energy that comes in from the downward directed AWS pipes so that the flow may enter the fish ladder channels laterally in more diffused and uniformly low velocities. There is a separate diffusion chambers for each pool (1-4). All basins are 6 feet wide. Basins 2 - 4 are 7.5 feet long and Basin 1 is 16 feet 4 inches. The inverts vary in elevation, with Basin 1 being the lowest. The floors are sloped 0.5% to drain southward towards the diffuser screens and ladder channel. The AWS pipes enter the basins through the north wall and the porosity plates are attached to the inside of the south walls of the basins. The diffuser screens are on the outside of the south walls of the basin, or inside of the walls in the adjacent fish ladder pools.

The auxiliary water diffuser screens are located flush along the ladder wall. The screens are intended to prevent fish from entering the auxiliary water supply diffusion basins and to provide a uniform discharge

of auxiliary water into the ladder system. The screens are fabricated from 304L stainless steel grating and consist of 3/16 inch thick bars with 15/16 inch gaps. There are 5 diffuser screens. The diffuser screens are 6 ft wide by 5 ft tall. Each diffuser screen has a porosity plate behind it.

The porosity plate provides a uniform discharge through the diffuser screens by creating most of the hydraulic resistance and head drop between diffusion basin and adjacent fish ladder pool. The porosity plates are constructed of 304L stainless steel plate. The porosity plates have equivalent height and width as the diffuser screens. The porosity plates are 5/8-inches thick with 3/4 inch diameter holes at 1.5 inch staggered centers (22.7% porosity).



Diffuser 1
Screens

2.3. PRE-SORT POOL FEATURES

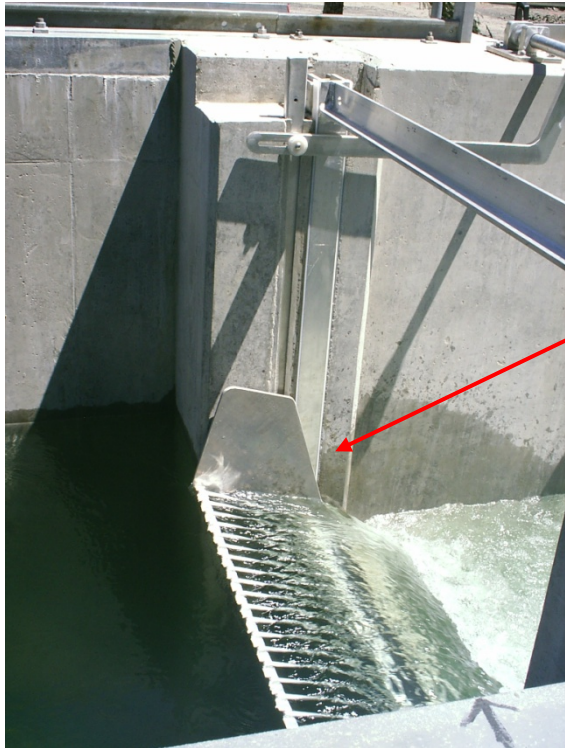


REPLACE PHOTO PER FOLLOW-ON to include end of fish ladder false weir and closure gate...

Fish jump from the fish ladder, over a finger weir, into the pre-sort pool. The 44 ft long, 11 ft wide, 13 ft tall pre-sort pool is constructed of reinforced concrete. There is one contraction joint located at the center of the pre-sort pool. Water is supplied to the pre-sort pool through two floor diffusers. During normal operation, the water is about 6 feet deep. If water supply is disrupted, the pre-sort pool will maintain 5 feet of depth.

2.3.1. Finger Weir

A finger weir is provided at the fish ladder to pre-sort pool transition. The finger weir prevents fish from dropping out of the pre-sort pool back into the ladder. The finger weir can be adjusted to match any changes to the pre-sort pool level; typically the pre-sort pool water elevation does not change and the finger weir will not need adjustment once the pre-sort pool water level has been set. Currently the finger weir is moved by a pole and locked in place by pinning the adjustment handle.



Finger Weir

2.3.2. Crowder

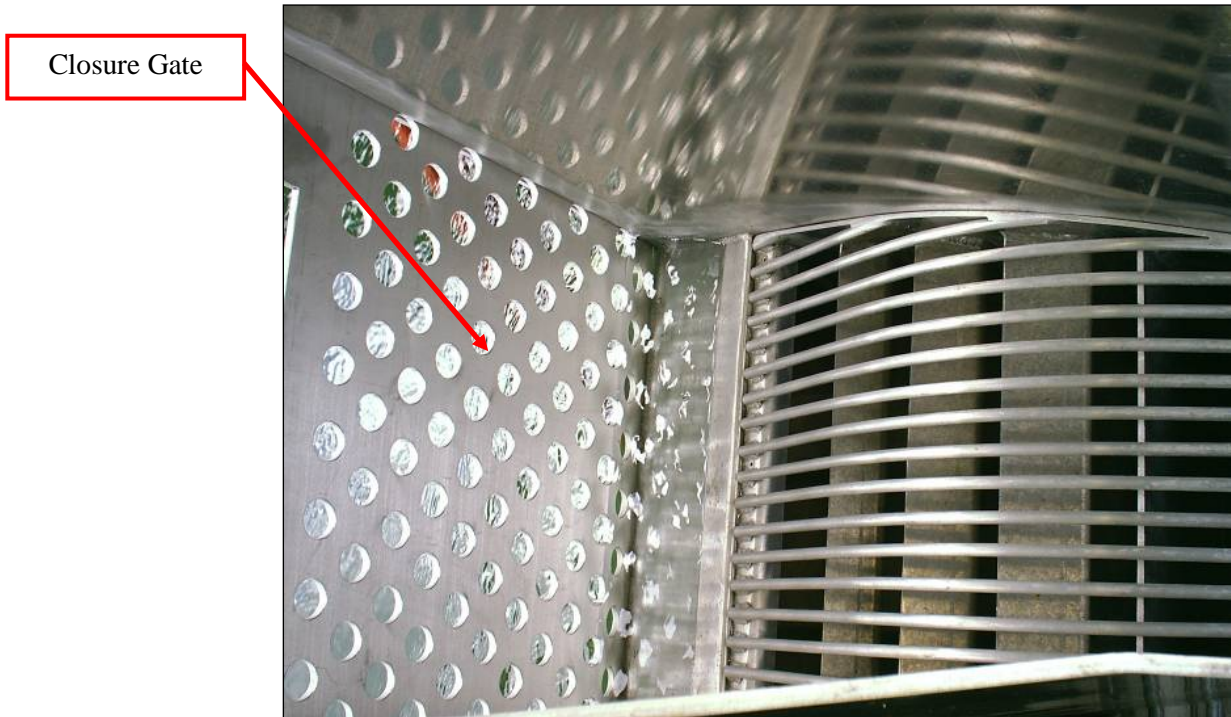


Crowder

Pre-sort pool

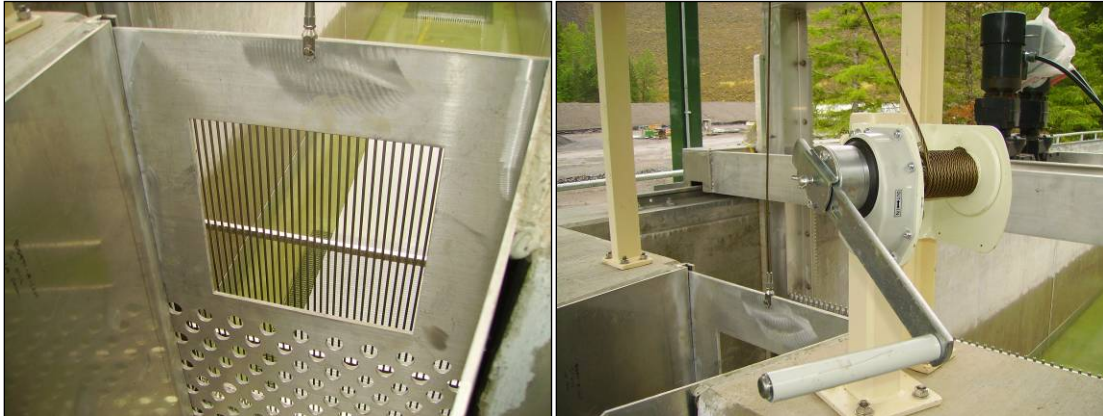
The Crowder is located in the presort pool. If the fish do not respond to the false weir and jump into the flume on their own, the Crowder is used to move them towards the false weir. The Crowder is operated from the control box located on the northwest side of the pre-sort pool. During operation the Crowder moves along the length of the presort pool forcing the fish to be concentrated next to the false weir. The Crowder lower edge can then be moved vertically to push fish into the entrance area of the false weir as necessary to get the fish moving thru the false weir.

2.3.3. False Weir



The false weir provides a falling water stream that enters the presort-pool. The water plunges into the presort pool stimulating the fish to jump. Under normal conditions the fish will jump over the false weir without the need to crowd the fish. The false weir's water stream can be changed in two ways; the water supply can be diverted from the floor diffusers in the pre-sort pool or the total volume of water in the pipe can be changed prior to the diversion valve. These modifications can be done independently or simultaneously, typically the operators will adjust these until the fish are jumping into the flume and no further changes are necessary.

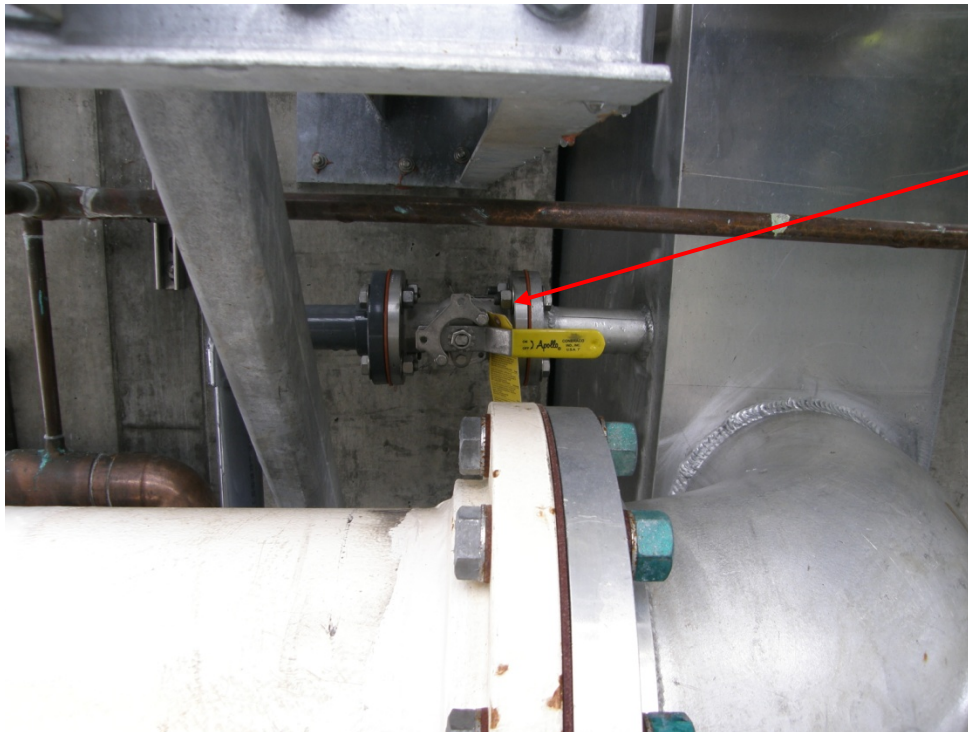
2.3.4. Closure Gate



The closure gate is an aluminum slide gate that is perforated to allow water to partially pass through. In the event that fish cannot be processed down the flume the gate can be lowered to keep the fish from jumping into the false weir water stream. The diversion valve actuation is very slow; the closure gate provides a temporary flow disturbance that keeps the fish from entering the flume.

ADD OVERALL PICTURE

2.3.5. False Weir Drains



False Weir Drain
2-inch Ball Valve

The False weir has two false weir drains. One drain is a 2-inch ball valve located on the side of the weir housing, and is used to fine tune the amount of water entering the flume at the backside of the false weir.

A larger drain is located at the back of the housing, beneath the flume. This drain is throttled with an 8 inch diameter butterfly valve that is located on the west side of the false weir below the work platform.

2.3.6. Pre-Sort Pool Valves

The pre-sort pool has two valves used during operations: the FWS diversion valve and the pre-sort pool drain valve.

CAUTION: The pre-sort pool fills as a result of activating the FWS pumps to fill the ladder; ensure the pre-sort drain is closed prior to filling the ladder.

2.3.6.1. FWS Diversion Valve Assembly

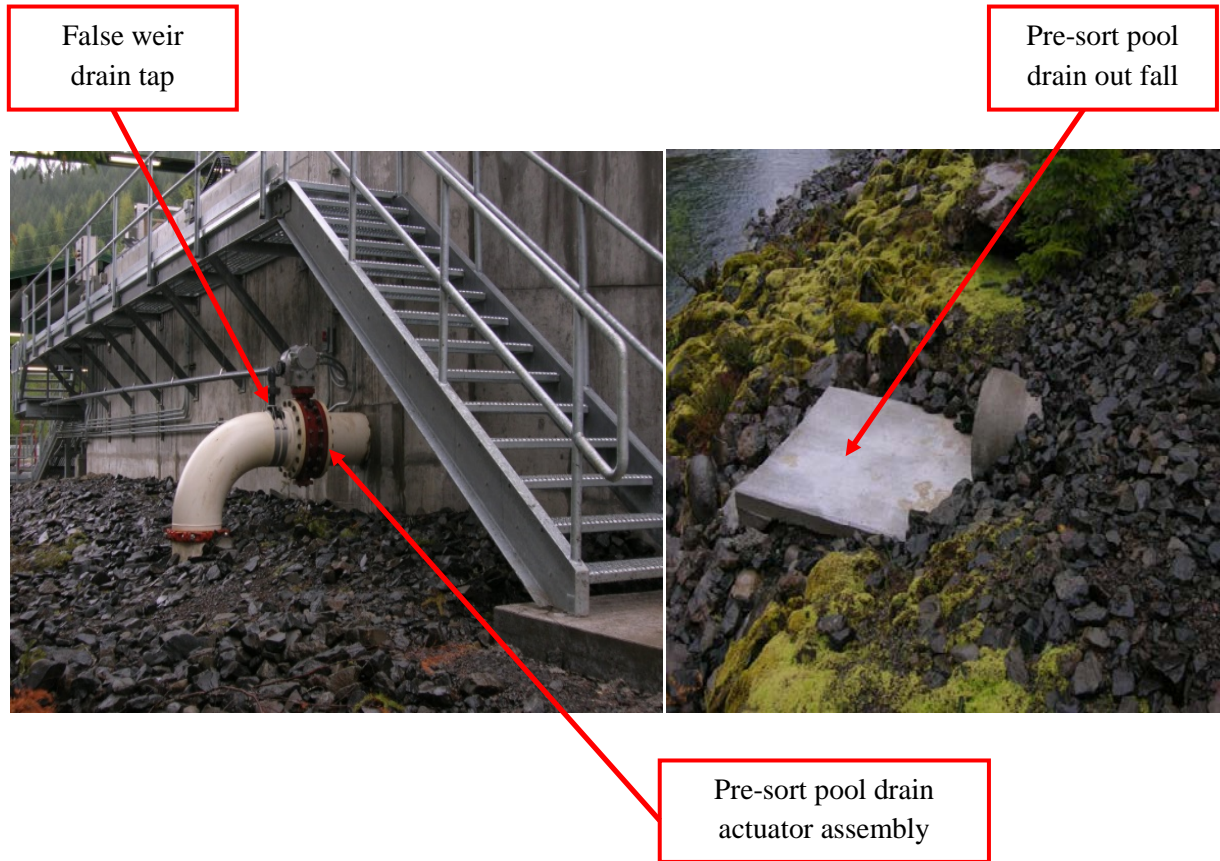


Needs a new picture showing the handrails

Water flow from the FWS pumps is directed by a 24" pipe to a diversion valve assembly. This valve assembly has two operating positions; in one position it directs 100 percent of the flow to the pre-sort pool diffusers and in the other position it diverts a portion of the supply flow to a 13" pipe that provides water to the false weir leaving the remainder continuing to feed the pre-sort pool diffusers. The valves are operated manually to provide the most optimal fish processing capability. These valves are located in the vault near the pre-sort pool.

2.3.6.2. Pre-Sort Pool Drain Valve

The pre-sort pool drain valve is only used when the facility is winterized. The drain allows the pre-sort pool to empty below the ladder weir and it should not be used until all fish have been removed from the pre-sort pool. The drain empties into the river along the rocky embankment. [The drain pipe and discharge slab are in the following 2 photos.](#)



2.3.7. Diffusers

The pre-sort pool diffusers are approximately 2 ft deep and are located at the quarter points of the pre-sort pool floor. A perforated plate and diffuser grating is located in each diffuser. The perforation plates and diffuser screens are constructed of 304L stainless steel. The perforated plate and diffusers screens are 6 ft by 5 ft. [Porosity of the perforated plates is about 51 percent.](#) The diffusers are supplied by the FWS pumps. The diffusers provide hydraulic resistance to flow to reduce any jetting flow that may occur near the outlet of a water pipe.

2.3.8. Pre-Sort Pool Fence

To be added once the work is complete

2.4. SORTING AND HOLDING FACILITY



After jumping out of the pre-sort pool, over the false weir, fish enter the flumes of the sorting and holding facility. The sorting and holding facility structure is constructed of reinforced concrete and galvanized steel work platforms, and consists of two levels. The ground level consists of a drive through truck loading area and a mechanical and electrical room. The upper level consists of flumes, the post-sort pools, the anesthetic tank, the recovery tank, and elevated work platforms. The sorting and holding facility is covered by two steel roof structures. [The steel structures were manufactured by Litchfield Industries Landscape Elements.](#)

2.4.1. Fish Transfer Flumes

The flumes are constructed from aluminum and lined with neoprene [rubber](#). They provide a path for the fish to enter the anesthetic tank or post-sort pool 1 by way of a switch gate. A small amount of water is used to wet the surface of the flumes; this water originates at the false weir and is regulated by a 2”

diameter drain. The water that travels down the flume is captured by a drain located at the entrance of the anesthetic tank.



Recovery Tank
See section 2.8.1

Switch Gate See
section 2.4.2

Fish Transfer Flume

2.4.2. Switch Gate

The switch gate is located in the flumes and directs the fish into one of two places; the anesthetic tank or post-sort pool 1. The gate is pneumatically operated from two stations; one station is near the false weir and one is attached to the anesthetic tank. The gate actuation speed can be adjusted by a needle valve located near the actuator just upstream from the electronic valves. Excessive switch gate speed may fatigue components and reduce its operational life. The gate should be operated at the minimum speed necessary to keep up with fish processing.

2.4.3. Post-Sort Pools



Post-Sort Pools looking northward across the three pools

The three post-sort pools are constructed of reinforced concrete. The post-sort pools are 8.5 ft wide and 25.5 ft long. Water enters and exits the post-sort ponds through floor diffusers. The floor diffusers are 18 in by 36 in. A perforated plate and diffuser grating is located in each diffuser. The perforated plates and diffuser screens are constructed of 304L stainless steel. [Porosity of the perforated plates is about 51 percent.](#) Each post-sort pool has a 36 in diameter hole for fish discharge. The fish are transferred to the trucks through the fish discharge.



Post-Sort Pool Fish Transfer opening

2.4.4. Truck Loading Area

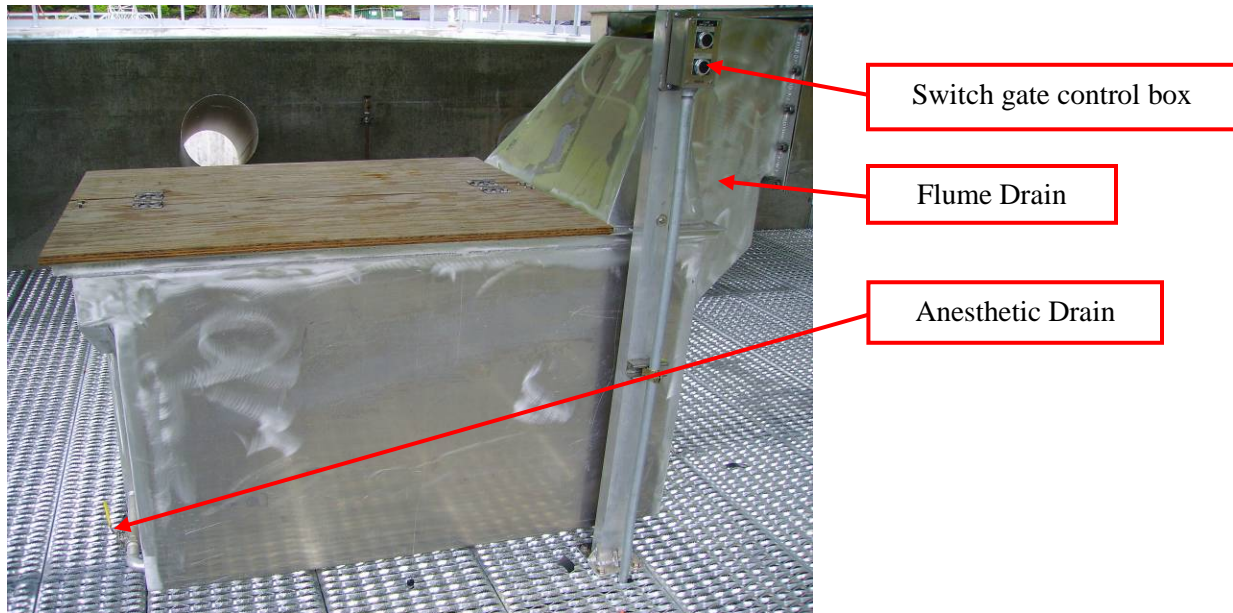
Truck loading occurs beneath the post-sort pools. The truck backs into the bay, first stopping below the truck fill pipe to fill the truck with water. Once this is completed the truck moves back aligning the 36" tank opening with the bellows assembly. A fish transfer operation can commence, see section 3.5.3.10.



2.4.5. Sorting Platform and Stairs

The sorting platform and stairs are fabricated from galvanized steel and are designed to EM 385-1-1 requirements. [The walking surface for all platforms and stair treads is galvanized Grip Strut.](#) The work platforms are also designed to support the mechanical equipment shown in the as-built drawings.

2.4.6. Anesthetic Tank



The anesthetic tank is located at the end of the flume in the sorting facility. The tank is used to anesthetize fish so they can be handled to determine their size and origin. The tank has a 2" diameter fill valve and a 1" diameter drain valve. The anesthetic is clove oil and the tank drains into the rocky area across from the generator near the post-sort pool concrete support structure. The tank has a flume drain that catches water from the flume and diverts it to an open drain.

CAUTION: Clove oil tainted water cannot be drained directly into the river by an open drain or other means. The tank has a UHMW removable lid. Attached to the tank is a regulated and filtered air source used to infuse extra oxygen into the water aiding a fish in recovery from the clove oil anesthetic.



Drain Pipe: Clove
oil tainted water
drain location.

2.5. MECHANICAL ROOM

The mechanical and electrical storage rooms are located in the sorting facility. The rooms have heaters.

2.5.1. Air Receiver

This air receiver provides air for the sorting facility's pneumatically operated valves and anesthetic tank aeration assembly. It has an electronic automatic drain valve to periodically remove water from the tank.

2.5.2. Heater

The heater provided in the mechanical room is identical to the heater in the storage room. The heater is intended to function to keep the rooms above freezing during the winter months.

2.6. ELECTRICAL ROOM

A precast concrete structure was supplied to house the electrical equipment needed for the operation of the FWS pumps, sorting facility, and other related systems. The main control cabinet is also located within this room.

2.7. STORAGE ROOM

A small (8'-0" by 4'-6") storage room is located below the Post-Sort Pools along the north side of the structure to allow for equipment and supplies for operation of the facility to be stored near the work areas.

2.8. FISH RETURN TO THE RIVER SYSTEM

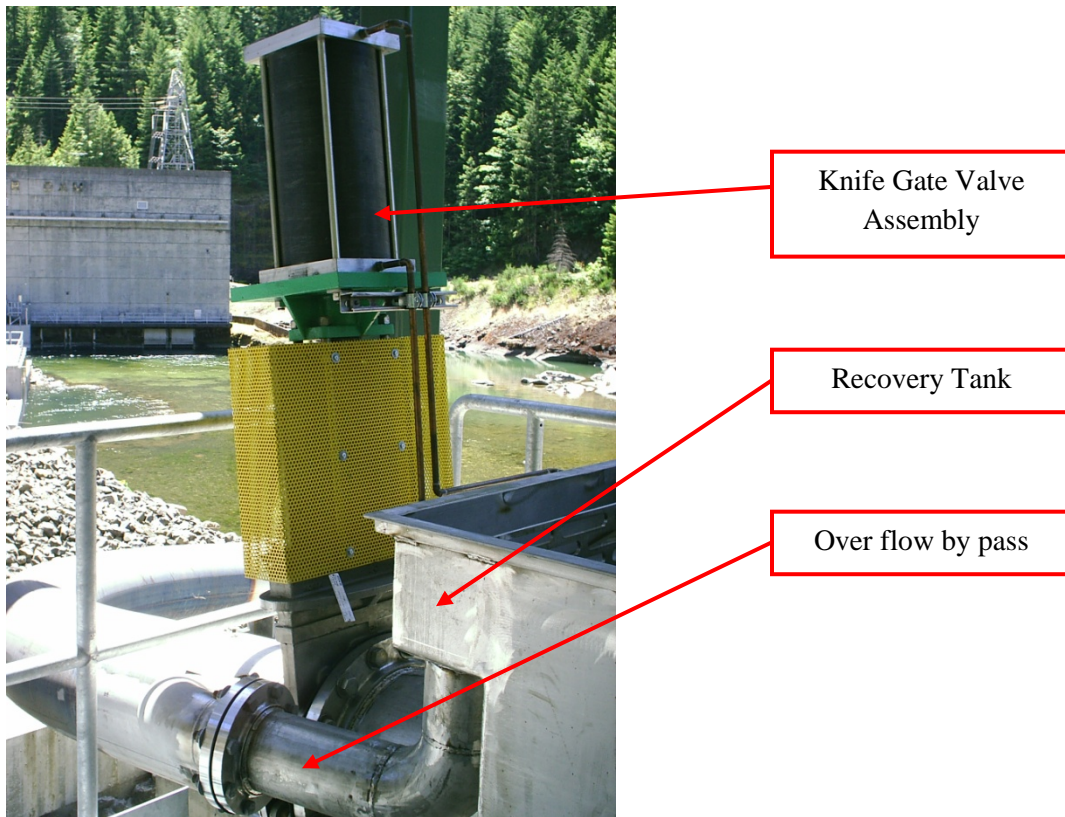
The fish return to the river system includes a recovery tank, an open/close gate valve and a steeply sloped pipe flume back to the tailrace. The purpose of the fish return is to safely and speedily return fish to the tailrace.

2.8.1. Recovery Tank

The recovery tank is located in the sorting facility on the river side near the handrail. It has a marine grade plywood lid with a **chain prop**. The tank has a 3” globe valve for filling the tank and circulating the water. The recovery tank is emptied by a pneumatic knife gate; the contents within the recovery tank travel by pipe and exit into the river near the FWS pump station.

2.8.2. Recovery Tank Knife Gate Valve

The knife gate is an 18”, pneumatically operated valve. The controls are located just northwest of the recovery tank near the hand railing.

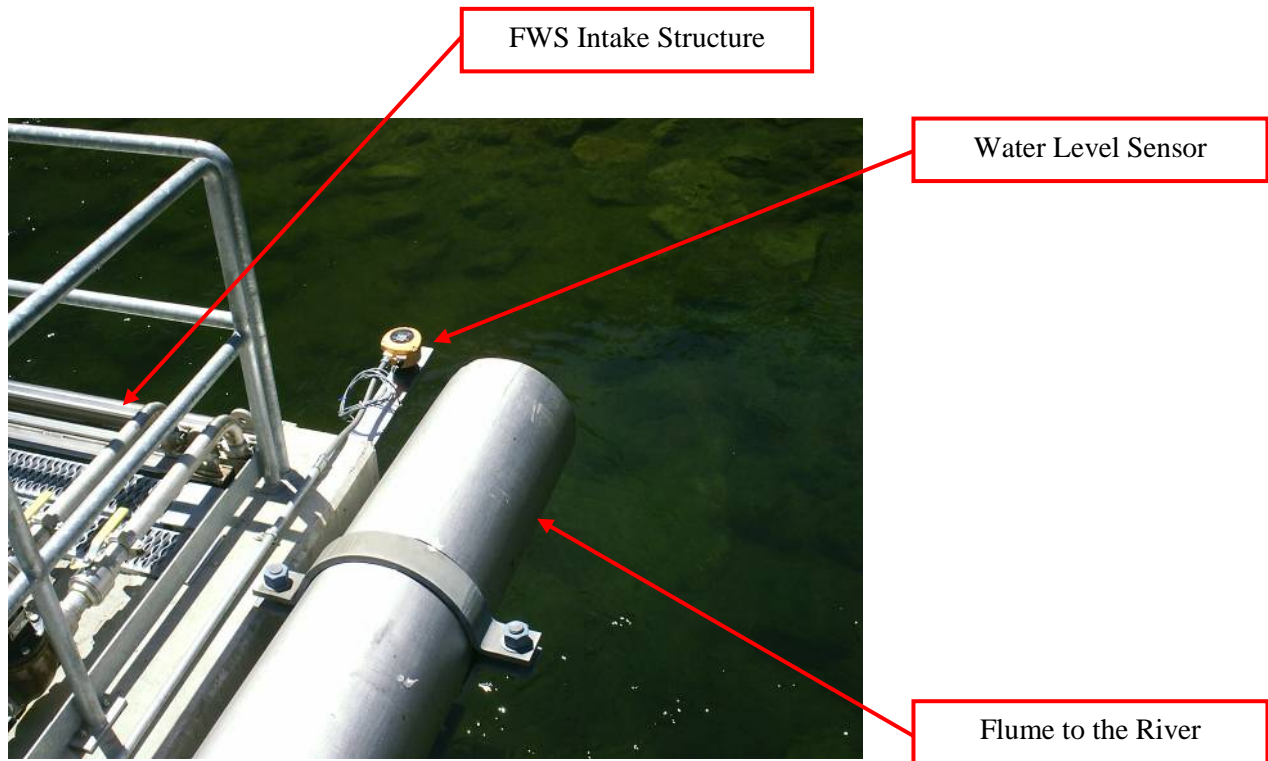


2.8.3. Flume to River

The fish return pipe begins after the recovery tank and knife gate valve and exits off the edge of the top of the FWS structure to discharge into the tailrace. The 102.6 ft long flume consists of 18-in OD T304 stainless steel pipe. The flume drops in elevation about 20 feet 9 inches and discharges to the tailrace

with an invert elevation of about 1256 feet. The pipe slope varies between 32% near the top to 10% at the bottom, with an average slope of 20%. Normal velocities will be between 10 -15 ft/s.

The fish return pipe has six access hatches located at all splice welds. The access hatches allow for inspection of the welds on the inside of the pipe. The access hatch covers are bolted on to the top of the fish return pipe. The fish return pipe is supported in seven locations. The pipe is held in place by pipe clamps that are welded on to a built up plate section. The pipe and pipe clamp assembly is bolted onto a support structure. Five of the structural supports consist of a hollow tube section and a concrete footing. One of the structural supports is bolted to the 10" concrete slab adjacent to the FWS. The structural support at the river end of the pipe is bolted on to the side of the FWS structure.





Flume to the River

2.9. POWER

2.9.1. Primary Feeder Breakers



Feeder circuit breakers XJ1F and XJ2F operate at 6.9KV and supply electrical power to the entire fish collection facility. XJ1F is energized through hydroelectric generator No.1 and/or the BPA transmission line. XJ2F is connected to the hydroelectric generator No.2 bus. Circuit breakers XJ1F and XJ2F are electrically interlocked such that both cannot be closed simultaneously. If one breaker is in the test or draw-out position, the other breaker is still operational.

2.9.2. Pad Mounted Transformer



The Fish Collection Facility transformer is rated 1000KVA, 6.9KV-480V, and is fed from circuit breakers XJ1F and XJ2F. This transformer supplies electrical power to the entire fish collection facility. The transformer has two internal load-break switches on the primary to permit paralleling of sources. The available switch positions are as shown below. Normally the load-break switches are in the “Source A & B” position and power is controlled through circuit breakers XJ1F or XJ2F.

- OFF
- SOURCE A (XJ1F)
- SOURCE B (XJ2F)
- SOURCES A & B

2.9.3. Emergency Generator and Automatic Transfer Switch (ATS)



The 150KW propane generator provides power to the FWS portion of the fish collection facility which includes all devices connected to MCC-FCQ2. The AWS portion of the facility (MCC-FCQ1) is not connected to an emergency generator. Upon loss of normal power from the powerhouse, the Automatic Transfer Switch (ATS) commands the genset to start, then connects MCC-FCQ2 to the emergency generator. Following restoration of normal power the genset will re-transfer MCC-FCQ2 back to the powerhouse feeder, following a preset time-delay.

Since the ATS is an open transfer type, all operating loads will momentarily lose power when switching between normal and emergency sources. All running VFD's and other loads not connected to an uninterruptable power supply will need to be restarted.

The generator supplies power to only the FWS portion of the fish facility. If the fish collection system is running and there is a loss of normal power, the emergency generator will start up. Within approximately one minute the PLC will automatically attempt to start one FWS pump. A single FWS pump will maintain adequate water in the presort tank and ladder to sustain life for any trapped fish until normal power is restored or a shutdown can be performed.

The generator is equipped with 12 volt battery charger that outputs 2 amp or 10 amps. If there is only light demand on the battery it will maintain a constant 2 amp float charge, but if the demand exceeds 2 amps the charger will automatically charge as high as 10 amps.

Note that if the 120VAC supply to the charger is off for a period of time and the battery drops below 12volts, the charger will not operate, as it is only designed as a float charger and not for recharging a dead battery. If the power is going to be off any length of time the battery should be disconnected to prevent unwanted discharge.

The Emergency Generator is equipped with a Hanson Tank Model P-1150 LP fuel tank, with 1150 gallon capacity. Propane vapor withdrawal fuel system and approximately 10 to 20% of the fuel tank capacity will be needed for fuel expansion. It is important to keep the tank filled above 20% for reliable operation. The fuel line is located underground after it leaves the tank and re-emerges from the concrete pad that the generator is setting on. There is a regulator and shut of valve on the concrete wall. The line then goes back under the pad and then re-emerges into the generator housing. There is an emergency fuel shut off push button located on the North side of the FWS building.

2.10. CONTROLS

2.10.1. Touch Screens



Located in the FWS Electric Building, the touch screen is used to control and monitor various devices and systems of the fish collection system. There are individual status and/or control screens for the following: Current status, Alarm history, AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder entrance gate, and AWS/FWS digital power meters. For some it may be easier to use a plastic stylus instead of a finger to press the virtual buttons.

2.10.2. SCADA

Located in the Cougar and Lookout point Control Rooms, SCADA screens are used to monitor various hardware and systems of the Fish Collection Facility. The screens include real-time data for the AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder

entrance gate, Primary feeder circuit breakers, Genset/ATS position, AWS/FWS digital power values, and Alarm status.

2.10.3. Water Level Sensors

The sensors used at the Cougar AFCF are Mobrey MSP400RH Series ultrasonic level transmitters. These sensors measure the water surface elevations at critical locations in the fish ladder system. The level transmitters compute the water surface elevations by reading the vertical distance from transmitter to the water surface. The sensor determines the vertical distance by recording the time it takes for a sonic signal to reflect off the water surface and return to the transmitter. Signal pulses are sent 1 (default; potential range is 0.5 – 2) times per second so that data from a turbulent water surface can be time averaged over a longer period. The elevations of the level transmitters are known and included the PLC logic. These sensors provide critical feedback data to the PLC, so that the PLC can determine if and what automatic changes are needed in the operation (e.g. AWS discharge, FWS discharge, diffuser valves, entrance gate opening) to keep the fish ladder system operating within fisheries criteria.



The following Table contains a list of Level Transmitters by numbering, locations, purposes and elevations. Included in the list are elevations of the Weir 31 crest, Pool 1 invert and top of wall at the Pre-sort pond. All of these elevations were surveyed with the installation of the level transmitters.

Table 1 – List of Level Transmitters with Locations, Purposes and Elevations

Level Transmitter	Location	Purpose	Sensor Elevation (feet)
LT-002	Ladder Pool 1	Provides Pool 1 depth	1263.62
		Monitors Entrance head (LT-02 - LT-10)	
		Monitor Diffuser 1 screen head differential (LT-003 – LT-002)	
LT-003	Pool 1 Diffuser Basin	Monitor Diffuser 1 screen head differential (LT-003 – LT-002)	1263.62

Project Features

LT-004	Removed for spare		
LT-005	Removed for spare		
LT-006	Removed for spare		
LT-007	Removed for spare		
LT-008	Removed for spare		
LT-009	Removed for spare		
LT-010	AWS Pump Station: Tailrace	Provides Tailwater elevation	1261.58
		Controls AWS discharge rate	
		Monitors Entrance head (LT-002 – LT-010)	
		Monitor AWS screen head differential for Airburst Cleaner (LT-010 – LT-011)	
LT-011	AWS Pump Station: between Porosity Plates and Pumps	Monitor AWS screen head differential for Airburst Cleaner (LT-010 – LT-011)	1260.37
LT-012	Ladder Pool 31	Provides ladder head—the difference between in elevation between the water surface and the weir crest in Pool 31	1287.94
		Control FWS Pump discharge rates to maintain 1-foot Ladder Head	
LT-013	FWS Pump Station: Tailrace	Monitor FWS screen head differential for Airburst Cleaner (LT-013 – LT-014)	1256.52
LT-014	FWS Pump Station: between Porosity Plates and Pumps	Monitor FWS screen head differential for Airburst Cleaner (LT-013 – LT-014)	1255.95
Other Pertinent Elevations			
	Weir 31 Crest		1282.84
	Entrance Gate and Pool 1 invert		1248.59
	Presort Pool –Top of Wall		1288.59

The specific locations of the level transmitters are shown at [Plate reference](#).

3. OPERATIONS AND MAINTENANCE

3.1. GENERAL MAINTENANCE POLICIES

This section describes the equipment and routine operation and maintenance procedures for the Cougar Adult Fish Collection Facility (AFCF). It also describes procedures for various emergency situations. The value of this manual depends on how it is used. For this reason, additional reference data and revised procedures and parameters should be inserted into the manual as dictated by changing conditions and operator experience with this particular facility.

3.1.1. Contractor Supplied O&M Manual

All employees should become familiar with the equipment and the respective manufacturer's operation and maintenance (O&M) literature before performing the procedures described in this section. All equipment should be maintained in accordance with the manufacturer's recommendations. Detailed information is provided in the manufacturer-supplied O&M manual, such as operation, maintenance, adjustment, troubleshooting, lubrication, startup, shutdown, assembly, spare parts, and storage. The manufacturer-supplied O&M manual should be kept current by inserting or replacing information as equipment items are added or replaced.

3.1.2. Routine Maintenance Procedures

All equipment should be operated and maintained in accordance with the manufacturer's instructions. This section describes general policies applicable to all areas. Efficient operation and maintenance of the facility requires that all areas be kept neat, clean, and organized. Operators should perform the required housekeeping in their assigned areas. Typical housekeeping tasks are listed below:

- Clean debris from fish screens and porosity plates.
- Keep the cooling surfaces of electric motors clean.
- Replace burned-out light bulbs.
- Keep general area clean and free of obstacles.
- Clean and touch up paint.
- Keep all grating, access covers, and safety shields in place.
- Keep all water hoses and power cords rolled up and properly stored.

3.1.3. Pre-Start-up Procedures

The following basic procedures are recommended before starting and operating all processes and equipment:

- Be sure that the appropriate HAND/OFF/AUTO switches, ON/OFF switches, etc. are turned OFF prior to energizing equipment electrical supply.
- Be sure all grating, equipment safety shields, and floor hatches are in place. Always keep grating, equipment shields, and floor hatches in place, except during maintenance procedures; then replace immediately upon completion of task.
- Check that all clothing, tools, etc. are removed from control panels and equipment.
- Check that all electrical junction boxes and control panels are properly closed.

- Valves and gates should work smoothly and seat properly.
- Valves and gates should be set in the correct position prior to start-up. Verify that all lock-out/tag-out procedures are completed.
- Make any needed repairs or adjustments prior to startup.
- Check that all equipment is properly lubricated and ready to operate. (Follow manufacturer's instructions.)
- Check that all foreign objects have been removed from equipment and piping.
- Check all equipment frequently during the first day of operation, after repair, replacement, or seasonal startup. If a malfunction occurs, do not continue to operate. Minor problems can often cause serious damage if not corrected.

3.2. ALARMS AND ALARM RESPONSE PROCEDURE

3.2.1. General

The facility operator should keep in regular contact with the control room operator at Lookout Point. If unsure of how to resolve any problem, the facility operator should consult with the Lookout Point control room operator. When the situation is resolved, the facility operator should notify control room operator. All true emergencies should immediately be reported to the Lookout Point control room.

3.2.2. Alarm Response Tables

Various system warnings generate alarms that are displayed at Lookout Point and the facility touch screens. Aside from water up procedures, and routine removal of waterborne trash and debris, proper alarm handling and response is the most crucial aspect of operator training. Refer to Appendix D for a table of alarms with cause, result and resolutions.

3.3. BASIC MAINTENANCE PROCEDURES

3.3.1. General

The operation and maintenance of buildings and their appurtenances is important for appearance and effective performance. The result of good maintenance is lower operating costs, better morale for staff, and better visitor image. To assist in achieving these objectives, the recommendations in this chapter should be followed. This chapter contains operation and maintenance procedures common to many of the Cougar Adult Fish Facility elements. For specific procedures for the various elements, see also the description of that element and the manufacturer's instructions for that element. An overall inspection should be made twice a year for determination of maintenance work required for each element. Inspections and maintenance of specific elements should be made on the schedule noted herein, or as noted in the manufacturer's instructions. The best policy is to complete maintenance work as it is required. Delaying maintenance work will only increase the cost and amount of work required, and decrease the life of the equipment. This policy should not preclude more frequent inspections and resulting maintenance. The material used for maintenance repairs shall conform or be equal to the original construction contract specification requirements.

3.3.2. Protective Coatings

Cougar AFCF buildings, facilities and other appurtenances were designed and constructed to minimize maintenance coating work. The buildings are pre-cast structures painted to resist weathering elements. Many features at this facility are fabricated using aluminum or stainless steel; they both weather well without the use of coatings. Minimizing the use of coatings reduces the amount of maintenance needed due to corrosion and wear and tear.

3.4. PREVENTATIVE MAINTENANCE MANAGEMENT

3.4.1. General

Periodic maintenance and inspection is required for all mechanical equipment. Proper and efficient maintenance of mechanical equipment will extend the useful life. The use of a maintenance management program will help to ensure that all equipment is maintained at the required intervals.

3.4.2. List of Contractor’s O&M Manuals

OUTLINE FOR CONTRACTOR MANUAL ONCE FINALIZED

3.4.3. Equipment Inspection and Maintenance

Visual and physical observations of the machinery and equipment should be performed by the operators on a regular basis. All unusual conditions are to be reported immediately to the facility manager. If the operator feels that damage to the piece of equipment and/or a safety hazard is created by this condition, the piece of equipment should be taken out of service immediately and the facility manager notified.

3.4.3.1. General Pump Maintenance

According to the manufacturer’s recommended maintenance schedule; the electrical cables and pump motor insulation must be checked annually before start-up each season. The thermistor, float switch and any other pump monitoring circuits must also be checked prior to system start-up. For additional information reference the KSB pump operation and maintenance manual located in Volume 1 of the Contractor supplied Operation and Maintenance manual. A maintenance log shall be used to record megger test results. Each year these results can be compared to determine the rate of degradation of the winding insulation. The table information below was provided by the manufacturer.

Item	Maintenance	Frequency
7.2.1	Measurement of Insulation Resistance	After 4,000 hrs, but at least once a year
7.2.2	Checks on Electrical terminals	
7.2.3	Checks on Monitoring sections Visual Checks on support chain/Rope	
7.2.4	Check on leakage chamber	After 16,000 hrs but at least once every 3 years
7.2.5	Oil Change	
	General Overhaul	After 24,000 hrs, but at least once every 5 years

3.4.4. Valve and Gate List

Note minor valves (Under 3 inches) and hose bibs may not be shown or numbered in this table.

Table 2 – Valve and Gate List with Locations

Valve and Gate List				
Valve Num.	Size	Valve Type	Actuator Type	General Location
1A	20"	Butterfly	Electric	Diffuser pool 1
1B	20"	Butterfly	Electric	Diffuser pool 1
2	16"	Butterfly	Electric	Diffuser pool 2
3	16"	Butterfly	Electric	Diffuser pool 3
4	16"	Butterfly	Electric	Diffuser pool 4
FC_FW_4	24"x24"x12"	Butterfly	Electric	Three way diversion valve vault
FC_FW_5	12"	Butterfly	Electric	Pre-sort pool drain
FC_FW_6	4"	Butterfly	Electric	Fish transfer area
FC_FW_7	8"	Butterfly	Electric	North side of sorting facility
FC_FW_8	36"	Knife Gate	Pneumatic	Fish transfer area
FC_FW_9	4"	Butterfly	Electric	Fish transfer area
FC_FW_10	8"	Butterfly	Electric	North side of sorting facility
FC_FW_11	36"	Knife Gate	Pneumatic	Fish transfer area
FC_FW_12	4"	Butterfly	Electric	Fish transfer area
FC_FW_13	8"	Butterfly	Electric	North side of sorting facility
FC_FW_14	36"	Knife Gate	Pneumatic	Fish transfer area
FC_FW_15	4"	Butterfly	Electric	North side of sorting facility
Entrance	6.5'x6'	Gate	Electric	Ladder Entrance
Wash. drain	4"	Globe	Manual	Near the Ladder Entrance

Revise

3.4.5. Maintenance of Structural Features

3.4.5.1. General

The concrete and steel features are expected to operate with minimal maintenance required due to the selection of materials used for this facility. The concrete structures are expected to last many, many years without any problems with the concrete. Some specific comments regarding the features are in following paragraphs.

3.4.5.2. Fish Ladder

Prior to startup each year the fish ladder should be visually inspected to see that no objects and debris are present anywhere within the fish ladder. Visual inspection should also include the condition of concrete surfaces and the various steel items such as fish screens, diffusers, lifting frame, personnel guardrails and walkways located near the entrance. Connector machine bolts and concrete anchors should be visually inspected for corrosion and replaced in kind as needed.

3.4.5.3. Cover Structures

All three of these structures should be visually inspected for corrosion spots or peeling paint in the metal roof and support columns and beams. Corrosion on metal items should be cleaned and metal surfaces recoated with materials as needed to match the initial coating. All fasteners shall be checked for corrosion and replaced in kind as needed.

3.4.5.4. Pre-Sort and Post-Sort Structures

Visually inspect the concrete surface for surface damage as needed every year or so. All steel features such as work platforms, walkways, personnel guard rails, Crowder rails, metal doors and the steel stairs should be inspected for corrosion. All connection fasteners for the work platforms and walkway system should be inspected and any corroded bolts replaced in kind as needed. The floor drainage pipes under the post-sort structure should be inspected to see that no debris has been deposited into the drop inlets. Columns and connections for the fish return pipe system should also be inspected for corrosion. Repaint or repair galvanizing as needed.

3.4.5.5. AWS and FWS Pump Stations

The pump stations should be visually inspected prior to facility startup to see that no debris is present on the metal screens or within the pump station tanks. The metal items and their connections should be inspected for corrosion. Connectors should be replaced in kind as needed.

3.5. OPERATION PROCEDURES

3.5.1. Facility Startup

To startup the Cougar AFCF, complete all items in the Pre-Activation Checklist (section 3.5.1) below, then follow the procedures in the Automatic Startup section (section 3.5.1.2). When automatic startup is not possible or desirable, Cougar AFCF startup can be done manually. To startup the Cougar AFCF manually, complete all items in the Pre-Activation Checklist (section 3.5.1), then follow the procedures in the Manual Startup section (section 3.5.1.2).

3.5.1.1. Pre-Activation Checklist

Before facility startup, do the following:

POWERHOUSE

- Check that the Sweitzer 351 relays are turned on and functioning properly with correct light indication for fish facility.
- Check that all Fish Facility alarms are in scan on SCADA
- Check that either breaker XJF1 or XJF2 is closed.
- Check that air supply valve number _____ to fish facility is open, do this slowly as the “Low Powerhouse Service Air alarm will annunciate” so just crack the valve until both fish facility receiver tanks are full, then open 10 percent.
- Check that all hose bibs and line drains at Fish Facility are closed.
- Slowly open the 4” Fish Facility water supply located in the water treatment room in the powerhouse. (Open slowly to avoid water hammer) Valve Number _____

AWS

- Assure that all bulkheads for the AWS pump intakes have been removed and stored in their proper location.
- Check that the AWS valve pit is dry and that drains are working properly, there may be a small amount of standing water, but not over 1”.
- In the AWS building on the MCC-FCQ1 480 VAC panel close the following breakers:
 - Breaker 4, Fish ladder gate actuator & Exclusion gate hoist.
 - Breaker 5, AWS diffuser valve actuators
 - Breaker 6, Surge protection panel
 - Breaker 7, Receptacle
 - Breaker 8, FLR1 transformer and distribution panel
 - Breaker 9, Surge protection panel
- In the AWS building check that all pertinent breakers are closed in the FLR1 panel
- Check that the 6” caps and ¾” plugs are all removed from the AWS and FWS pump vacuum valves, store them in the AWS building.
- Close or check closed the vacuum breaker isolation valve for each AWS pump
- Check that the drain plug or drain valve is closed on the AWS pump discharge pipe.
- Visually inspect the conductors to each AWS pump and disconnect to assure there is no damage.
- Check that the disconnect switches located at the pumps are closed for each AWS pump
- **Check that the fish ladder entrance gate is at least 30%, open and in the manual position.**
- Check that the fish screen gate is fully closed.
- Check that AWS diffuser valve FC-AW-7 is open, leave actuator function switch in remote position.
- Check that AWS diffuser valve FC-AW-8 is open, leave in actuator function switch in remote position.
- Check that AWS flow transducer is turned on and functioning properly, you must open the cabinet door; it is located on the fish ladder wall adjacent to where the AWS pipe rises out of the vault.
- Check that the level transmitters are working properly by reading the values for them on the PLC in the FWS house.
- Check that the air receivers for the fish screens are pressured up.
- Test the automatic function of the AWS screen cleaner by going thru each zone one by one and pressing the Screen start button for a few seconds, release the button to stop air flow. (Note: when the red charging light is on, you must wait for the system to recharge before going onto the next screen) Repeat this thru each screen. Note any valves that do not operate properly, and isolate them. Leave the AWS screen cleaner in AUTO mode.

AWS BUILDING

- Check the general condition of the building, lighting, water leaks, rodents etc.
- Check that the room heater is working properly
- Check that the HVAC unit is powered up
- Test run the HVAC unit and assure proper operation and leave the thermostat set at 55 degrees

- Visually inspect the control cabinet components, ensure that there is no burnt or loose wiring, check to make sure it is powered up.
- Check the condition of the main transformer, (CAUTION: you must open door on front of transformer to check; do not open the transformer door without donning the appropriate level of ARCFLASH gear), oil level, leaks etc. note which position the disconnect is in.

FWS

- Assure that all bulkheads for the FWS pump intakes have been removed and stored in their proper location.
- At the FWS building check closed the 600 amp main breaker at panel FXQX
- In the FWS building on the MCC-FCQ2 480 VAC panel Close the following breakers:
 - Breaker 54, 480 Volt receptacle
 - Breaker 55, FLR2 transformer and distribution panel
 - Breaker 56, surge protection panel
 - Breaker 57, Post-sort pool fill valves
 - Breaker 58, Post-sort pool drain valves
 - Breaker 59, Presort pool diversion and drain valve actuators
- In the FWS building check that all pertinent breakers are closed in the FLR2 panel
- Check that the 4" caps and ½" plugs are all removed from FWS pump vacuum valves, store them in the FWS building.
- Open or check open the vacuum breaker isolation valve for each FWS pump
- Check that the **drain plug or drain valve** is closed on the FWS pump discharge pipe.
- Visually inspect the conductors to each FWS pump and disconnect to assure there is no damage.
- Check that the disconnect switches located at the pumps are closed for each FWS pump
- Check that the level transmitters are working properly by reading the values for them on the PLC in the FWS building.
- Check that the air receivers for the fish screens are pressured up.
- Test the automatic function of the FWS screen cleaner by going thru each zone one by one and pressing the Screen start button for a few seconds, release the button to stop air flow. (Note: when the red charging light is on, you must wait for the system to recharge before going onto the next screen) Repeat this thru each screen. Note any valves that do not operate properly, and isolate them. Leave the FWS screen cleaner in AUTO mode.

FWS BUILDING

- Check the general condition of the building, lighting, water leaks, rodents etc.
- Check that the room heater working is properly
- Check that the HVAC unit is powered up
- Test run the HVAC unit and assure proper operation and leave the thermostat set at 55 degrees
- Visually inspect the control cabinet components, ensure that there is no burnt or loose wiring, check to make sure it is powered up.
- Check the phone communications and verify with Lookout Point Control room that they have SCADA indication of Cougar Fish Facility

CROWDER

- Check that the breaker on the crowder cabinet is closed
- Check the light indication on the crowder cabinet
- Run the crowder full distance travel in both directions and check that the limit switches and lights are working
- Run the crowder lift full raise and lower and check that the limit switches and lights are working.

PRESORT POOL

- Close the presort pool drain valve, check proper light indication
- Operate the false weir valve full open and full close, observe operation and leave in manual operation
- Operate the Presort pool fill valve full open and full close, observe operation and then leave in the full open position

FLUME

- Operate the diverter gate several times and leave diverter gate to the anesthetic tank position

RECOVERY TANK

- Open the water fill valve and fill the tank, then open the air operated knife gate and release the water, allow line to flush for a moment and then close the water valve
- Close the knife gate
- Check for any water leaks from pipes

ANESTHESIA TANK

- Open the fill valve to the anesthesia tank and allow to fill, observe the water level and make sure not to overflow tank. Close the fill valve and open the drain valve.
- Check for any water leaks from pipes

POST-SORT POOL TANKS

- Operate the post-sort pool 1 fill valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 2 fill valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 3 fill valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 1 drain valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 2 drain valve full open and then full close, observe operation and light indication
- Operate the post-sort pool 3 drain valve full open and then full close, observe operation and light indication
- Operate post-sort pool 1, 36" air operated knife gate full open and full close and observe operation, gate should close and seal completely

- Operate post-sort pool 2, 36” air operated knife gate full open and full close and observe operation, gate should close and seal completely
- Operate post-sort pool 3, 36” air operated knife gate full open and full close and observe operation, gate should close and seal completely
- Operate the truck fill valve full open and full closed, observe operation
- Operate each bellows lift and leave them in the full extended position

EMERGENCY GENERATOR

- Remove the access cover to the generator and check oil level, coolant level, battery condition, belt condition and for any leaks.
- Close the main output breaker on the generator
- Place the generator in AUTO position
- Check to make sure the charger is working properly
- Replace the access cover
- On the retaining wall next to the generator check the fuel pressure, it should be _____ PSI
- Check the fuel level at the propane tank and note _____ PSI

AUTOMATIC TRANSFER SWITCH (ATS)

- Check that the ATS is powered up
- The ATS should be in AUTO position and switched to normal power source. Press “Reset Status” button if desired.
- Check the condition of the remote alarm panel for the emergency generator, located inside the FWS building on the PLC panel. There should not be any alarms, note if any are present and remedy the issue. Abnormal conditions should be corrected before proceeding.
- Open the main 600 amp breaker at FXQX
- Generator should start up immediately and ATS should transfer load to the generator, check the light indication on the ATS to assure that it transferred properly.
- Allow the generator to warm up and then reclose the 600 amp breaker at FXQX, the generator should go thru a 20 minute cool down cycle and shut down
- Leave the ATS in AUTO position

AIR RECEIVERS

- Check that the AWS air receiver pressure gage is working properly, open the moisture release valve on the bottom of the tank and bleed off any moisture in the tank.
- Check that the FWS air receiver pressure gage is working properly, open the moisture release valve on the bottom of the tank and bleed off any moisture in the tank.
- Check that the Post-Sort Pool knife valve air receiver pressure gage is working properly, open the moisture release valve on the bottom of the tank and bleed off any moisture in the tank.

STORAGE AND EQUIPMENT ROOMS

- Check that both storage rooms and adjacent mechanical and electrical rooms are dry and free of rodents
- Check to see that all lighting is working properly

- Check that heaters are working properly

FACILITY LIGHTING

- Check that all exterior lights are working properly
- Check that all work lights are working properly on post-sort pool and anesthetic tank areas

SECURITY FENCES AND GATES

- Visually inspect the perimeter fences and gates to assure that there are no openings or damage.

TOUCH SCREENS

- Review "System Diagnostics Screen" and clear all. Abnormal conditions should be corrected before proceeding.
- Review "Alarm History Screen" and clear all alarms before starting equipment.
- Review "Entrance Gate" screen and verify unit switched to AUTO and READY lights are active for both automatic and manual control.
- Review "Screen Cleaner" screen and verify AWS and FWS systems indicate "Ready for Auto Operation."
- Review "Power Meter" screen and verify AWS and FWS meter status OKAY.
- Review "Diffuser Valve" screen and verify valves are switched to AUTO and READY lights are active for both automatic and manual control.
- Review "Water Sensor" screen to verify all sensors reporting data. Note -99.9 indicates trouble.
- Review "FWS Pump" screen and confirm FWS pump system is ready for both automatic and manual control.
- Review "AWS Pump" screen and confirm AWS pump system is ready for both automatic and manual control.

3.5.1.2. Automatic Startup

Once all items in the Pre-Activation Checklist (section 3.5.1.1) have been completed, follow the procedures below to start up the Cougar AFCF.

1. Ensure the fish screen gate is down
2. From the touch screen place the entrance gate in AUTO control. Verify the entrance gate is open at least 10 percent.
3. Ensure all actuators are in "remote" operation
4. At the presort pool valve operating station, Check that the flow control potentiometer for the false weir is set to "Min" this ensures flow from the presort pool will not be diverted to the false weir.
5. Check that the presort pool drain valve is closed; this is indicated by a labeled light that says "closed".
6. Close the breakers for the AWS pumps located in panel MCC-FCQ1 and place each selector switch in "auto".
7. At the FWS electric room, on panel MCC-FCQ2, close the breakers on all 3 FWS VFDs and place each selector switch in "auto".
8. To begin FWS pump operations
 - a. Locate touch screen in FWS electric room (located on the PLC cabinet)
 - b. If necessary, touch the screen to bring the unit out of sleep mode

- c. Go to “Home” screen
 - d. Touch the button “FWS pumps”
 - e. Place the pumps in “AUTO” control
 - f. Touch the button “start pumps”
 - g. Touch the button “YES” to confirm you would like to start the pumps
 - h. Note: the program will decide which two pumps to start and the PLC will adjust them until Pool 31 water level is in criteria and there is about 1.5ft of differential between the river and pool 1 water elevation. Observe the value for “ER” (set point error), as it approaches zero it will be safe to move on to the AWS system. The Ladder equalizing operation may take up to 20 minutes
 - i. Touch the “X” to go to the home screen
9. PLC will pre-set the Entrance gate to the expected gate opening based on TW and AWS discharge (see Table 4).
10. To begin AWS pump operations
- a. Locate touch screen in FWS electric room
 - b. If necessary, touch the screen to bring the unit out of sleep mode
 - c. Go to “Home” screen
 - d. Touch the button “AWS pumps”
 - e. Touch the button “Diffuser Valves”
 - f. Manually open diffusers 1a and 1b.
 - g. Manually close diffusers 2, 3, and 4.
 - h. Exit to the home screen and touch “AWS Pumps”
 - i. Touch the button “auto control”
 - j. Touch the button “start pumps”
 - k. Touch the button “YES” to confirm you would like to start the pumps
 - l. Observe pump operation until the CFS set point (SV) error is less than 5.0 CFS of the measured flow (PV). CAUTION: If the pumps take longer than 2 minutes to get the measured flow to within 5 cfs of the set point there may be air entrainment. Refer to section 3.6.1
 - m. If measured flow is within 5 cfs of the set point then go to the diffuser valve screen and touch “Auto Control”
 - n. Note: the program will decide which pumps to start. The program will run the pumps until flow rate matches tailrace based on criteria. The entrance gate will adjust based on minimum pool 1 depth (5 feet) and entrance head (difference between water surface elevations in pool 1 and tailrace: 1.1 – 1.4 feet).
 - o. Touch the “X” to go to the home screen
11. Observe operation;
- a. IF THE AWS PUMPS ARE RUNNING AT 100% MAX RPM AND/OR THE AWS FLOW METER DOES NOT INCREASE RAPIDLY TO THE EXPECTED DISCHARGE RATE and remains low, then the AWS pumps have failed establish a siphon and sweep out the residual air in the AWS pipeline system so that the flow meter can function properly. Go to Section 3.6.1 “Trouble Shooting AWS Pumps” for corrective procedures;
 - b. if the system is running out of criteria the pumps can be placed in manual operation by touching the “manual operation” button. The keypad can be used to adjust pump speeds.
12. The valves, pumps, and the entrance gate can also be controlled manually

- a. WARNING ONLY QUALIFIED PERSONELL SHOULD ATTEMPT MANUAL OPERATION.
- b. CLOSING VALVES AT HIGH FLOWS MAY DAMAGE PUMPS.
- c. CLOSING THE ENTRANCE GATE AT HIGH FLOWS WILL OVERFLOW THE LADDER
- d. For manual control of the pumps touch the button “manual control” and adjust using the keypad.
- e. For manual control of the valves touch “diffuser valves” button at the home screen and press “adjust” for the pump that needs to be adjusted. Note the actuator moves closed or open and should not be used in an intermediate position.
- f. For entrance gate control; from the home screen touch the button “entrance gate” and then touch the button “manual control”. The opening can be adjusted by touching the “keypad” and entering three numbers corresponding to the percent open desired.

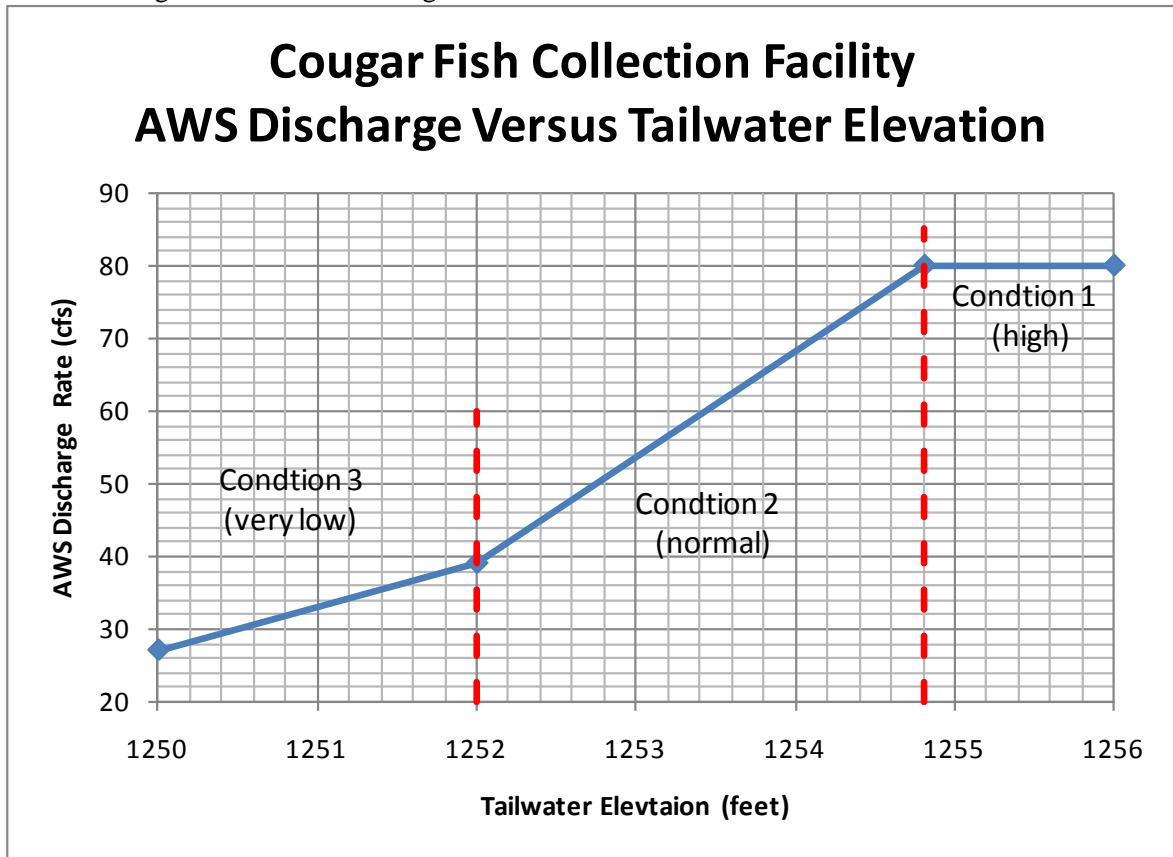
3.5.1.3. Manual Startup

Once all items in the Pre-Activation Checklist (section 3.5.1) have been completed, follow the procedures below to start up the Cougar AFCF manually. (Note: Automatic Startup should be used when possible.)

1. Check current tailwater level (TW staff gage or LT-010)
2. Determine target AWS discharge rate (see Figure 2 or Table 3)
 - a. Condition 3 is a rare single AWS pump operation for tailwater elevations below 1252 feet.¹ This condition will occur when the turbine unit discharge is < 300 cfs (normal minimum single unit operation).
 - b. Condition 2 represents normal operation in which 1 or 2 units are operating with total discharge \geq 300 cfs and the tailwater elevation is between 1252 – 1254.8 feet. For condition 2, discharge is increased as a linear function of tailwater elevation.
 - c. Condition 1 represents an unusually high tailwater condition where fish ladder criteria may not be fully met.

1. ¹ This was the condition during the Commissioning and Endurance Tests in July 2010.

Figure 2 – AWS Discharge Rate as Function of Tailwater Elevation



3. Determine target diffuser valve settings (see Figure 3 or Table 3)
 - a. Diffuser valves are either 100% open or fully closed
 - b. A minimum of two valves should be 100% open. Diffuser valves (1-A and 1-B) are always open (except when trouble shooting AWS pump system, Section 3.6.1)
 - c. More valves are opened with increased tailwater elevation. Above tailwater elevation 1254.2 feet, all diffuser valves are open.

Figure 3 – Diffuser Valve Settings as Function of Tailwater Elevation

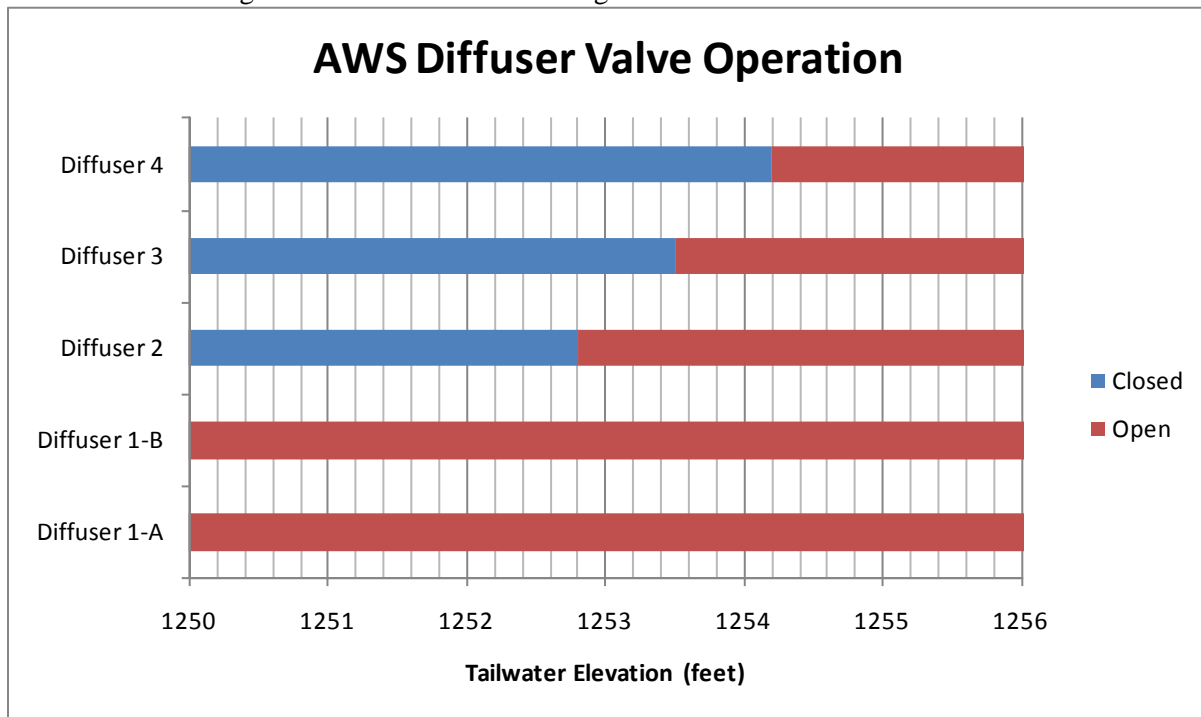


Table 3 shows the combined information for both AWS discharge and the maximum diffuser valve² that should be open as a function of tailwater elevation. It also shows the number of AWS pumps in operation. Normally there are two AWS pumps in operation. However in the rare low tailwater operations below 1252 feet (condition 3), there should only be one AWS pump operating.

² The maximum diffuser valve is defined as the largest valve number (4 > 3 > 2 > 1-B > 1-A) identifying the valve. It also represents the north-most or farthest downstream from the Powerhouse of the valves that will be open at the given tailwater elevation. Any valves with ID numbers above the maximum valve should be fully closed.

Table 3 - Combined Table for AWS Discharge, Number of Pumps Operating and Maximum Diffuser Valve Open Versus Tailwater Elevation

COMBINED TABLE FOR AWS DISCHARGE AND VALVE SETTING VERSUS TAILWATER ELEVATION							
Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open	Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open
1250.0	27	1	1-B	1252.8	51	2	2
1250.1	28	1	1-B	1252.9	52	2	2
1250.2	28	1	1-B	1253.0	54	2	2
1250.3	29	1	1-B	1253.1	55	2	2
1250.4	29	1	1-B	1253.2	56	2	2
1250.5	30	1	1-B	1253.3	58	2	2
1250.6	31	1	1-B	1253.4	59	2	2
1250.7	31	1	1-B	1253.5	61	2	3
1250.8	32	1	1-B	1253.6	62	2	3
1250.9	32	1	1-B	1253.7	64	2	3
1251.0	33	1	1-B	1253.8	65	2	3
1251.1	34	1	1-B	1253.9	67	2	3
1251.2	34	1	1-B	1254.0	68	2	3
1251.3	35	1	1-B	1254.1	70	2	3
1251.4	35	1	1-B	1254.2	71	2	4
1251.5	36	1	1-B	1254.3	72	2	4
1251.6	37	1	1-B	1254.4	74	2	4
1251.7	37	1	1-B	1254.5	75	2	4
1251.8	38	1	1-B	1254.6	77	2	4
1251.9	38	1	1-B	1254.7	78	2	4
1252.0	39	2	1-B	1254.8	80	2	4
1252.1	40	2	1-B	1254.9	80	2	4
1252.2	42	2	1-B	1255.0	80	2	4
1252.3	43	2	1-B	1255.1	80	2	4
1252.4	45	2	1-B	1255.2	80	2	4
1252.5	46	2	1-B	1255.3	80	2	4
1252.6	48	2	1-B	1255.4	80	2	4
1252.7	49	2	1-B	1255.5	80	2	4

4. Close the fish ladder entrance gate
 - a. Place entrance gate actuator function switch into local control position manual.
 - b. **Open entrance gate to 15 percent.** Note: the initial entrance gate opening is below biological criteria, no fish will pass because the fish gate screen should be blocking the entrance.
5. At presort pool valve operating station, ensure the flow adjustment potentiometer is set at “max”, this ensures all FWS flow is diverted to the pre-sort pool and fish ladder.
6. At presort pool valve operating station, check that the flow control potentiometer for the false weir is set to “Min” this ensures flow from the presort pool will not be diverted to the false weir.

7. Check that the presort pool drain valve is closed; this is indicated by a labeled light that says “closed”.
8. At FWS Electrical Room and on panel MCC-FCQ2, close the breakers on all 3 FWS pumps.
9. Pick two FWS pumps, preferably two pumps with the fewest runtime hours, for operation and move the selector switch for each pump (located on the VFD cabinet) to “hand” position. Perform the following operations for each pump that is selected for operation.
 - a. Ensure that a green light indicates the pump is ready
 - b. Press the square green button; the pump should begin accelerating to 45 Hz, this is the preset minimum pump RPM. A red light should be lit indicating that the pump is running
 - c. Press and hold the arrow up button until the pump starts to accelerate; this may take 5-7 seconds.
 - d. Push the arrow up until the display reads 54 Hz (91% max RPM)³
10. Observe the water level in fish ladder pool 31 (staff gage or LT-012) ensuring its level is approximately 1.0 foot over the weir crest.
11. Adjust pump speed to meet pool 1 height criteria, see section 3.5.2.3, using the ramp buttons
12. Wait at least 20 minutes to allow the water flow over the weirs to stabilize
13. Open the fish ladder entrance gate to the gate opening for the current tailwater elevation, as shown in Table 4.
 - a. Find the current tailwater elevation in left column, move across the same row over to sixth column to obtain % of maximum gate opening. Note that tailwater levels below 1252.7 feet are on the left half of table, and tailwater levels above 1252.8 feet are on the right half of table.
 - b. Pool 1 water depth will be less than 5 feet until AWS pumps are started into operation.
 - c. The minimum biological opening for fish passage is normally 30 percent (1.5 ft).
 - d. The PLC approximates the initial gate opening with the following equation: %Max GO = $20\% + 10.6\% * (TW-1250)$

³ Note: the minimum RPM for FWS pumps is 45 Hz or 75%.

Table 4 – Expected Entrance Gate Opening (% of Maximum Open) for Start-up Tailwater Elevation

TABLE OF EXPECTED ENTRANCE GATE OPENING VERSUS TAILWATER ELEVATION											
TW	Qaws	DH	Qent	GO	% of Max GO	TW	Qaws	DH	Qent	GO	% of Max GO
Tailwater	AWS	Target	Entrance	Gate		Tailwater	AWS	Target	Entrance	Gate	
Elevation (ft)	Discharge (cfs)	Entr Head (ft)	Discharge (cfs)	Opening (ft)		Elevation (ft)	Discharge (cfs)	Entr Head (ft)	Discharge (cfs)	Opening (ft)	
1250.0	27	3.60	45	1.0	20%	1252.8	51	1.25	69	2.6	51%
1250.1	28	3.50	46	1.0	20%	1252.9	52	1.25	70	2.6	52%
1250.2	28	3.40	46	1.0	21%	1253.0	54	1.25	72	2.7	53%
1250.3	29	3.30	47	1.1	21%	1253.1	55	1.25	73	2.7	54%
1250.4	29	3.20	48	1.1	22%	1253.2	56	1.25	75	2.8	55%
1250.5	30	3.10	48	1.1	23%	1253.3	58	1.25	76	2.8	57%
1250.6	31	3.00	49	1.2	23%	1253.4	59	1.25	78	2.9	58%
1250.7	31	2.90	49	1.2	24%	1253.5	61	1.25	79	2.9	59%
1250.8	32	2.80	50	1.2	25%	1253.6	62	1.25	80	3.0	60%
1250.9	32	2.70	51	1.3	26%	1253.7	64	1.25	82	3.0	61%
1251.0	33	2.60	51	1.3	26%	1253.8	65	1.25	83	3.1	62%
1251.1	34	2.50	52	1.4	27%	1253.9	67	1.25	85	3.2	63%
1251.2	34	2.40	52	1.4	28%	1254.0	68	1.25	86	3.2	64%
1251.3	35	2.30	53	1.5	29%	1254.1	70	1.25	88	3.3	65%
1251.4	35	2.20	54	1.5	30%	1254.2	71	1.25	89	3.3	66%
1251.5	36	2.10	54	1.6	31%	1254.3	72	1.25	91	3.4	67%
1251.6	37	2.00	55	1.6	32%	1254.4	74	1.25	92	3.4	68%
1251.7	37	1.90	55	1.7	33%	1254.5	75	1.25	94	3.5	70%
1251.8	38	1.80	56	1.7	35%	1254.6	77	1.25	95	3.5	71%
1251.9	38	1.70	57	1.8	36%	1254.7	78	1.25	97	3.6	72%
1252.0	39	1.60	57	1.9	38%	1254.8	80	1.25	98	3.6	73%
1252.1	40	1.50	59	2.0	40%	1254.9	80	1.25	98	3.6	73%
1252.2	42	1.40	60	2.1	42%	1255.0	80	1.25	98	3.6	73%
1252.3	43	1.30	62	2.2	45%	1255.1	80	1.25	98	3.6	73%
1252.4	45	1.25	63	2.3	47%	1255.2	80	1.25	98	3.6	73%
1252.5	46	1.25	64	2.4	48%	1255.3	80	1.25	98	3.6	73%
1252.6	48	1.25	66	2.4	49%	1255.4	80	1.25	98	3.6	73%
1252.7	49	1.25	67	2.5	50%	1255.5	80	1.25	98	3.6	73%

14. Use the hoist to lift the fish ladder fish screen gate to a point that will clear the water surface by at least 2 ft for all tailrace elevations.
15. Open diffuser valves 1A and 1B. All other valves should be fully closed.
16. Close the diffuser valves (using the actuator controls) that correspond to the current tailwater conditions per Table 3. Close the breakers for the AWS pumps located in panel MCC-FCQ1
17. Pick two AWS pumps for operation and move each selector switch located on the VFD cabinet to “hand” position. Perform the following operations for each pump that is selected for operation.
 - a. Ensure that a green light indicates the pumps are ready
 - b. Press the square green button; the pump should begin accelerating to 30 Hz, this is the preset minimum pump RPM. A red light should be lit indicating that the pumps are running
 - c. Press and hold the arrow up button until the pump starts to accelerate; this may take 5-7 seconds.
 - d. Push the arrow up until the display reads 50 Hz (83% max RPM)⁴
18. The AWS pumps will be temporarily noisy while the pipe fills with water, but should quiet within 2 - 5 minutes
19. Set pump speed and fish ladder entrance gate height;
 - a. Adjust AWS pump speed to match the target discharge rate determined in step 2
 - b. Open or close the fish ladder entrance gate to regulate entrance head to 1.0 – 1.5 feet (entrance head is difference between water level elevations in pool 1 and tailwater) and assure that pool 1 water depth \geq 5 feet (pool 1 water level \geq 1253.6 feet)
 - i. Opening the gate will reduce pool height for a given flow rate
 - ii. Closing the gate will increase pool height for a given flow rate
 - iii. The entrance gate should be lowered or raised as a function of DH subject to the following governing rules:
 - Minimum Gate Opening (GO) with FWS only = 0.75 feet = 15% GO
 - Minimum GO with AWS + FWS = 1.5 feet = 30% GO (Fisheries criteria)
 - Maximum GO = 5 feet = 100% GO (Physical limits)
 - Minimum Pool depth = 5 feet (Fisheries criteria)
 - Optimum entrance head (DH) is between 1.1 – 1.4 feet (average 1.25 feet)
 - iv. The target entrance head (DH) is the maximum of the following two values:
 - 1.25 feet \pm 0.15 feet
 - 1248.6 + 5.0 – LT-010

See Table 5 to determine recommended adjustments (feet or % opening) in the entrance gate opening based on the latest on entrance head measurement or Pool 1 depth. Changes needed to correct the entrance head are shown in the upper portion of the table, and changes required to raise the Pool 1 depth to the minimum 5 feet are shown in the bottom portion. Note that recommended adjustments preceded by negative signs means the entrance gate opening should be reduced.

- c. Check AWS discharge rate and modify AWS pump speed if entrance gate change was large enough to change the flow rate.

⁴ Note: The Minimum RPM for the AWS Pumps is 30 Hz or 50%.

20. Monitor Tailrace conditions and adjust pump speed, valves and entrance gate to maintain the following criteria:
 - a. Weir 31 pool ladder head 1.0 feet +/- 0.1 feet (Check every 10 minutes)
 - b. Pool 1 water depth at least 5 feet deep (Check every 30 minutes)
 - c. Ladder flow to tailrace differential from 1.1 feet to 1.4 feet (Check every 30 minutes)
 - d. The guidance from Table 3 and Table 4 (and PLC operation) are configured to assure that the difference in water level elevations between Pool 2 and Pool 1 is ≤ 1 foot
21. Check after 60 minutes: check the tailwater elevation
 - a. If no change, then no action is required with AWS pumps or diffuser valves and go to step 19.
 - b. If changed, repeat steps 1-a , 1-b, and go to step 18

Table 5 – Manual Operation of Entrance Gate to Regulate Entrance Head (DH)

Entrance Gate Adjustments				
DH = Entrance head = LT-002 - LT-010				
Change Condition:		Action	Change in GO	
IF DH \leq	0.5 ft	Reduce gate opening	-1.0	Feet or -20%
IF DH is between	0.5 ft and 0.8 ft	Reduce gate opening	-0.5	Feet or -10%
IF DH is between	0.8 ft and 1.0 ft	Reduce gate opening	-0.3	Feet or -6%
IF DH is between	1.0 ft and 1.1 ft	Reduce gate opening	-0.1	Feet or -2%
IF DH is between	1.1 ft and 1.4 ft	no change		
IF DH is between	1.4 ft and 1.5 ft	Increase gate opening	0.1	Feet or +2%
IF DH is between	1.5 ft and 1.7 ft	Increase gate opening	0.1	Feet or +2%
IF DH is between	1.7 ft and 2.0 ft	Increase gate opening	0.2	Feet or +4%
IF DH \geq	2.0 ft	Increase gate opening	0.3	Feet or +6%
NOTES:				
* Minimum Allowable GO = 1.5 feet; Maximum Allowable Go = 5.0 feet.				
Y = Pool 1 Depth = LT-002 - Invert Elevation 1248.6 feet				
Change Condition:		Action	Change in GO	
IF Y \leq	4.5 ft	Reduce gate opening	15%	
IF Y is between	4.5 ft and 4.8 ft	Reduce gate opening	10%	
IF Y is between	4.8 ft and 5.0 ft	Reduce gate opening	5%	

3.5.2. Normal Facility Operation

To operate the Cougar AFCF, follow the procedures in the Automatic Normal Operation section (section 3.5.2.2). When automatic operation it is not possible or desirable, Cougar AFCF operation can be done manually. To operate the Cougar AFCF manually, follow the procedures in the Manual Startup section (section 3.5.1.2). For the facility to operate satisfactorily, the normal operating criteria in section 3.5.2.1 must be met.

3.5.2.1. Normal Operating Criteria

The following information details operational criteria for operation of the facility. Any deviation observed should be reported to the engineering design branch at Robert Duncan Plaza.

See plate M-444

Pump output varies to meet these conditions.

See section 3.5.2.4.

LADDER

- Ladder entrance head is $1.25 \text{ ft} \pm 0.15\text{ft}$
- Pool 1 depth = $5 \text{ ft} \pm 0.1\text{ft}$
- Ladder pool differential at Pool 31 = $1 \text{ ft} \pm 0.1\text{ft}$ (PLC applies $0.90 \text{ ft} \pm 0.1\text{ft}$)
 - Pool 31 depth = $6.0 \text{ ft} \pm 0.1\text{ft}$

3.5.2.2. Automatic Normal Operation

To operate the Cougar AFCF, follow the procedures below. For the facility to operate satisfactorily, the normal operating criteria in section 3.5.2.1 must be met.

1. The selector switch located on the VFD cabinet; should be in “auto” position for each FWS pump (or minimum two operating pumps).
 - a. FWS pumps will automatically adjust to meet ladder head (1.0 ± 0.1 feet) at Pool 31 (LT-012) regardless of changes due to operation of false weir, or filling of post-sort ponds.
2. The selector switch located on the VFD cabinet; should be in “auto” position for each AWS pump (or minimum two operation pumps).
 - a. Diffuser Valves will adjust automatically when tailwater readings (LT-010) cross a setpoint for open/close of a diffuser valve as shown in Table 6 or Figure 5.
 - b. Program will adjust AWS discharge as a direct function of tailwater reading (LT-010) as shown in Table 6 or Figure 4.
 - c. Diffuser valves to open or close. The program will run the AWS pumps until flow rate matches tailrace requirements based on criteria. The entrance gate will adjust based on minimum pool 1 depth (5 feet) and entrance head (difference between water surface elevations in pool 1 and tailrace: 1.1 – 1.4 feet) similar in procedure to Table 7.
 - d. Touch the “X” to go to the home screen
3. Observe operation and periodically compare pertinent level transmitters against staff gages (some minor differences or variation can be expected in all of these comparisons due to flow turbulence)
 - a. Check LT-012 with staff gage at Pool 31.
 - b. Check LT-0101 against tailwater staff gage.
 - c. Check LT-002 against pool 1 staff gage
4. If the system is running out of criteria the pumps can be placed in manual operation by touching the “manual operation” button. The keypad can be used to adjust pump speeds.
5. The valves, pumps, and the entrance gate can also be controlled manually
 - a. **WARNING ONLY QUALIFIED PERSONELL SHOULD ATTEMPT MANUAL OPERATION.**
 - b. **CLOSING VALVES AT HIGH FLOWS MAY DAMAGE PUMPS.**

- c. CLOSING THE ENTRANCE GATE AT HIGH FLOWS WILL OVERFLOW THE LADDER
- d. For manual control of the pumps touch the button “manual control” and adjust using the keypad
- e. For manual control of the valves touch “diffuser valves” button at the home screen and press “adjust” for the pump that needs to be adjusted. Note the actuator moves closed or open and should not be used in an intermediate position.
- f. For entrance gate control; from the home screen touch the button “entrance gate” and then touch the button “manual control”. The opening can be adjusted by touching the keypad button and entering three numbers corresponding to the percent open desired.

3.5.2.3. Manual Normal Operation

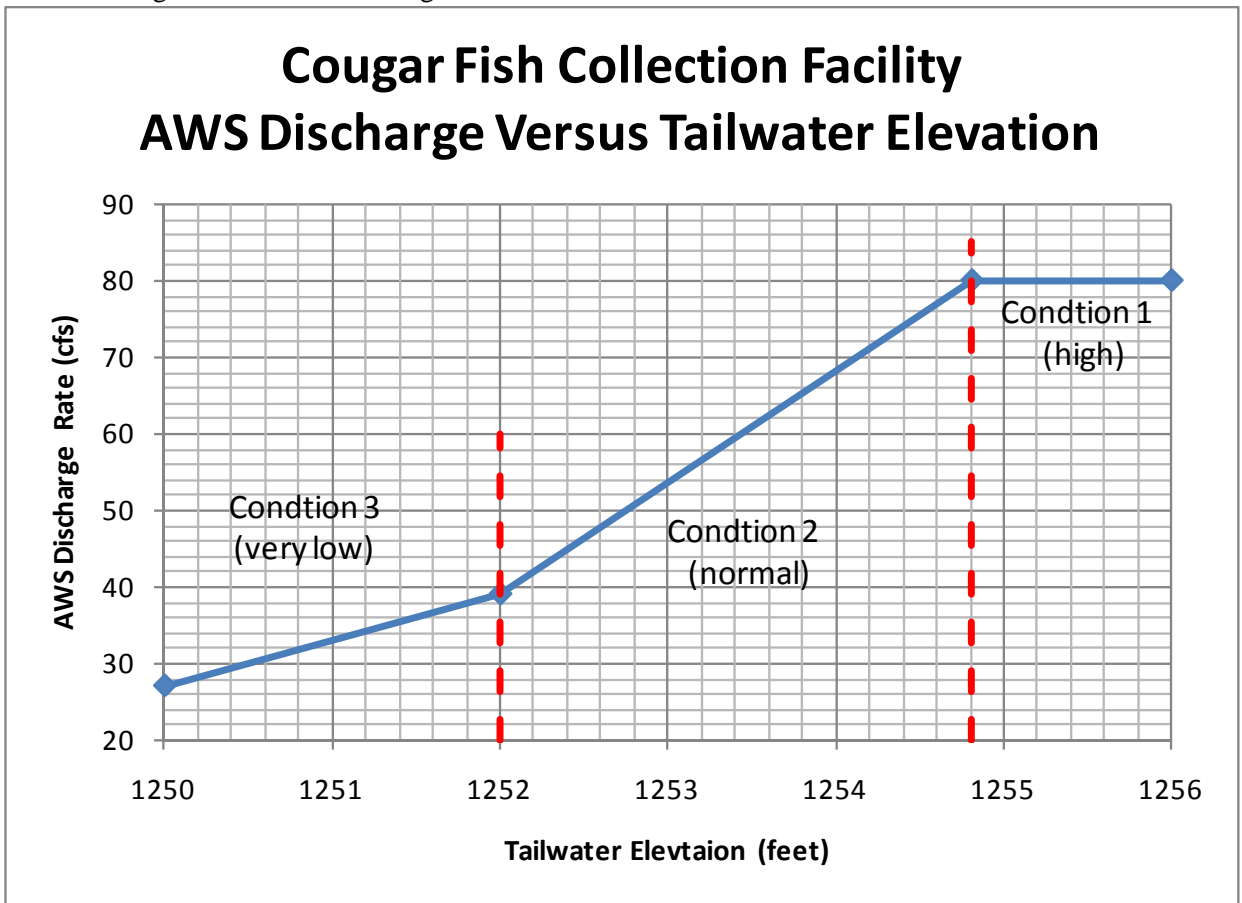
When automatic operation it is not possible or desirable, Cougar AFCF operation can be done manually. To operate the Cougar AFCF manually, follow the procedures below. (Note: Automatic Normal Operation should be used when possible.) For the facility to operate satisfactorily, the normal operating criteria in section 3.5.2.1 must be met.

In the event the PLC is unable to control the pumps for automatic operations, there are a number of staff gauges for manual verification of water levels. Operations personnel will need to verify the facility is running within ESA fish criteria during this time.

1. The selector switch located on the VFD cabinet; should be in “auto” position for each FWS pump (or minimum two operating pumps).
 - a. FWS pumps will automatically adjust to meet ladder head (1.0 ± 0.1 feet) at Pool 31 (LT-012) regardless of changes due to tailwater change, operation of false weir, or filling of post-sort ponds.
2. The selector switch located on the VFD cabinet; should be in “auto” position for each AWS pump (or minimum two operation pumps).
 - a. Diffuser Valves will adjust automatically when tailwater readings (LT-010) cross a setpoint for open/close of a diffuser valve as shown in Table 7 or Figure 5.
 - b. Program will adjust AWS discharge as a direct function of tailwater reading (LT-010) as shown in Table 7 or Figure 4.
 - c. Diffuser valves to open or close. The program will run the pumps until flow rate matches tailrace based on criteria. The entrance gate will adjust based on minimum pool 1 depth (5 feet) and entrance head (difference between water surface elevations in pool 1 and tailrace: 1.1 – 1.4 feet).
 - d. Touch the “X” to go to the home screen
3. For manual control of the following components:
 - a. All pumps: touch the button “manual control” for FWS and AWS pumps (or just one, if only one set needs to be in manual) and adjust by entering three numbers corresponding to the percent open desired.
 - b. Diffuser valves: touch “diffuser valves” button at the home screen and press “adjust” for the valve that that needs to be opened or closed. Note the actuator moves closed or open and should not be used in an intermediate position.

- c. Entrance gate: from the home screen, touch the button “entrance gate” and then touch the button “manual control”. The opening can be adjusted by touching the “keypad” button and entering three numbers corresponding to the percent open desired.
- 4. Check Ladder Head at Pool 31
 - a. Read ladder head at 10 minute intervals
 - b. Read ladder head from Staff gage or LT-012
 - c. Target ladder head = 1.0 feet \pm 0.1 feet
 - i. If Ladder head > 1.1 feet, reduce FWS pump speeds (%RPM)
 - ii. If Ladder head < 0.9 feet, increase FWS pump speeds (% of max RPM)
 - iii. Typical percent of max RPM is between 85 – 90%
- 5. Record tailwater level (TW staff gage or LT-010)
 - a. Read tailwater level at 60 minute intervals.
 - b. If tailwater elevation changed, then adjust AWS discharge rate (see Table 6 or Figure 4)
 - c.

Figure 4 – AWS Discharge Rate as Function of Tailwater Elevation



- d. If tailwater changed such that it has crossed a setpoint for an AWS diffuser valve (see Figure 5 or Table 6), THEN open or close diffuser valve depending on whether the tailrace is rising or falling.
- e. EXAMPLE 1 (Rising TW):
 - i. TW < 1252.8 feet in previous reading,

- 1. Status: Diffuser valves 1-A and 1-B open
- ii. TW goes above 1252.8 feet,
- iii. THEN open Diffuser Valve 2 (No other change)
- f. EXAMPLE 2 (Falling TW)
 - i. TW > 1254.2 feet in previous reading,
 - 1. Status All Diffuser Valves are open
 - ii. TW drops below 1254.2 feet
 - iii. THEN close Diffuser Valve 4

Figure 5 – Diffuser Valve Settings as Function of Tailwater Elevation

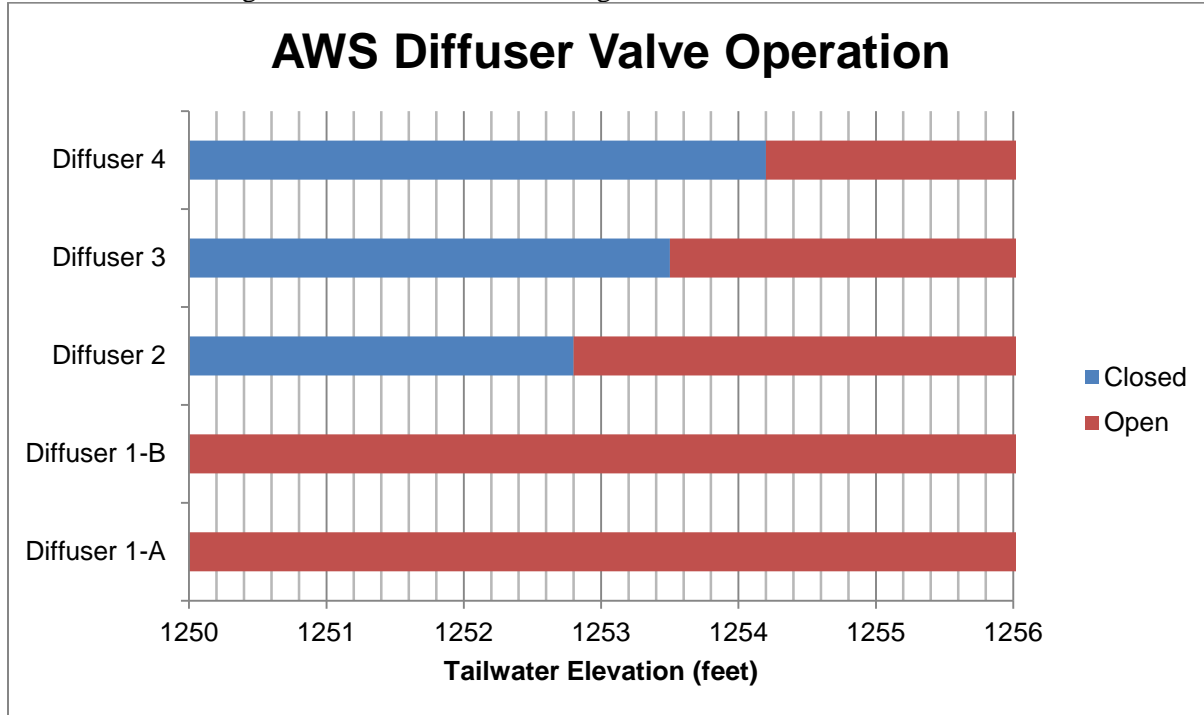


Table 6 – Combined Table for AWS Discharge, Number of Pump Operating and Maximum Diffuser Valve Open Versus Tailwater Elevation

COMBINED TABLE FOR AWS DISCHARGE AND VALVE SETTING VERSUS TAILWATER ELEVATION								
Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open		Tailwater Elevation (ft)	AWS Discharge (cfs)	Number of Pumps Operating	Maximum Diffuser Valve Open
1250.0	27	1	1-B		1252.8	51	2	2
1250.1	28	1	1-B		1252.9	52	2	2
1250.2	28	1	1-B		1253.0	54	2	2
1250.3	29	1	1-B		1253.1	55	2	2
1250.4	29	1	1-B		1253.2	56	2	2
1250.5	30	1	1-B		1253.3	58	2	2
1250.6	31	1	1-B		1253.4	59	2	2
1250.7	31	1	1-B		1253.5	61	2	3
1250.8	32	1	1-B		1253.6	62	2	3
1250.9	32	1	1-B		1253.7	64	2	3
1251.0	33	1	1-B		1253.8	65	2	3
1251.1	34	1	1-B		1253.9	67	2	3
1251.2	34	1	1-B		1254.0	68	2	3
1251.3	35	1	1-B		1254.1	70	2	3
1251.4	35	1	1-B		1254.2	71	2	4
1251.5	36	1	1-B		1254.3	72	2	4
1251.6	37	1	1-B		1254.4	74	2	4
1251.7	37	1	1-B		1254.5	75	2	4
1251.8	38	1	1-B		1254.6	77	2	4
1251.9	38	1	1-B		1254.7	78	2	4
1252.0	39	2	1-B		1254.8	80	2	4
1252.1	40	2	1-B		1254.9	80	2	4
1252.2	42	2	1-B		1255.0	80	2	4
1252.3	43	2	1-B		1255.1	80	2	4
1252.4	45	2	1-B		1255.2	80	2	4
1252.5	46	2	1-B		1255.3	80	2	4
1252.6	48	2	1-B		1255.4	80	2	4
1252.7	49	2	1-B		1255.5	80	2	4

- g. Record entrance head (If Staff Gage: pool 1 elevation – TW)
- h. Read tailwater level at 30 minute intervals
- i. Entrance head = difference between water surface elevations in Pool 1 (Pool 1 staff gage or LT-002) and Tailrace (TW staff gage or LT-010). The entrance head and Pool 1 depth values can be directly read from the Touch screen for ‘Entrance Gate’ in the PLC room.

- i. Open/close entrance gate to regulate entrance head (1.1 – 1.4 feet) and assure that pool 1 water depth \geq 5 feet (or pool 1 water level \geq 1253.6 feet). See Table 7 for recommended adjustments based on entrance head and pool 1 readings.
 1. Opening gate will reduce pool height for a given flow rate
 2. Closing gate will increase pool height for a given flow rate.
 3. The entrance gate should be lowered or raised as a function of DH subject to the following governing rules:
 - o Minimum Gate Opening (GO) with FWS only = 0.75 feet = 15% GO
 - o Minimum GO with AWS + FWS = 1.5 feet = 30% GO (Fisheries criteria)
 - o Maximum GO = 5 feet = 100% GO (Physical limits)
 - o Minimum Pool depth = 5 feet (Fisheries criteria)
 - o Optimum entrance head (DH) is between 1.1 – 1.4 feet (average 1.25 feet)

- ii. The target entrance head (DH) is the maximum of the following two values:
 - 1.25 feet \pm 0.15 feet
 - 1248.6 + 5.0 – LT-010

Table 7 – Manual Operation of Entrance Gate to Regulate Entrance Head (DH)

Entrance Gate Adjustments		
DH = Entrance head = LT-002 - LT-010		
Change Condition:	Action	Change in GO
IF DH \leq 0.5 ft	Reduce gate opening	-1.0 Feet or -20%
IF DH is between 0.5 ft and 0.8 ft	Reduce gate opening	-0.5 Feet or -10%
IF DH is between 0.8 ft and 1.0 ft	Reduce gate opening	-0.3 Feet or -6%
IF DH is between 1.0 ft and 1.1 ft	Reduce gate opening	-0.1 Feet or -2%
IF DH is between 1.1 ft and 1.4 ft	no change	
IF DH is between 1.4 ft and 1.5 ft	Increase gate opening	0.1 Feet or +2%
IF DH is between 1.5 ft and 1.7 ft	Increase gate opening	0.1 Feet or +2%
IF DH is between 1.7 ft and 2.0 ft	Increase gate opening	0.2 Feet or +4%
IF DH \geq 2.0 ft	Increase gate opening	0.3 Feet or +6%
NOTES:		
* Minimum Allowable GO = 1.5 feet; Maximum Allowable Go = 5.0 feet.		
Y = Pool 1 Depth = LT-002 - Invert Elevation 1248.6 feet		
Change Condition:	Action	Change in GO
IF Y \leq 4.5 ft	Reduce gate opening	15%
IF Y is between 4.5 ft and 4.8 ft	Reduce gate opening	10%
IF Y is between 4.8 ft and 5.0 ft	Reduce gate opening	5%

3.5.3. Fish Processing Operation Procedures

3.5.3.1. Finger weir

LOCATION:

South end of pre-sort pool
Reference picture in section 2.3.1.

REFERENCE:

- Contract drawing S-118 thru S-124

DESCRIPTION:

The finger weir is a moveable piece of grating that keeps fish from jumping out of the pre-sort pool and keeps any debris from traveling down the ladder.

OPERATION:

The finger weir is adjusted to match the water level of the pre-sort pool. The long handle located on the South East side of the pre-sort pool locks the weir in place. A pin keeps the handle in the locked position. To move the handle, remove the pin, lift the handle, and then use a pole to adjust the grating. Once satisfied with the new position push the handle down and retain it with the pin. See Figure 6

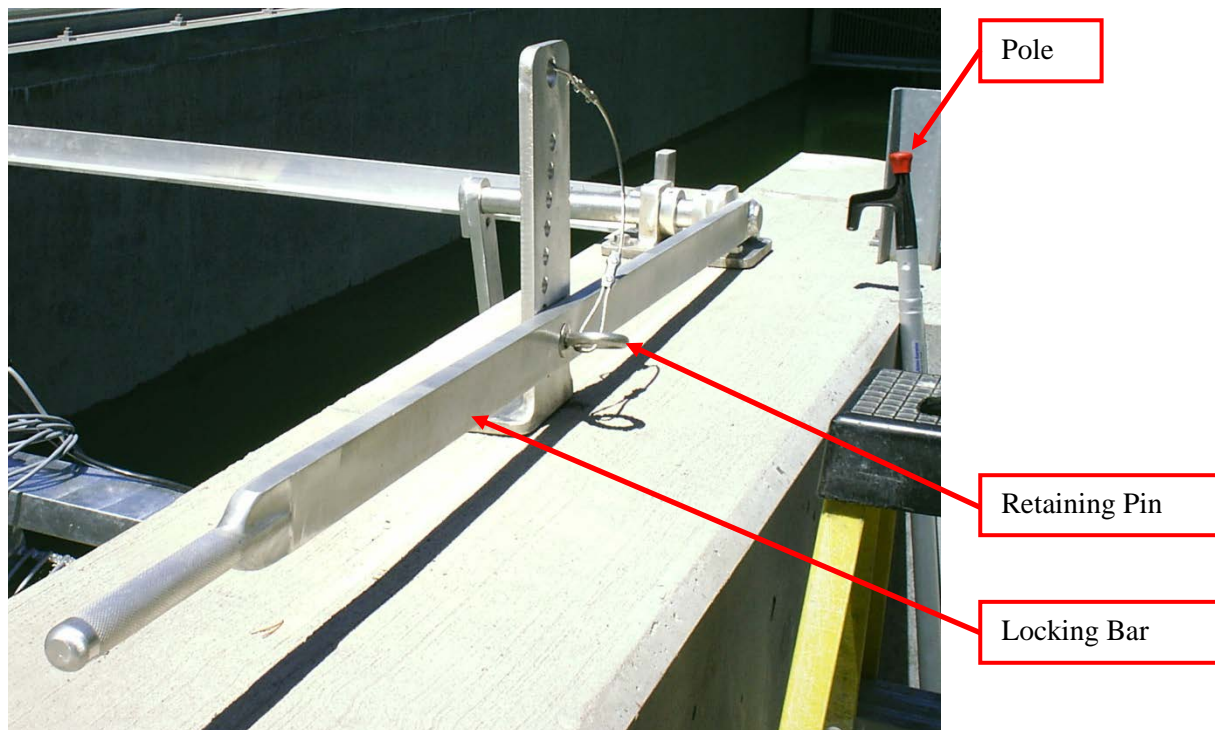


Figure 6 - Finger Weir Handle

3.5.3.2. Crowder

LOCATION:

South end of pre-sort pool (Ready to crowd fish)

North end of pre-sort pool (Parked for storage)
Reference picture in section 2.3.2.

REFERENCE:

- Contract drawing M-432 thru M-441

DESCRIPTION:

The crowder presents a screen barricade at the south side of the pre-sort pool, mechanically forcing fish north to jump into the false weir.

OPERATION:

The crowder is operated from the cabinet located at the North West corner of the pre-sort pool. The crowder is operated by button and will slowly ramp up to full speed in the direction specified until it reaches a ramping sensor that decelerates the crowder down to a stop. The screen moves up and down without any ramping. The buttons do not need to be held to function and the stop button can be pressed at anytime. **The Crowder has a traversing speed of 5 FT/MIN; crowding time could be up to 20 Min.**

3.5.3.3. False Weir

LOCATION: North end of pre-sort pool. Reference picture in section 2.3.3.

REFERENCE:

- Contract drawing M-415 and M-418

DESCRIPTION:

The False weir presents a hydraulic profile that induces a fish to jump. Once the fish has cleared the false weir, it enters the flume to be processed.

OPERATION:

The false weir is operated from the cabinet on the north west side of the pre-sort pool. See Figure 7. The false weir works by diverting the ladder flow from the pre-sort pool inlet diffusers to the false weir. The three way diversion valve controls this flow in two ways; it separates the flow and then meters the flow to the false weir. Generally the false weir flow is tuned to stimulate the majority of the fish into jumping and then left alone.

AVOID: Operation of the false weir while filling the truck and post-sort pools. These operations will diminish the operation of the false weir and may drive the ladder out of criteria for the duration of operations.

NEVER: Operate the diversion valve at less than 43 percent open with the false weir valve 100 percent open or less than 70 percent open with the false weir valve closed. Prior to closing the diversion valve, the false weir valve should be at least 50 percent open.

CAUTION: The pumps will not run beyond 100% of their rated operation. In the event sorting facility operations utilize the remaining capacity of the pumps the ladder may fall out of criteria.

NOTE: Tailwater elevation will affect flow; there may be some variation if there is a large change in tailwater elevation.

Prior to operation of the false weir:

- Verify that the 8” drain valve is fully open.
- Verify that the 2” drain valve is fully open.
- Ensure false weir valve is at least 50 open. This control is located on the outside of the cabinet.
- Move the diversion valve to 50 percent open. This control is located on the inside of the cabinet.
- During false weir operation; the system is the most efficient if the false weir valve is 100% open and the diversion valve is set from 50% open to 85% open. The water plume should be adjusted with the diversion valve only and flow through the false weir should be minimized if possible (Biologist determined).
- Adjust 8” drain allowing a small stream of water to lubricate the surface of the flume (Biologist determined).
- Fine tune using the 2” drain valve if excess water dilutes the clove oil concentration in the anesthetic tank.
- Fish transfer operations may commence
- After the fish have been processed the diversion valve is set to 100 percent open and the false weir valve is set to 100 percent closed.

TUNING

The false weir requires adjustment to maximize the amount of water presented to the fish in the pre-sort pool and drained on the backside to optimize the amount of water in the flume. The amount of water in the flume should be determined by a biologist. There are two drains for the false weir; one 2 inch diameter drain and one 8 inch diameter drain. The 8 inch drain should be adjusted first and if finer adjustment is needed, the 2 inch drain can be used to more precisely control the flow of water in the flume.

See Figure 8.



False Weir Valve control:
Min: False weir is not active. Flow from the FWS pumps is diverted through the pre-sort diffusers into the pre-sort pool.
Max: Maximum flow that is available goes through the false weir. Caution: The valve is very slow to open and close, adjust in small increments.

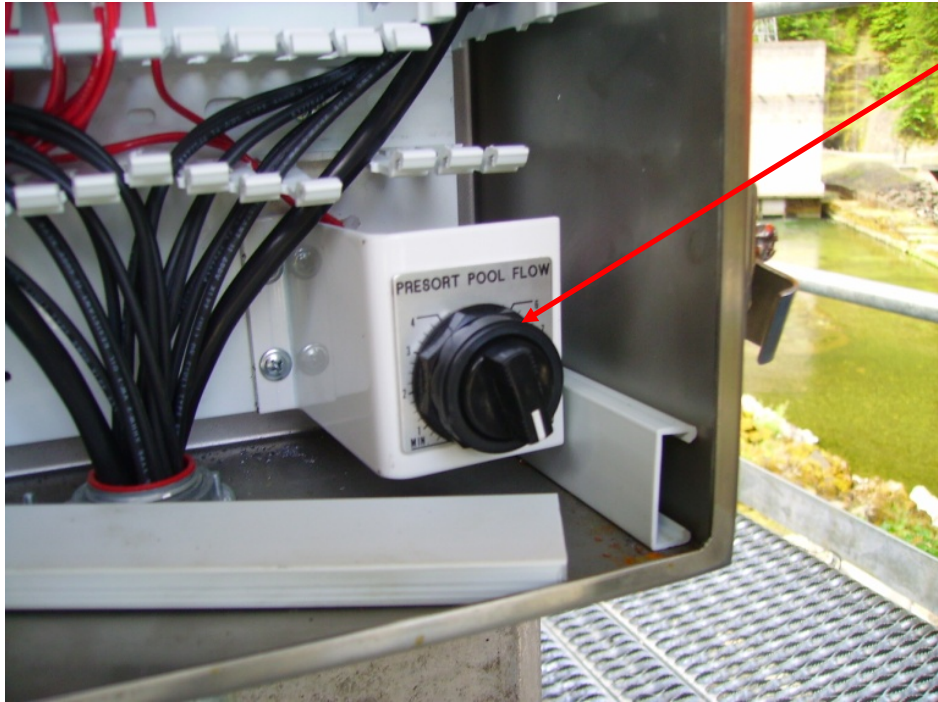
Valve position indicator lights

Figure 7 – False Weir Cabinet

ADJUSTING FLOW

Inside the control cabinet there is another potentiometer that controls flow bias. The potentiometer controls the position of the diversion valve. This valve redirects supply flow from the pre-sort pool to the false weir. The flow bias should be adjusted with the false weir flow valve at 100 percent open. The biologists have determined the ideal settings to process fish; the diversion valve control should be set to 5.2 with the false weir valve set to 10.0 and both false weir drains at 100 percent open.

CAUTION: VERIFY BOTH DRAINS ARE OPEN PRIOR TO OPERATING THE FALSE WEIR TO AVOID OVERFILLING THE ANESTHETIC TANK.



Diversion Valve Control

Figure 8 - Inside of Cabinet



8" Butterfly valve

Figure 9 - 8 inch Drain Location

3.5.3.4. Switch Gate

LOCATION:

Sorting Facility, second floor.
Reference picture in section 2.4.1.

REFERENCE:

- Contract drawing M-415, M-422 thru M-424

DESCRIPTION:

The switch gate is a separation in the fish transfer flume where fish can be directed to pool 1 or the anesthetic tank.

OPERATION:

An operator may operate the switch gate from two locations; one location is near the crowder operation cabinet and the other is located at the anesthetic tank. A needle valve near the pneumatic cylinder controls the speed of the gate, currently it is set for minimum speed. Recommend keeping the gate speed slow to minimize stress on components and structure.

3.5.3.5. Post-Sort Pool Fill Controls

LOCATION:

Sorting Facility, upper level, Eastern side of the post-sort pools.

REFERENCE:

- Contract Drawing E-404

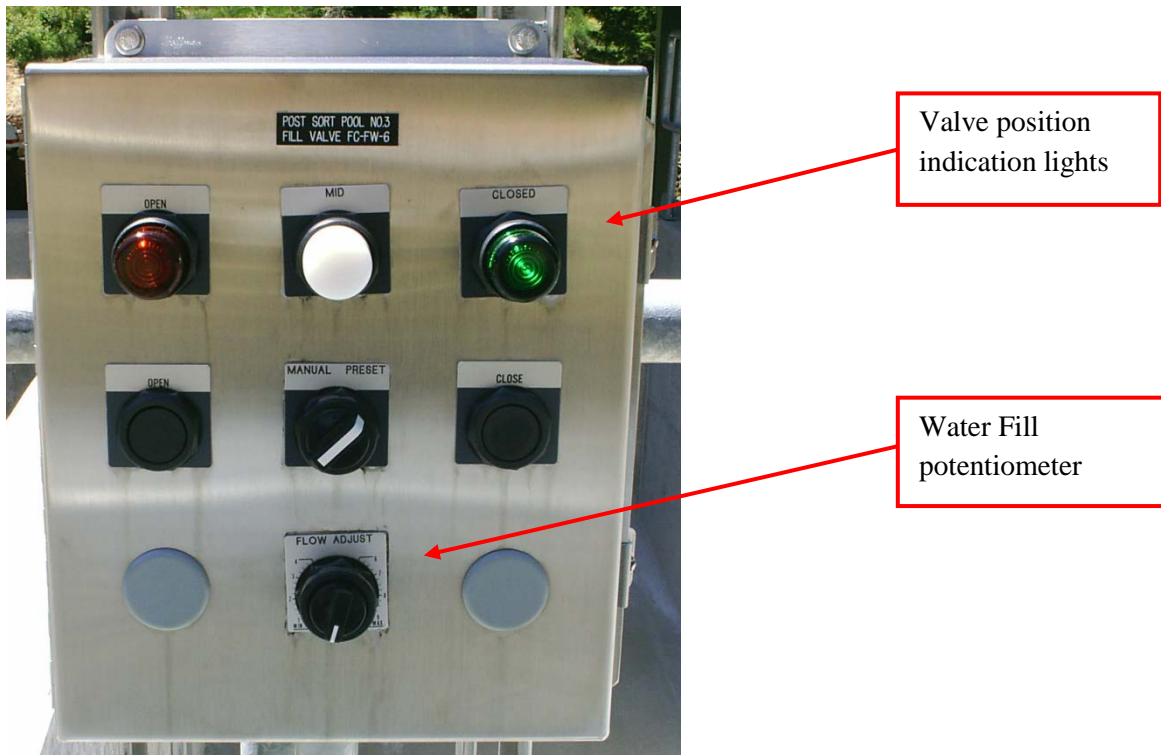
DESCRIPTION:

These control boxes regulate the filling and recirculation of water in the post-sort pools.

OPERATION:

Prior to filling the post-sort pool the operator must ensure the knife gate at the bottom of the pool is closed. To fill the pool the following tasks are completed:

- Set the water fill potentiometer to “max”, after a short period of time water will emerge from the water fill diffuser in the floor of the post-sort pool.
- Observe the water level in the pool until it reaches the overflow drain on the western interior wall of the pool
- Set the water fill potentiometer to a lower level such that the draining water does not overwhelm the overflow drain.



3.5.3.6. Post-Sort Pool Drain Controls

LOCATION:

Sorting Facility, upper level, Western side of the post-sort pools.

REFERENCE:

- Contract Drawing E-404

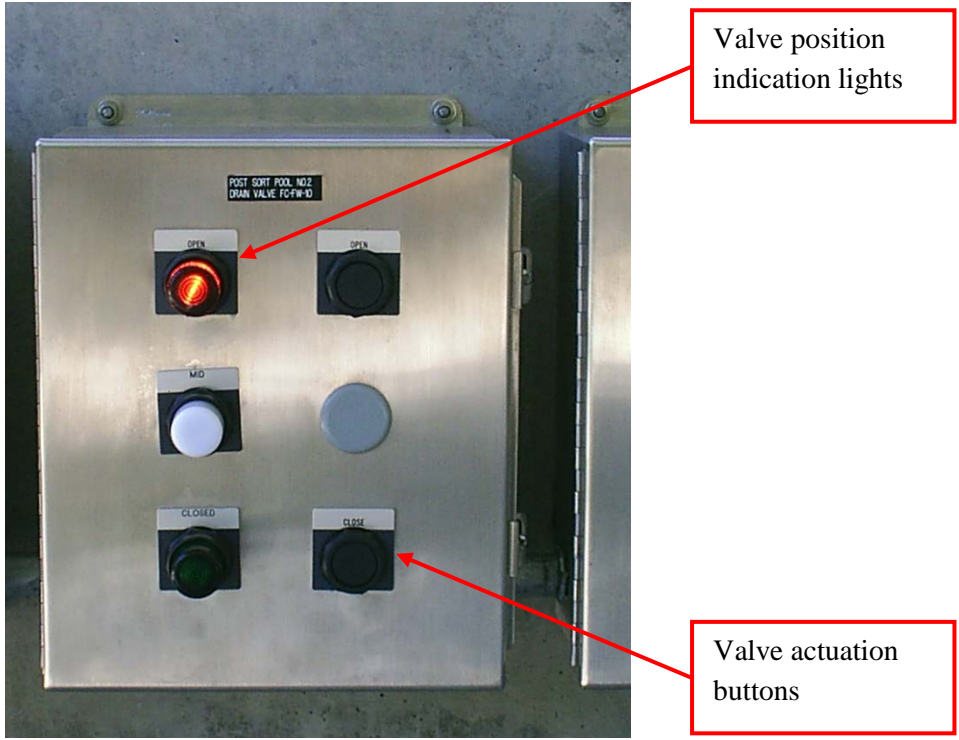
DESCRIPTION:

These control boxes regulate the draining operation for the post-sort pools.

OPERATION:

Press and hold the open button to open the drain (momentary?)

Press and hold the close button to close the drain.



3.5.3.7. Truck Fill Pipe Controls

LOCATION:

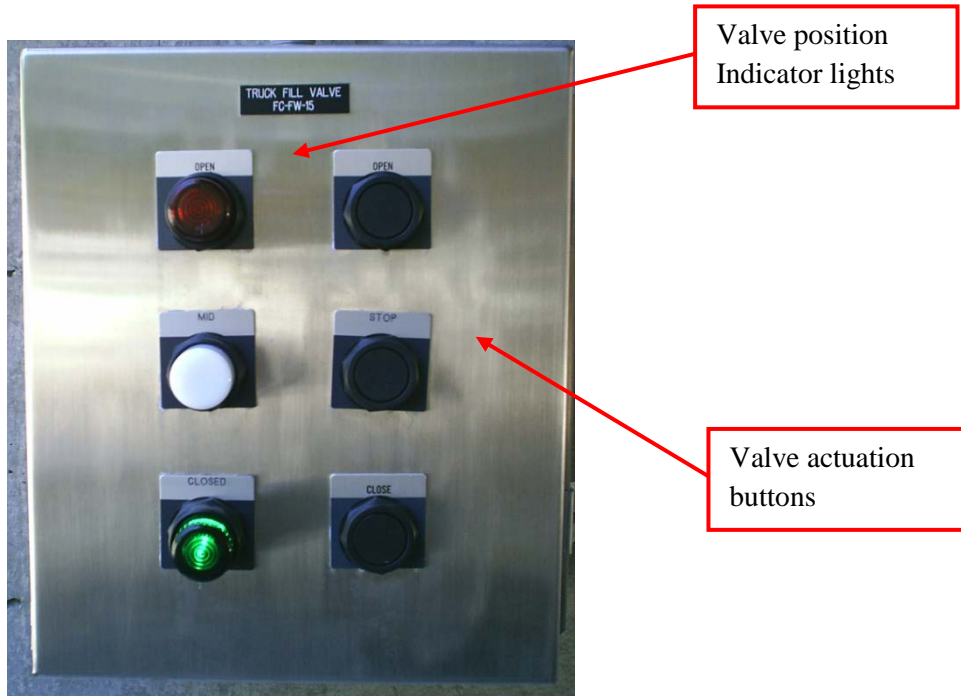
Sorting Facility, Eastern side wall of the lower level.

REFERENCE:

- Contract Drawing E-

DESCRIPTION:

These control boxes regulate the draining operation for the post-sort pools.



OPERATION:

Press the open button to open the drain

Press the stop button to stop the valve in its current position.

Press the close button to close the drain.

3.5.3.8. Bellow Hoists

LOCATION:

Sorting Facility, lower level, Western side of the fish transfer area.

REFERENCE:

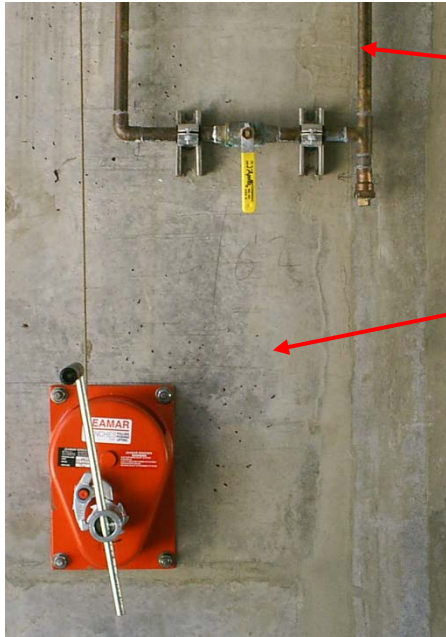
- Contract Drawing E-404

DESCRIPTION:

Manual hand crank hoists, typical for three bellows.

OPERATION:

To deploy the bellows the operator cranks counter clockwise to extend the bellows and clock wise to retract the bellows. Note the manual hoist has a built in friction clutch, it is not necessary to lock it in place.



Bellows fill valve

Bellow hoist

3.5.3.9. Post-Sort Knife Gate Controls

LOCATION:

Sorting Facility, lower level, Western side of the fish transfer area.

REFERENCE:

- Contract Drawing M-429 and M-430

DESCRIPTION:

The knife gate controls are pneumatic 4 position 2 way detent valves, manually actuated.

OPERATION:

Moving the detent lever will open or close the knife gate valve overhead.



3.5.3.10. Fish Transfer Operation

LOCATION:

Sorting Facility, lower level, beneath the post-sort pools.
Reference picture in section 2.4.4.

REFERENCE:

- Contract Drawing M-429,M-430

DESCRIPTION:

The Fish Transfer operation involves the use of the post-sort pool controls, the truck fill pipe, the bellows hoists, the knife gate control valves, four pairs of vise grips, and a drain valve located on the truck.

OPERATION:

A fish transfer operation will include the following steps:

1. Identify the post-sort pool that will transfer the fish.
2. Start draining the water from the identified post-sort pool by using the post-sort pool drain controls.
3. Maneuver the fish truck so the opening in the top of the truck tank is aligned with the truck fill pipe.
4. Fill the truck tank with water using the fill valve control box, monitor the truck tank water level and fill until water flows out of the vents at the top of the truck tank.
5. Maneuver the fish truck so the opening in the top of the truck tank is aligned with the bellows assembly that is associated with the drained pool.
6. Once the pool has drained a light will indicate...For the follow on contract
7. Attach the bellows to the opening on the top of the truck tank and secure using the four vise grips. This connection must be sealed, ensure the vise grips are securely fastened and evenly distributed around the lip of the bellow assembly.
8. Start filling the bellows with water by turning on the bellows fill valve.
9. Observe the bellows vent valve, and once water begins to come, out close the valve.
10. Open the knife gate.
11. Open the truck drain valve.
12. The operator must observe the process and then close the truck drain valve once the water level in the truck tank is approximately 12" below the top of the tank.
13. Disconnect the bellows assembly and hoist the bellows upward to clear any obstacles on the truck.

3.5.3.11. Anesthetic Tank

LOCATION:

Sorting Facility, second floor.

Reference picture in section 2.4.6.

REFERENCE:

- Contract drawing M-425, M-426.

DESCRIPTION:

The Anesthetic tank is a large aluminum tank attached to the end of the flume. It has a 2 inch fill valve, aeration system, 1 inch drain valve, 2 inch flume drain, and marine plywood lids.

OPERATION:

A biologist will determine the concentration of clove oil to use with a filled tank of water.

The 2 inch flume drain empties water into the open drain for the facility.

The 1 inch drain empties the water in the rocky area on the bottom level of the facility.

The aeration system uses filtered compressed air and an aeration stone to oxygenate the water. A biologist will determine the rate of infusion and when to use the system.

3.5.3.12. Recovery Tank

LOCATION:

Sorting Facility, second floor, South West corner

Reference picture in section 2.4.1.

REFERENCE:

- Contract drawing M-427

DESCRIPTION:

The recovery tank is a large stainless steel tank outfitted with a globe valve.

OPERATION:

A globe valve is used to fill the tank with water and provide water circulation. A biologist will determine the rate of recirculation water needed by the fish. Anesthetized fish are placed in the tank to recover.

Once a biologist has determined the fish is able to function properly the knife gate is opened and the fish are returned to the river. The knife gate is operated by button. See Figure 10.

Figure 10 – Recovery Tank

Insert Recovery Tank Picture Here

3.5.4. Normal Facility Shutdown

To shut down the Cougar AFCF AWS system, follow the procedures in section 3.5.4.1 AWS System Shutdown. To shut down the entire Cougar AFCF, follow the procedures in sections 3.5.4.2 (Facility Shutdown), 3.5.4.3 (Dewatering Procedure), and 3.5.4.4 (Winterization).

3.5.4.1. AWS System Shutdown

To shut down the Cougar AFCF AWS system, follow the procedures below.

1. From AWS screen, press the “stop pumps” **push button and confirm**
2. Change to manual control of Entrance Gate and lower to 30% opening or 18 inches (minimum opening for fish passage)
 - a. Pool 1 may drop below 5 feet if TW is low. Use biological discretion on whether or not to lower to minimum gate opening (15%) or 9 inches to raise depth in pool 1.
3. Leave AWS air relief valves closed—i.e. No Change to either FWS or AWS Vacuum Valves/air relief valves
4. Leave all diffuser valves in current settings
5. AWS Pumps must be shut down for 24 to 48 hours prior to raising the fish screen gate out of the water

3.5.4.2. Facility Shutdown

To shut down the Cougar AFCF for the season, follow the procedures below, and in sections 3.5.4.3 (Dewatering Procedure) and 3.5.4.4 (Winterization). To shut down only the AWS system, follow the procedures in section 3.5.4.1 AWS System Shutdown.

1. From AWS screen, press the “stop pumps” **push button and confirm**
2. Change to manual control of Entrance Gate and lower to 30% opening or 18 inches (minimum opening for fish passage)
 - a. Pool 1 may drop below 5 feet if TW is low. Use biological discretion on whether or not to lower to minimum gate opening (15%) or 9 inches to raise depth in pool 1.
3. Open AWS Vacuum Breaker/air relief valves located on top of each AWS pump can and below Air Relief Valves (FWS Vacuum Valves/air relief valves are always stay open).
 - a. Rotate valve actuator until the pointer on the unit says “open”
 - b. Opened air valves will allow water to drain out of AWS piping
4. Wait 4 hours then close all diffuser valves (Valves 1-A, 1-B, 2, 3, 4)
5. AWS Pumps must be shut down for 24 to 48 hours prior to dewatering the facility or raising the fish screen gate out of the water

3.5.4.3. Dewatering Procedure

After completing the Facility Shutdown procedures (section 3.5.4.2) follow the procedures below to dewater the Cougar AFCF.

1. Close the fish screen gate at the fish ladder entrance to prevent any additional fish from entering the fish ladder. Continue to operate the fish ladder, if necessary, long enough to allow fish in transit to reach and enter the pre-sort pool.
2. Change to manual control of the FWS pumps
3. Initiate drawdown of the fish ladder flow from 21 cfs to a level allowing visual inspection for fish presence and fish recovery (approximately 6 to 10 cfs). Will need to shut off one of FWS Pump when reducing flow below 10 cfs (55% of max RPM). Flow level in the fish ladder can be adjusted by changing the output of pumps (down to approximately 6 cfs) and by diverting flow from the pre-sort pool through an overflow line leading to the diffuser chambers. These procedures will also permit control of the water level in the pre-sort pool while retaining function of other fish handling facility features.
4. Recover any remaining fish as necessary

- a. Process any fish found in the pre-sort pool or recovered from the fish ladder. Processed fish may be released to the tailrace via the return flume or moved to the post-sort pools.
 - b. Load fish retained in the post-sort pools for transport to a release site.
5. Drain the pre- and post-sort pools. Wash down and clean the entire fish handling facility
 6. Shut off last FWS pump (status—all pumps are off)
 7. Close entrance gate to protect ladder against debris intrusion during high water levels, when not operation, and when shutting down for season (leave open if temporary shutdown). The control system limits gate closure to 15% open, thus full gate closure is not possible from the touch-screen. To fully close the entrance gate you must place the actuator switch in “local”, then select close using integral switch. After lowering, move switch to “stop” and open disconnect.

3.5.4.4. Winterization

After completing the Dewatering Procedure (section 3.5.4.3) follow the procedures below to winterize the Cougar AFCF.

1. Close the 3” water supply valve to fish facility located in powerhouse
2. Open the hose bib located on the wall next to the truck fill valve
3. Remove the plugs on all three bellows fill valves and open the valves on the bellows fill valves
4. Open the 3” water supply line drain located under the upper work area and above emergency generator
5. Open all hose bib valves at fish facility
6. Open the 3” water supply line drain valve located next to powerhouse and under a 12” manhole access cover.
7. At the AWS pump discharge header, locate a 1” plug on header and remove, to drain header. (NOTE: this may be changed to a 2” ball valve later)
8. At the FWS pump discharge header, locate the 2” ball valve and open to drain header. (NOTE: This valve does not currently exist but will be installed during the follow on contract)
9. Open the drain in the anesthetic tank
10. Open the 12” knife valve on the fish recovery tank
11. Open the 2” fill valve on the recovery tank
12. Open the drain valve on the presort pool
13. Open the presort pool fill valve
14. Open the false weir fill valve
15. Open the drain valves to the post-sort pools (3 each)
16. Close the Post-sort pool fill valves (3 each)
17. Open the knife valves to all 3 post-sort pools to allow water to drain out on ground
18. Close the air supply valve to post-sort pool knife valves, located next to the receiver inside the room next to valves.
19. Close the air supply to knife valve receiver located inside of storage room next to knife gate valves
20. Open the knife gate receiver tank drain valve located in the storage room and leave open
21. Close the air supply valve to the FWS air receiver tank
22. Open the FWS air receiver tank drain
23. Crank down all three bellows on knife gates
24. Open the 480VAC breakers on MCC-FCQ2 supply to FWS pumps (3 each)
25. Open the 480VAC breaker on MCC-FCQ2 supply to diversion valve and supply valve presort pool
26. Open the 480VAC breaker on MCC-FCQ2 supply to post-sort pool fill valves
27. Open the 480VAC breaker on MCC-FCQ2 supply to post-sort pool drain valves and truck fill valve
28. Position the crowder under the roof overhang to the parked position
29. At the FWS screen cleaner station turn FWS screen cleaner to on
30. Open the vacuum relief air vent ball valve on all three FWS pumps

31. At the AWS screen cleaner station turn AWS screen cleaner to on
32. Set the FWS building heater thermostat to 50 degrees
33. Set the storage room heater thermostat to 50 degrees
34. Turn the Emergency genset ATS to off position
35. Turn the Emergency genset to off position
36. Close the air supply valve to the AWS air receiver tank
37. Open the AWS air receiver tank drain
38. Close the entrance gate located at the fish ladder entrance
39. Close the fish screen gate
40. Open the 480VAC breakers on panel MCC-FCQ1 supply to AWS pumps (3 each)
41. Open the 480VAC breaker on panel MCC-FCQ1 supply to Ladder gates actuator & hoist
42. Open the 480VAC breaker on panel MCC-FCQ1 supply to AWS diffuser valve actuators
43. Open the vacuum relief valve on all three AWS pumps by manually operating the valve at the pump to the open position
44. Open the vacuum relief valve air vent ball valve for all three AWS pumps
45. Set AWS building heater thermostat to 50 degrees
46. Close the fish facility 2" air supply valve located in the powerhouse

3.5.5. Emergency Operations

3.5.5.1. Planned Power Outage

Follow the same steps as detailed if the outage is anticipated to last longer than the following times:

- a. Duration the generator can run and
- b. Acceptable duration for leaving fish in partially filled pools. (2010 field observations have shown that fish will continue to try swimming upstream even through the depth in the pool diminishes in the upstream direction during a generator-powered single pump operation.)

SHUT OFF ALL PUMPS PRIOR TO SHUTTING DOWN POWER.

(This helps preserve the life of the pumps.)

3.5.5.2. Un-planned Power Outage (Type II)

A Type-Two emergency power outage is typically unplanned and results from electrical grid failure caused by such things as downed power lines or transformer issues. During grid failure, both turbine units immediately shut down and all flow from the forebay is diverted to the regulating outlet. Basic minimum electrical service is provided to the fish collection facility from a propane powered generator that is designed to start automatically when the electrical power supply is disrupted. Normal fish collection facility operation is not possible under these conditions. The AWS system will shut down and the FWS system will provide 10 cfs of flow to the pre-sort pool and fish ladder until the collection facility can be shut down. This discharge will prevent the ladder pools from draining entirely; most or all flow will discharge through orifices only.

1. Fish Collection Facility Startup during Type II Power Outage: Fish collection facility operation would not be initiated under a Type II Emergency Powerhouse Outage condition.
2. Fish Collection Facility Shut Down during Power Outages.
 - a. Procedure for Shut Down under a Type II Emergency Powerhouse Outage
 - i. The fish facility propane powered emergency generator automatically starts and the ATS (automatic transfer switch) closes and transfers power from generator to panel MCC-FCQ2. One FWS pump should start.

- ii. AWS pumps will be automatically shut down as power supply is no longer sufficient to support their operation.
- iii. Flow from the FWS system drops to 10 cfs (and single FWS pump operation) through the pre-sort pool and fish ladder. Water service to the fish handling area may be limited or no longer available.
- iv. Initiate drawdown of the fish ladder flow from 10 cfs to a level allowing visual inspection for fish presence and fish recovery. Recover any remaining fish as necessary (this is detailed in Appendix A). Some fish may be coaxed to exit from the fish ladder entrance. Flow level in the fish ladder can be adjusted by changing the FWS pump output (down to approximately 6 cfs) and by diverting flow from the pre-sort pool through an overflow line leading to the diffuser chambers. These procedures will also permit control of the water level in the pre-sort pool.
- v. Process any fish found in the pre-sort pool or recovered from the fish ladder. The flumes may not be functioning. Fish may be transported and released to the tailrace or moved to the post-sort pools.
- vi. Load fish retained in the post-sort pools for transport to a release site.
- vii. Drain the pre- and post-sort pools. Wash down and clean the entire fish handling facility, if possible.
- viii. Shut down the FWS system, drain water lines, and secure all facility features for the non-operating season.

3.5.6. Power

3.5.6.1. Primary Feeder Breakers

LOCATION: Powerhouse Control Room. Reference Figure 11.

IDENTIFICATION: XJ1F and XJ2F (also shown as XJF1 and XJF2)



Figure 11 – Primary Feeder Breakers

REFERENCE: Contract Drawing E-601, sheet 19/54 depicts one-line distribution diagram showing electrical location of XJ1F and XJ2F. Contract Drawing E-802, sheet 48/54 depicts breaker control schematic.

DESCRIPTION: Feeder circuit breakers XJ1F and XJ2F operate at 6.9KV and supply electrical power to the entire fish collection facility. XJ1F is energized through hydroelectric generator No.1 and/or the BPA transmission line. XJ2F is connected to the hydroelectric generator No.2 bus. Circuit breakers XJ1F and XJ2F are electrically interlocked such that both cannot be closed simultaneously. If one breaker is in the test or draw-out position, the other breaker is still operational.

OPERATION: Circuit breakers XJ1F & XJ2F can be operated locally at the unit or remotely from a SCADA terminal. Switching from one circuit breaker to another will disrupt power to the Fish Collection Facility since both circuit breakers cannot be closed simultaneously. Prior to opening XJ1F or XJ2F the Fish Collection Facility control systems should be placed in manual from any touch screen, and all pumps (variable speed drives) should be stopped. An orderly system shutdown will prevent abrupt removal of power to the equipment while loaded, and should prevent damage to VFD power electronics. After closing XJ1F or XJ2F all pumps should be restarted from the local touch screen, and all control systems returned to automatic.

CAUTION: The load-break switches at the pad mounted transformer are physically connected to XJ1F and XJ2F feeders, thus can back-feed the load side of XJ1F or XJ2F with 6,900 volts. Prior to servicing or working on XJ1F or XJ2F ensure the equipment is de-energized, the appropriate load-break switch on the pad mounted transformer is open, and all appropriate grounds are in place.

SCADA ALARMS

- **COMMAND FAILURE:** Breaker XJ1F (or XJ2F) failed to close or open following a SCADA command.
- **POWER LOSS OR INVALID STATE:** 52A & 52B auxiliary contacts from XJ1F (or XJ2F) appear as both being closed or open, which is an invalid state.

3.5.6.2. Pad Mounted Transformer

LOCATION: Adjacent to AWS Electrical Bldg. Reference Figure 12.

IDENTIFICATION: FT1



Figure 12 – Pad Mounted Transformer

REFERENCE: Contract Drawing E-601, sheet 19/54 depicts one-line distribution diagram showing electrical location of FT1 and alternate source switches.

DESCRIPTION: The Fish Collection Facility transformer is rated 1000KVA, 6.9KV-480V, and is fed from circuit breakers XJ1F and XJ2F. This transformer supplies electrical power to the entire fish collection facility. The transformer has two internal load-break switches on the primary to permit paralleling of sources. The available switch positions are as shown below. Normally the load-break switches are in the “Source A & B” position and power is controlled through circuit breakers XJ1F or XJ2F.

- OFF
- SOURCE A (XJ1F)
- SOURCE B (XJ2F)
- SOURCES A & B

OPERATION: The load-break switches permit must be operated at the transformer with a hot stick. Normally feeder breaks XJF1 and XJF2 should be opened prior to any switching operation. Note that switching from one source to another will disrupt power to the Fish Collection Facility. Prior to any power switching operation the Fish Collection Facility control systems should be placed in manual from any touch screen, and all pumps (variable speed drives) should be stopped. An orderly system shutdown will prevent abrupt removal of power to the equipment while loaded, and prevent potential damage to VFD power electronics. After restoring normal power, all pumps should be restarted from the local touch screen, and all control systems returned to automatic. Prior to servicing or working on transformer FT1 ensure the unit is de-energized, both XJ1F and XJ2F are locked open, and appropriate grounds are in place.

CAUTION: The pad mounted transformer contains approximately 587 gallons of Envirotemp FR3 Fluid. Reference the Material Safety Data Sheet for chemical characteristics, hazard data, reactivity data, control measures, and precautions for safe handling and use. The transformer pad contains a lockable drain valve and liquid level switch to detect fluid leaks or accumulated precipitation. The drain should normally be closed, and water should not be allowed to accumulate within the spill containment pad. The liquid level alarm is connected to the SCADA system.

3.5.6.3. Emergency Generator and Automatic Transfer Switch (ATS)

LOCATION: Sorting facility behind electric room. Reference Figure 13.



Figure 13 – Emergency Generator

REFERENCE:

- Contract drawing E-601, sheet 19/54 depicts one-line distribution diagram showing electrical location of generator and automatic transfer switch (ATS).
- Contract drawing E-604, sheet 22/54 depicts one-line diagram of MCC-FCQ2.
- Contract drawing E-704, sheet 32/54 depicts ATS interface to PLC.
- Contract drawing E-705, sheet 33/54 depicts generator annunciator interface to PLC.

DESCRIPTION: The 150KW propane generator provides power to the FWS portion of the fish collection facility which includes all devices connected to MCC-FCQ2. The AWS portion of the facility (MCC-FCQ1) is not connected to an emergency generator. Upon loss of normal power from the powerhouse, the ATS commands the genset to start, then connects MCC-FCQ2 to the emergency generator. Following restoration of normal power the genset will re-transfer MCC-FCQ2 back to the powerhouse feeder, following a preset time-delay.

Since the ATS is an open transfer type, all operating loads will momentarily lose power when switching between normal and emergency sources. All running VFD's and other loads not connected to an uninterruptable power supply will need to be restarted.

OPERATION:

The emergency generator and ATS can be operated in manual or automatic. Normally the equipment is configured to run automatically while the fish facility is operational and processing fish.

If the generator is in the automatic position the generator main breaker must be closed, and is located inside the generator cabinet. It is always good practice to check this breaker on routine inspections. If the generator receives a start command and the breaker is not closed, the generator will only run long enough to burn the propane inside the line between the shut off valve and the generator, as the shut off valve is supplied from the generator breaker. The generator will then shutdown with a "Low Fuel Pressure" fault.

If there is any fault present on the generator while an automatic or manual start command is given, the generator will crank but not start. All faults must be cleared prior to starting the unit.

The generator supplies power to only the FWS portion of the fish facility. If the fish collection system is running and there is a loss of normal power, the emergency generator will start up. Within approximately one minute the PLC will automatically attempt to start one FWS pump. A single FWS pump will maintain adequate water in the presort tank and ladder to sustain life for any trapped fish until normal power is restored or a shutdown can be performed.

TESTING

The generator may be tested in automatic or manual modes. Do not test in automatic while the fish collection system is operational, as FWS power will be lost.

Manual Testing

1. Set "Manual/Off/Auto" switch located inside the generator access panel to manual start position. The generator should start up immediately.
2. Stop the by setting "Manual/Off/Auto" switch to off.

Automatic Testing:

1. Verify "Manual/Off/Auto" switch in "Auto"
2. Verify generator main circuit breaker is closed
3. Verify the ATS is in "Auto"
4. Open the main FWS disconnect switch FXQX

5. Upon loss of power after opening FXQX the generator will start and the ATS will transfer the FWS electrical loads from MCC-FCQ2 to the generator.
6. To finish testing and transfer power back to the normal supply close the main disconnect switch FXQX.
7. There is a programmed 20 minute time delay before the ATS will re-transfer to the normal supply and shut-down the generator. However; this can be bypassed by turning the ATS H-O-A switch to the off position, which will cause the transfer to occur within a few seconds.
8. The generator will cool down unloaded and shut down automatically.

CHARGING SYSTEM

The generator is equipped with 12 volt battery charger that outputs 2 amp or 10 amps. If there is only light demand on the battery it will maintain a constant 2 amp float charge, but if the demand exceeds 2 amps the charger will automatically charge as high as 10 amps.

Note that if the 120VAC supply to the charger is off for a period of time and the battery drops below 12volts, the charger will not operate, as it is only designed as a float charger and not for recharging a dead battery. If the power is going to be off any length of time the battery should be disconnected to prevent unwanted discharge.

FUEL TANK

- The fuel system is equipped with a Hanson Tank Model P-1150 LP fuel tank, with 1150 gallon capacity
- Propane vapor withdrawal fuel system and approximately 10 to 20% of the fuel tank capacity will be needed for fuel expansion. It is important to keep the tank filled above 20% for reliable operation.
- The fuel line is located underground after it leaves the tank and re-emerges from the concrete pad that the generator is setting on. There is a regulator and shut off valve on the concrete wall. The line then goes back under the pad and then re-emerges into the generator housing.
- There is an emergency fuel shut off push button located on the North side of the FWS building.

3.5.7. Controls

3.5.7.1. Variable Frequency Drive-AWS Pumps

LOCATION: AWS Electric Building.

IDENTIFICATION: VFD-004, VFD-005, and VFD-006

REFERENCE:

- Drawing E-602, sheet 20/54 depicts one-line distribution diagram showing electrical location of AWS Pumps.
- Drawing E-608, sheet 26/54 depicts Pump VFD control schematic.

DESCRIPTION: There are three AWS pumps and each is controlled by a variable frequency drive (VFD).

Two AWS pumps are considered essential for normal operation, while the remaining is a backup or standby unit. Under automatic *AWS Pump System* control one or two units may be called to run as determined by the river elevation. Under automatic *AWS Pump System* control the VFD's operate in unison as required to maintain adequate AWS flow. If a VFD is switched to manual, start/stop and speed control must be performed by a local operator. Automatic *AWS Pump System* control is not permitted when any VFD is operated in manual mode.

OPERATION:

Each VFD permits manual or automatic control of an AWS pump by setting the Hand-Off-Auto selector switch. The normal or default setting is "Auto".

OFF: When the Hand-Off-Auto selector switch is set to "Off" the VFD is disabled.

HAND: When the Hand-Off-Auto selector switch is set to "Hand" a pump may be operated manually by pressing the green run button on the digital human interface module "HIM". The unit may be stopped by pressing the red button on the digital human interface module. The pump speed may also be controlled through the HIM by pressing the up or down arrows. If the *AWS Pump System* is running in automatic and a VFD is manually started, the *AWS Pump System* will switch to manual mode and automatic control will cease.

AUTO: When the Hand-Off-Auto selector switch is set to "Auto" the digital human interface module is locked out, except for the stop button. A VFD/pump may start, stop, or change speed at any time while the *AWS Pump System* is running in automatic, as determined from SCADA or a local touch screen.

HIM OPERATION: Reference the full O&M manual for complete operating and programming instructions.

AUTO EXERCISE: Each pump should be exercised every 30 days (720 hours). Automatic exercising is achieved by swapping the standby pump with a running pump. Automatic pump swapping will occur under normal operating conditions while the *AWS Pump System* is in automatic mode. Automatic exercising will not occur when the diesel genset is operating, the standby pump is unavailable, the *AWS Pump System* is not in automatic mode, or the river level is so low that only one pump is required to operate. Note that automatic exercising is based on computed standby time and not run-time hours as reported by the VFD. If a VFD is placed in "Manual" or "Off" it is not in standby and excluded from auto exercise tracking. The VFD standby counter is reset after the pump is operated.

VFD AUX FAULT: A message of "F02 - Aux Fault" indicates the VFD has been faulted by at least one externally connected device. This typically occurs during power-up, and can be reset by pressing the red stop button on the HIM, or switching the selector switch to "OFF" then back to desired position. The PLC will also attempt to automatically reset the fault if the H-O-A is in the "Auto" position. If the "F02 - Aux Fault" persists it is caused by one of the following.

- Local disconnect switch at pump is open.
- Moisture detected inside submersible pump. Check "pumpsafe" module at VFD cabinet.
- Loss of phase detected. Check phase loss relay at VFD cabinet.

- Motor over temperature detected. Check “pumpsafe” module at VFD cabinet.

CAUTION: While the unit is running avoid opening the load-break (disconnect) switch, which is located adjacent to the pump. Always stop the VFD and open the VFD disconnect switch prior to opening the pump disconnect. Prior to servicing or working on a VFD ensure the equipment is de-energized, the appropriate disconnect switch is open, and all appropriate grounds are in place.

STATUS

- RUN LIGHT (RED): Indicates VFD is supplying electrical power to the pump motor.
- POWER LIGHT (GREEN): Indicates 120VAC control power at VFD is available.
- HIM STATUS: Reference the full O&M manual for accessing and viewing VFD data.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- VFD NETWORK ERROR: PLC to VFD communications failure or VFD is de-energized.
- VFD INTERNAL ALARM OR FAULT: VFD Internal fault or alarm has occurred. Alarm also includes external remote disconnect switch, pump motor moisture sensor, pump motor thermal switch, and VFD phase monitor relay. Reference VFD user manual for listing of all internal fault and alarm codes.
- VFD DISABLED OR NOT IN AUTO: Hand-off-Auto selector switch not in “Auto” or VFD not enabled.

3.5.7.2. Variable Frequency Drive-FWS Pumps

LOCATION: FWS Electric Building.

IDENTIFICATION: VFD-001, VFD-002, and VFD-003

REFERENCE:

- Drawing E-604, sheet 22/54 depicts one-line distribution diagram showing electrical location of FWS Pumps.
- Drawing E-608, sheet 26/54 depicts Pump VFD control schematic.

DESCRIPTION: There are three FWS pumps and each is controlled by a variable frequency drive (VFD). Two FWS pumps are considered essential for normal operation, while the remaining is a backup or standby unit. Under automatic *FWS Pump System* control two units always run when normal power is available. If only standby generator power is available then only one unit operates under automatic *FWS Pump System* control. During automatic *FWS Pump System* control the VFD’s operate in unison as required to maintain adequate water elevation in ladder pool #31. If a VFD is switched to manual, start/stop and speed control must be performed by a local operator. Automatic *FWS Pump System* control is not permitted when any VFD is running in manual mode.

OPERATION:

Each VFD permits manual or automatic control of an FWS pump by setting the Hand-Off-Auto selector switch. The normal or default setting is “Auto”.

OFF: When the Hand-Off-Auto selector switch is set to “Off” the VFD is disabled.

HAND: When the Hand-Off-Auto selector switch is set to “Hand” a pump may be operated manually by pressing the green run button on the digital human interface module “HIM”. The unit may be stopped by pressing the red button on the digital human interface module. The pump speed may also be controlled through the HIM by pressing the up or down arrows. If the *FWS Pump System* is running in automatic and a VFD is manually started, the *FWS Pump System* will switch to manual mode and automatic control will cease.

AUTO: When the Hand-Off-Auto selector switch is set to “Auto” the digital human interface module is locked out, except for the stop button. A VFD/pump may start, stop, or change speed at any time while the FWS Pump System is running in automatic, as determined from SCADA or a local touch screen.

HIM OPERATION: Reference the full O&M manual for complete operating and programming instructions.

AUTO EXERCISE: Each pump should be exercised every 30 days (720 hours). Automatic exercising is achieved by swapping the standby pump with a running pump. Automatic pump swapping will occur under normal operating conditions while the FWS Pump System is in automatic mode. Automatic exercising will not occur when the diesel genset is operating, the standby pump is unavailable, or the *FWS Pump System* is not in automatic mode. Note that automatic exercising is based on computed standby time and not run-time hours as reported by the VFD. If a VFD is placed in “Manual” or “Off” it is not in standby and excluded from auto exercise tracking. The VFD standby counter is reset after the pump is operated.

VFD AUX FAULT: A message of “F02 - Aux Fault” indicates the VFD has been faulted by at least one externally connected device. This typically occurs during power-up, and can be reset by pressing the red stop button on the HIM, or switching the selector switch to “OFF” then back to desired position. The PLC will also attempt to automatically reset the fault if the H-O-A is in the “Auto” position. If the “F02 - Aux Fault” persists it is caused by one of the following.

- Local disconnect switch at pump is open.
- Moisture detected inside submersible pump. Check “pumpsafe” module at VFD cabinet.
- Loss of phase detected. Check phase loss relay at VFD cabinet.
- Motor over temperature detected. Check “pumpsafe” module at VFD cabinet.

CAUTION: While the unit is running avoid opening the load-break (disconnect) switch, which is located adjacent to the pump. Always stop the VFD and open the VFD disconnect switch prior to opening the pump disconnect. Prior to servicing or working on a VFD ensure the equipment is de-energized, the appropriate disconnect switch is open, and all appropriate grounds are in place.

STATUS

- RUN LIGHT (RED): Indicates VFD is supplying electrical power to the pump motor.
- POWER LIGHT (GREEN): Indicates 120VAC control power at VFD is available.
- HIM STATUS: Reference the full O&M manual for accessing and viewing VFD data.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- VFD NETWORK ERROR: PLC to VFD communications failure or VFD is de-energized.
- VFD INTERNAL ALARM OR FAULT: VFD Internal fault or alarm has occurred. Alarm also includes external remote disconnect switch, pump motor moisture sensor, pump motor thermal switch, and VFD phase monitor relay. Reference VFD user manual for listing of all internal fault and alarm codes.
- VFD DISABLED OR NOT IN AUTO: Hand-off-Auto selector switch not in “Auto” or VFD not enabled.

3.5.7.3. PLC Controlled Actuators for Entrance Gate and Valves

LOCATION: AWS Diffuser Valves and Fish Ladder Entrance Gate

IDENTIFICATION:

- VAM-007: Pool 1, Valve #1A
- VAM-008: Pool 1, Valve #1B
- VAM-009: Pool 2, Valve #2
- VAM-010: Pool 3, Valve #3
- VAM-011: Pool 4, Valve #4
- GAM-001: Ladder Entrance Gate

REFERENCE:

- Drawing E-401, sheet 08 of 54 depicts physical location of actuators.
- Drawing E-602, sheet 20 of 54 one-line diagram shows electrical location of actuators.
- Drawing E-610, sheet 28 of 54 shows disconnect switch enclosures.
- Drawing E-717, sheet 45 of 54 contains valve schedule and connection diagrams.

DESCRIPTION: The electric actuators are used to operate the AWS diffuser valves and fish ladder entrance gate. The AWS diffuser valve actuators require 480V and are fed from a single 40A feeder from the AWS electric building. The entrance gate actuator is fed from a separate 480V, 30A feeder from the AWS electric building. The actuators are not connected to the emergency generator circuit.

OPERATION: The actuators can be operated both locally and remotely as described below. The normal or default actuator setting is “Remote” with the hand/auto lever in “Auto”. See MFR installation and maintenance instructions for manual hand-wheel operations.

Local Control

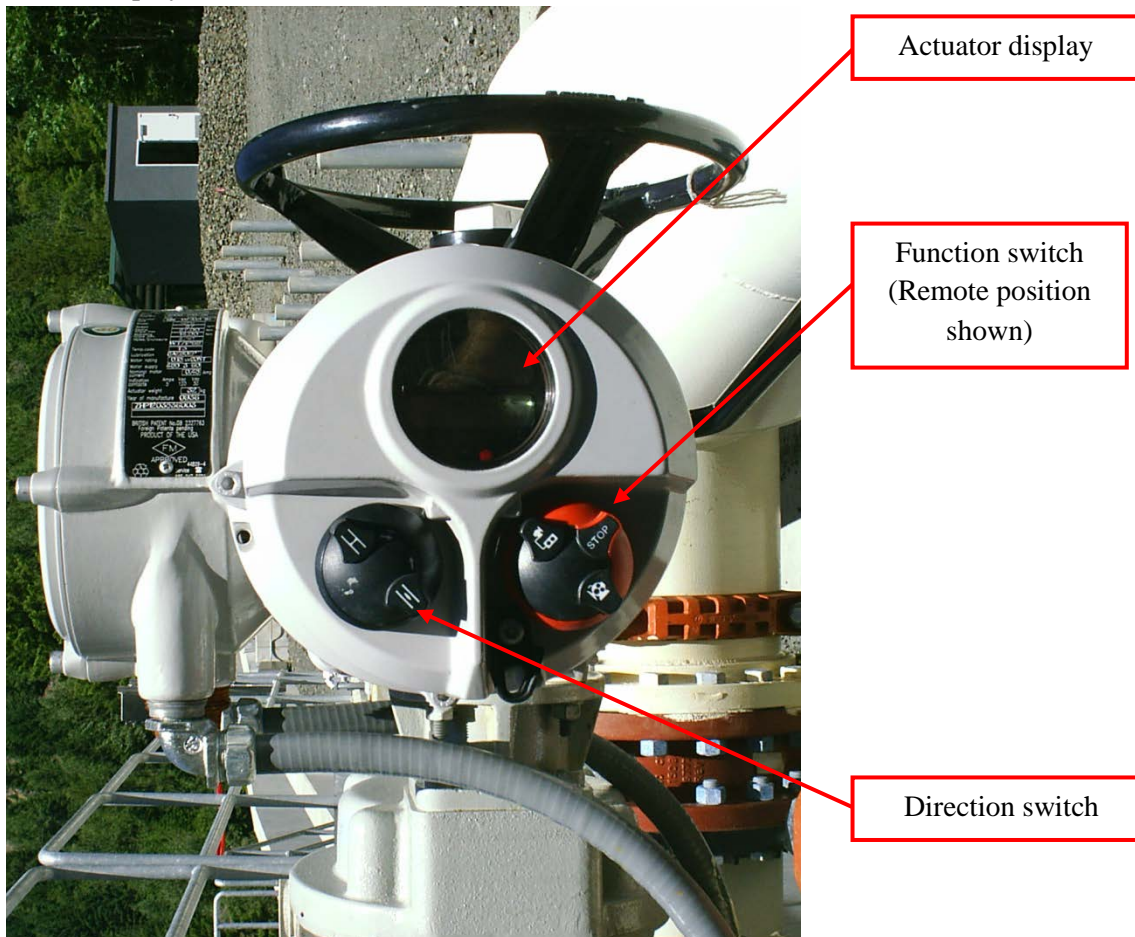
- With the red selector switch set to "Local" (counterclockwise), the black "Open/Close" sector switch can be used to change the gate or valve position. The actuator will stop automatically upon reaching full open or close. To stop movement mid-position, turn the red selector switch clockwise to "Stop".

Remote Control

- With the red selector switch set to "Remote", a Fish Collection Facility touch-screen can be used to operate the actuator. To stop movement, turn the red selector clockwise to "Stop".

Local Indication

- When fully open two LEDs turn red, the open symbol is shown, and "Open Limit" is displayed.
- During mid-travel two LEDs turn amber, % open is shown, and "Stopped" is displayed when there is no actuator movement.
- When fully closed two LEDs turn green, the closed symbol is shown, and "Closed Limit" is displayed.



CAUTION: Prior to servicing or working on any actuator ensure unit is de-energized and the local disconnect switch is locked open. Only authorized personnel shall service equipment.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- ACTUATOR NETWORK ERROR: Communication problem or loss of power has occurred.
- ACUTATOR INTERNAL ALARM: Actuator detected internal fault or alarm event.
- ACTUATOR SW NOT IN REMOTE: Red selector switch at actuator not in “Remote” position.

3.5.7.4. Stand Alone Electric Actuators for Valves

LOCATION: FWS Sorting Facility

IDENTIFICATION:

- VAM-001: Post-Sort Pool 1, Drain Valve #FC-FW-7
- VAM-002: Post-Sort Pool 2, Drain Valve #FC-FW-10
- VAM-003: Post-Sort Pool 3, Drain Valve #FC-FW-13
- VAM-004: Post-Sort Pool 1, Fill Valve #FC-FW-6
- VAM-005: Post-Sort Pool 2, Fill Valve #FC-FW-9
- VAM-006: Post-Sort Pool 3, Fill Valve #FC-FW-12
- VAM-12A: Pre-Sort Pool, 24” Diversion Valve #FC-FW-4A
- VAM-12B: Pre-Sort Pool, 12” Diversion Valve #FC-FW-4B
- VAM-013: Pre-Sort Pool, Drain Valve #FC-FW-5
- VAM-014: Truck Fill Valve #FC-FW-15

REFERENCE:

- Drawing E-404, sheet 08 of 54 depicts physical location of actuators & control cabinets.
- Drawing E-604, sheet 22 of 54 one-line diagram shows electrical location of actuators.
- Drawing E-610, sheet 28 of 54 shows disconnect switch enclosures.
- Drawing E-717, sheet 45 of 54 contains valve schedule and connection diagrams.

DESCRIPTION: Electric actuators are used to operate various presort, post-sort, and truck fill valves as listed above. All valve actuators require 480V and are fed from various circuit breakers from the FWS electric building. The actuators may be operated under emergency generator power.

OPERATION: The actuators can be operated both locally and remotely as described below. The normal or default actuator setting is “Remote” with the hand/auto lever in “Auto”. See MFR installation and maintenance instructions for manual hand-wheel operations.

Local Control

- With the red selector switch set to "Local" (counterclockwise), the black “Open/Close” sector switch can be used to change valve position. The actuator will stop automatically upon reaching full open or close. To stop movement mid-position, turn the red selector switch clockwise to "Stop". Note that the actuators are not readily accessible from the ground and should be remotely controlled as described as below.

Local Indication

- When fully open two LEDs turn red, the open symbol is shown, and "Open Limit" is displayed.
- During mid-travel two LEDs turn amber, % open is shown, and "Stopped" is displayed when there is no actuator movement.
- When fully closed two LEDs turn green, the closed symbol is shown, and "Closed Limit" is displayed.

Remote Control

- With the red selector switch on the actuator set to "Remote", a remote operator station can be used to control the actuator and valve.
- Drain Valves for Sorting Pools (See Figure 14)
 - Open or Close pushbutton must be held to operate valve. Releasing a button stops movement.
- Fill Valves for Post-Sort Pools
 - With the cabinet selector switch in Manual, the Open or Close pushbutton must be held to operate valve. Releasing a button stops movement.
 - With the cabinet selector switch in Auto, the rotary potentiometer is used to set valve position. On the potentiometer dial, 0% corresponds to closed, while 100% corresponds to fully open.
- Presort Pool Diversion Valves
 - With the cabinet selector switch Off, the 24" valve will close and the 12" valve will open.
 - With the cabinet selector switch On, the 24" valve can be adjusted by rotary potentiometer located on the cabinet door. The rotary potentiometer for the 12" valve is located inside the cabinet and is not normally changed. On the potentiometer dial; 0% corresponds to closed, while 100% corresponds to fully open.
- Truck Fill Valve
 - Open or Close pushbuttons initiate valve action. Movement continues until the Stop pushbutton is pressed or open/close limit reached.
 - Cabinet lights: Green indicates closed, red indicates open, white indicates position between open & closed.

Remote Indication

- Cabinet lights: Green indicates closed, red indicates open, white indicates any position between open & closed.



Figure 14 –Controls for Drain Valves for Sorting Pools

CAUTION: Prior to servicing or working on any actuator ensure unit is de-energized and the local disconnect switch is locked open. Only authorized personnel shall service equipment.

SCADA ALARMS

Equipment is not connected to SCADA system, thus remote alarming is not available.

3.5.7.5. AWS Air Burst Cabinet

LOCATION: Adjacent to river at AWS intake screens

IDENTIFICATION: AWS Screen Cleaner

REFERENCE: Contract Drawing E-713, sheet 41/54 depicts cabinet layout and schematic diagram.

DESCRIPTION:

- There are five vertical intake screens, each subdivided into four zones. Zone 1 is the lowest in the water, while zone 4 is the highest and is typically not submerged. There are 20 solenoid valves, one for each zone within each vertical screen.
- Automatic Zone Selection:
 - a. Zone 1 only 1250.0 < River elevation < 1252 ft.
 - b. Zones 1 – 2 1250.0 < River elevation < 1254 ft.
 - c. Zones 1 – 3 1250.0 < River elevation < 1256 ft.
 - d. Zones 1 – 4 1250.0 < River elevation < 1259 ft.

- During an automatic cleaning cycle, each solenoid valve is configured to operate for 3 seconds on and 1 second off. The transition time (delay) between screens is currently set for 3 seconds.
- The minimum air tank pressure required to begin an automatic cleaning cycle or transition to the next vertical screen is 95 PSI. If the tank pressure drops below 95 PSI mid cycle the system will hold before processing the next screen. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.
- The minimum tank pressure required operate any valve is 75 PSI. If the tank pressure drops below 75 PSI the automatic cleaning process will hold. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.

OPERATIONAL MODES

The AWS air burst cabinet permits manual or automatic control of the AWS screen cleaner system by setting the Hand-Off-Auto selector switch. The normal or default setting is “Auto”.

- OFF: When the Hand-Off-Auto selector switch is set to “Off” the screen cleaner is disabled.
- HAND: When switched to “Hand” an individual screen may be cleaned by setting the appropriate zone via the selector switch and pressing the desired push-button. The air blast will continue as long as the push-button is pressed. For example, to manually clean the upper most section of screen 5 set the zone selector switch to 4 and hold the screen 5 pushbutton. No automatic cleaning cycles will occur when the switch is not in “Auto”. The “Ready” light must be illuminated to operate in manual.
- AUTO: When switched to “Auto” all submerged screens will be automatically cleaned based on the zone selection criteria, assuming the system ready light is illuminated. Auto cleaning cycles are initiated by the following events.
 - e. Pressing and holding any of the 5 cabinet pushbuttons for at least 3 seconds continuously.
 - f. Touch screen in the FWS electric room.
 - g. Differential pressure across the intake screens exceeds 0.6ft. A high differential cleaning event will cycle no more than once every 10 minutes to prevent depleting the air supply, even if a high differential condition persists following a cleaning cycle.
 - h. Time based every 12 hours. Start at 12:00am and 12:00pm.

STATUS

- READY LIGHT (GREEN)
 - i. In “Hand” mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 75 PSI.
 - j. In “Auto” mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 95 PSI, water level transmitters LT-010 & LT-011 are functional, the river elevation is between 1250.0 and 1259.0 ft, and the system is not already operating an automatic cleaning cycle.
 - k. During an automatic cleaning cycle the green light will flash.
- CHARGING LIGHT (RED)

1. If the air tank pressure is between 25 and 95 PSI and increasing, the charging light is illuminated. Beyond 95 PSI the air tank is assumed to be fully charged. Below 25 PSI the air tank is considered discharged and not in service.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- **INCOMPLETE SEQUENCE:** An automatic cleaning cycle did not complete within 5 minutes.
- **PLC HARDWARE TROUBLE:** A problem with the I/O hardware has been detected.
- **SUSTAINED LOW PRESSURE:** Receiver tank pressure remained below 95 PSI for 120 seconds and the system is in either “Auto” or “Manual”.
- **SUSTAINED VERY LOW PRESSURE:** Receiver tank pressure remained below 75 PSI for 60 seconds and the system is in either “Auto” or “Manual”.
- **CLEANING CYCLE FAILED:** A differential pressure across the intake screens exceeding 0.6ft remains immediately following an automatic cleaning cycle.
- **SUSTAINED DIRTY SCREEN:** A differential pressure across the intake screens exceeding 1.0ft exists for 11 minutes or longer.
- **WATER RANGE ERROR:** The measured river level is not between 1250.0 and 1259.0ft.
- **CLEANING CYCLE ABORTED.** Automatic cleaning cycle aborted due following: A) H-O-A selector switched from “Auto”. B) I/O Hardware error detected. C) Water level sensor failure or out-of-range error. D) Incomplete sequence due to low air pressure.
- **SYSTEM NOT IN AUTO:** Cabinet selector switch not in “Auto” position.

3.5.7.6. FWS Air Burst Cabinet

LOCATION: Adjacent to river at FWS intake screens

IDENTIFICATION: FWS Screen Cleaner

REFERENCE: Contract Drawing E-712, sheet 40/54 depicts cabinet layout and schematic diagram.

DESCRIPTION:

- There are two vertical intake screens, each subdivided into four zones. Zone 1 is the lowest in the water, while zone 4 is the highest and is typically not submerged. There are 8 solenoid valves, one for each zone within each vertical screen.
- Automatic Zone Selection:
 - m. Zone 1 only 1250.0 < River elevation < 1252 ft.
 - n. Zones 1 – 2 1250.0 < River elevation < 1254 ft.
 - o. Zones 1 – 3 1250.0 < River elevation < 1256 ft.
 - p. Zones 1 – 4 1250.0 < River elevation < 1259 ft.
- During an automatic cleaning cycle, each solenoid valve is configured to operate for 4 seconds on and 1 second off. The transition time (delay) between screens is currently set for 3 seconds.
- The minimum air tank pressure required to begin an automatic cleaning cycle or transition to the next vertical screen is 95 PSI. If the tank pressure drops below 95 PSI mid cycle the system will

hold before processing the next screen. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.

- The minimum tank pressure required operate any valve is 75 PSI. If the tank pressure drops below 75 PSI the automatic cleaning process will hold. If the tank pressure does not recover within 5 minutes an incomplete sequence alarm is generated and the system resets.

OPERATIONAL MODES

The FWS air burst cabinet permits manual or automatic control of the FWS screen cleaner system by setting the Hand-Off-Auto selector switch. The normal or default setting is “Auto”.

- OFF: When the Hand-Off-Auto selector switch is set to “Off” the screen cleaner is disabled.
- HAND: When switched to “Hand” an individual screen may be cleaned by setting the appropriate zone via the selector switch and pressing the desired push-button. The air blast will continue as long as the push-button is pressed. For example, to manually clean the upper most section of screen 2 set the zone selector switch to 4 and hold the screen 2 pushbutton. No automatic cleaning cycles will occur when the switch is not in “Auto”. The “Ready” light must be illuminated to operate in manual.
- AUTO: When switched to “Auto” all submerged screens will be automatically cleaned based on the zone selection criteria, assuming the system ready light is illuminated. Auto cleaning cycles are initiated by the following events.
 - q. Pressing and holding any of the two cabinet pushbuttons for at least 3 seconds continuously.
 - r. Touch screen in the FWS electric room.
 - s. Differential pressure across the intake screens exceeds 0.6ft. A high differential cleaning event will cycle no more than once every 10 minutes to prevent depleting the air supply, even if a high differential condition persists following a cleaning cycle.
 - t. Time based every 4 hours. Start at 1:30am, 5:30am, 9:30am, 1:30pm, 5:30pm, & 9:30pm.

STATUS

- READY LIGHT (GREEN)
 - u. In “Hand” mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 75 PSI.
 - v. In “Auto” mode the green ready light is continuously illuminated when no PLC problems are detected, the tank air pressure is above 95 PSI, water level transmitters LT-013 & LT-014 are functional, the river elevation is between 1250.0 and 1259.0 ft, and the system is not already operating an automatic cleaning cycle.
 - w. During an automatic cleaning cycle the green light will flash.
- CHARGING LIGHT (RED)
 - If the air tank pressure is between 25 and 95 PSI and increasing, the charging light is illuminated. Beyond 95 PSI the air tank is assumed to be fully charged. Below 25 PSI the air tank is considered discharged and not in service.

SCADA ALARMS

Reference alarm summary matrix for additional information.

- **INCOMPLETE SEQUENCE:** An automatic cleaning cycle did not complete within 3 minutes.
- **PLC HARDWARE TROUBLE:** A problem with the I/O hardware has been detected.
- **SUSTAINED LOW PRESSURE:** Receiver tank pressure remained below 95 PSI for 120 seconds and the system is in either “Auto” or “Manual”.
- **SUSTAINED VERY LOW PRESSURE:** Receiver tank pressure remained below 75 PSI for 60 seconds and the system is in either “Auto” or “Manual”.
- **CLEANING CYCLE FAILED:** A differential pressure across the intake screens exceeding 0.6ft remains immediately following an automatic cleaning cycle.
- **SUSTAINED DIRTY SCREEN:** A differential pressure across the intake screens exceeding 1.0ft exists for 11 minutes or longer.
- **WATER RANGE ERROR:** The measured river level is not between 1250.0 and 1259.0ft.
- **CLEANING CYCLE ABORTED.** Automatic cleaning cycle aborted due following: A) H-O-A selector switched from “Auto”. B) I/O Hardware error detected. C) Water level sensor failure or out-of-range error. D) Incomplete sequence due to low air pressure.
- **SYSTEM NOT IN AUTO:** Cabinet selector switch not in “Auto” position.

3.5.7.7. Touch Screens

LOCATION: FWS Electric Building.

IDENTIFICATION: FWS PLC Cabinet

REFERENCE:

- Drawing E-703, sheet 31/54 depicts PLC cabinet layout and power schematic.

DESCRIPTION:

The touch screen is used to control and monitor various devices and systems of the fish collection system. There are individual status and/or control screens for the following: Current status, Alarm history, AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder entrance gate, and AWS/FWS digital power meters. For some it may be easier to use a plastic stylus instead of a finger to press the virtual buttons.

OPERATION:

The MAIN screen is used to access all other screens and is shown in Figure 15. Each blue button opens other Fish Collection Facility screens as labeled. The date and time match the local PLC clock and cannot be modified.

The alarm object provides a brief listing of recent alarms. For additional alarm information go to the alarm “HISTORY” and/or alarm “STATUS” screens.

The “ACK ALM” button can be used to acknowledge individual alarms, as selected by the up/down arrows. The “ACK ALL” button will acknowledge all current alarms. Acknowledging an alarm does not

clear an alarm, even if it is no longer present. Alarm clearing can be performed on the alarm history screen.

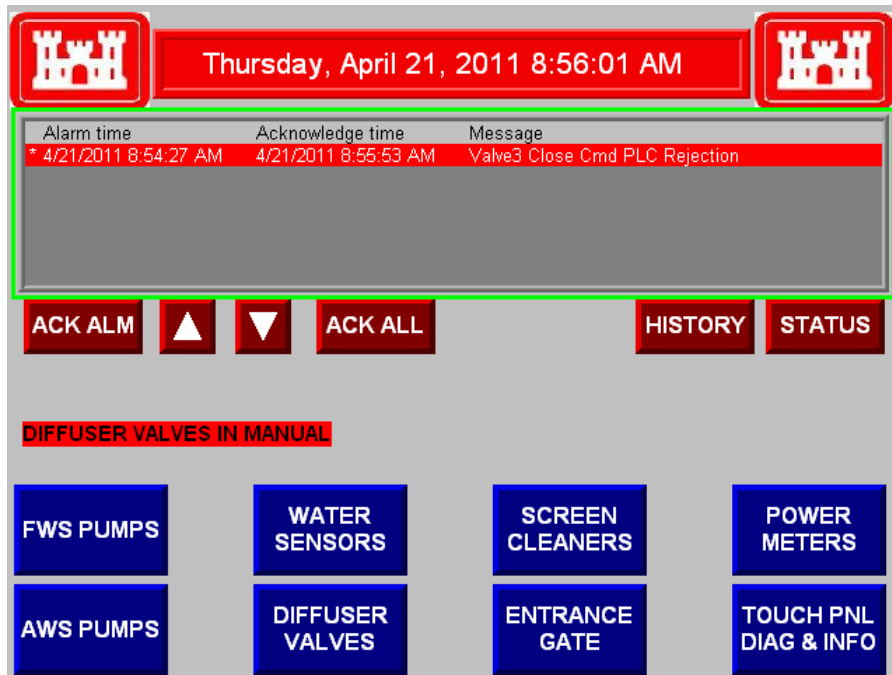


Figure 15 – Main Touch Screen

The FWS PUMP screen is shown in Figure 16, and is used to control and monitor the FWS Pump System. The upper screen displays the status of each VFD. A red background behind “Pump No.” indicates running, while a green background indicates off. “Available” or “Not-Available” status is displayed for each non-running pump, and indicates whether unit is available for automatic startup.

The green “START PUMPS” button starts the FWS pumping system. A confirmation “yes/no” screen is displayed after pressing the button. Once the system is started the controller determines how many pumps should operate, regardless of Auto/Manual control selection.

The red “STOP PUMPS” button stops the FWS pumping system. A confirmation “yes/no” screen is displayed after pressing the button. Following confirmation to stop all pumps, the controller will shut-down all VFD’s that have their H-O-A switch in “auto”.

The “AUTO CONTROL” push button sets the control mode for the FWS pump system. In automatic mode the pump speed is adjusted by the controller. If the green “Ready” symbol above the button is not visible then the system cannot be placed in “Auto”. The red “NOT READY” symbol indicates flow sensor trouble, water level sensor trouble, no pumps available, or at least one pump is running in manual.

- CO represents Controller Output, and should match the Pump Speed shown.
- SP is the water level Set Point for ladder pool #31 and cannot be changed.
- PV represents Process Variable and is the actual water level measured in pool #31.

- ER is the difference between SP and PV and is normally +/- 0.1 ft. with both pumps running. Note that with only one pump running the system cannot maintain a 0.9 ft water level at ladder pool #31, resulting in a high error.

The “MANUAL CONTROL” push button sets the control mode for the FWS Pump Control System. In manual mode the pump speed is adjusted through the “Key Pad” setting. The “Key Pad” pump speed setting must be between 75% and 100% of maximum. If a red “NOT READY” symbol is visible above button then either no pumps are available or at least one pump is running in manual.

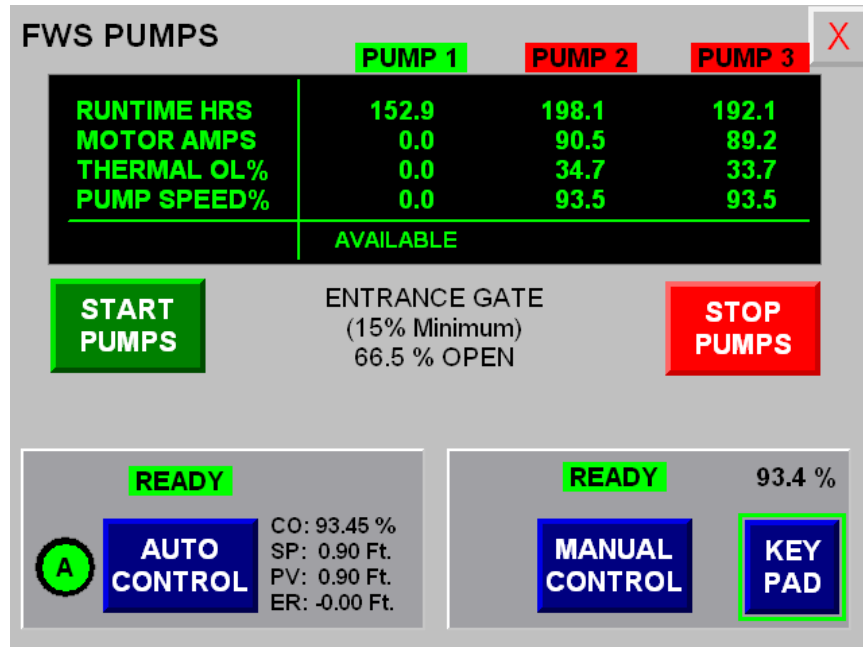


Figure 16 – FWS Pumps Touch Screen

The AWS PUMP screen is shown in Figure 17, and is used to control and monitor the AWS Pump System. The upper screen displays the status of each VFD. A red background behind “Pump No.” indicates running, while a green background indicates off. “Available” or “Not-Available” status is displayed for each non-running pump, and indicates whether unit is available for automatic startup.

The green “START PUMPS” button starts the AWS pumping system. A confirmation “yes/no” screen is displayed after pressing the button. Once the system is started the controller determines how many pumps should operate, regardless of Auto/Manual control selection.

The red “STOP PUMPS” button stops the AWS pumping system. A confirmation “yes/no” screen is displayed after pressing the button. Following confirmation to stop all pumps, the controller will shut-down all VFD’s that have their H-O-A switch in “auto”.

The “AUTO CONTROL” push button sets the control mode for the AWS pump system. In automatic mode the pump speed is adjusted by the controller. If the green “Ready” symbol above the button is not

visible then the system cannot be placed in “Auto”. The red “NOT READY” symbol indicates flow sensor trouble, water level sensor trouble, no pumps available, or at least one pump is running in manual.

- CO represents Controller Output, and should match the pump speed shown.
- SP is the desired water flow Set Point and is automatically determined.
- PV represents Process Variable and is the actual flow measured.
- ER is the difference between SP and PV and is normally within +/- 5.0 CFS.

The “MANUAL CONTROL” push button sets the control mode for the AWS Pump Control System. In manual mode the pump speed is adjusted through the “Key Pad” setting. The “Key Pad” pump speed setting must be between 50% and 100% of maximum. If a red “NOT READY” symbol is visible above button then either no pumps are available or at least one pump is running in manual.

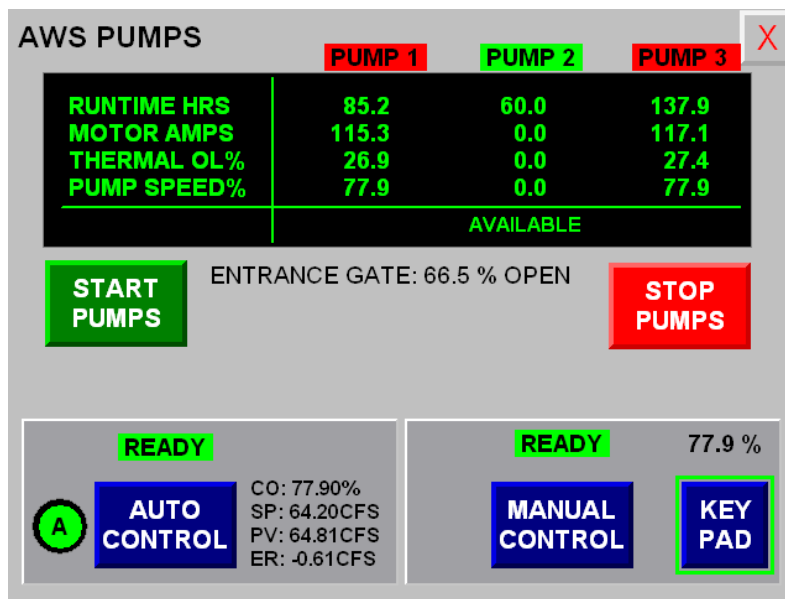


Figure 17 – AWS Pumps Touch Screen

The WATER LEVEL SENSOR screen is shown in Figure 18 and displays water elevations for various locations throughout the system. A value of -99.9 indicates sensor trouble and the actual water level or elevation is unknown.

REFERENCE:

- Drawing E-718, sheet 46 of 54 has level sensor schedule.
- Drawings E-401, sheet 8 of 54 depicts physical location of LT.002 & LT.003.
- Drawings E-402, sheet 9 of 54 depicts physical location of LT.010 & LT.011.
- Drawings E-403, sheet 10 of 54 depicts physical location of LT.013 & LT.014.
- Drawings E-404, sheet 11 of 54 depicts physical location of LT.012.

WATER LEVEL SENSORS			
<u>SENSOR</u>	<u>LOCATION</u>	<u>ELEVATION</u>	<u>DELTA</u>
LT.002	AWS POOL 1	1254.98	0.52
LT.003	*AWS DIFFUSER 1	1255.51	
LT.010	AWS RIVER	1253.74	-0.18
LT.011	AWS INTAKE SCREEN	1253.55	
LT.013	FWS RIVER	1253.52	-0.11
LT.014	FWS INTAKE SCREEN	1253.41	
LT.012	FWS LADDER POOL #31	1283.77	

* Indicates Sensor Not Essential for Automatic Control.

Figure 18 –Water Level Sensors Touch Screen

The DIFFUSER VALVE screen is shown in Figure 19, Figure 20, and Figure 21. This screen permits automatic control of all five valves or manual control of individual valves. The valve actuator “Local-Off-Remote” switch position, valve opening, and alarm information is also displayed.

SCADA ALARMS:

- **FCF VALVE SYSTEM FAILED TO MANUAL – NOTIFY OPERATOR.** Indicates AWS diffuser valve system jumped from automatic control to manual control due to valve actuator trouble, network trouble, or any valve actuator switch not in “remote”.

The “AUTO CONTROL” push button sets the control mode for the AWS diffuser valve system. In automatic mode all five valves are adjusted by the controller. If the green “READY” symbol near the button is not visible then the system cannot be placed in “Auto”. The red “NOT READY” symbol indicates at least one of the valve actuators are not switched to “Remote”, a network problem exists, or an actuator has an internal alarm. Other conditions causing “NOT READY” are AWS river level sensor trouble (LT.010) and at least one valve with analog positioning disabled.

AWS DIFFUSER VALVES X				
DESCRIPTION	ADJUST	SWITCH	ALARM	% OPEN
POOL 1, VALVE #1A	AUTOMATIC	AUTO		100.0
POOL 1, VALVE #1B	AUTOMATIC	AUTO		100.0
POOL 2, VALVE #2	AUTOMATIC	AUTO		100.0
POOL 3, VALVE #3	AUTOMATIC	AUTO		100.0
POOL 4, VALVE #4	AUTOMATIC	AUTO		0.0



	AUTO CONTROL	READY		MANUAL CONTROL	READY
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Figure 19 – Diffuser Valve Touch Screen (Automatic Mode)

The “MANUAL CONTROL” push button sets the control mode for the AWS diffuser valve system. In manual mode the valves are individually adjusted by an operator. If the green “READY” symbol near the button is not visible then no actuators can be remotely controlled. A “NOT READY” symbol indicates no actuator is switched to “Remote”, all have network problems, all are unpowered, or all have internal alarms. Manual remote valve positioning is either fully open or close, thus a stop pushbutton is not provided.

AWS DIFFUSER VALVES X				
DESCRIPTION	ADJUST	SWITCH	ALARM	% OPEN
POOL 1, VALVE #1A	MANUAL	AUTO		100.0
POOL 1, VALVE #1B	MANUAL	AUTO		100.0
POOL 2, VALVE #2	MANUAL	AUTO		0.0
POOL 3, VALVE #3	MANUAL	AUTO		0.0
POOL 4, VALVE #4	MANUAL	AUTO		0.0


AUTO CONTROL	READY		MANUAL CONTROL	READY
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Figure 20 – Diffuser Valve Touch Screen (Manual Mode)

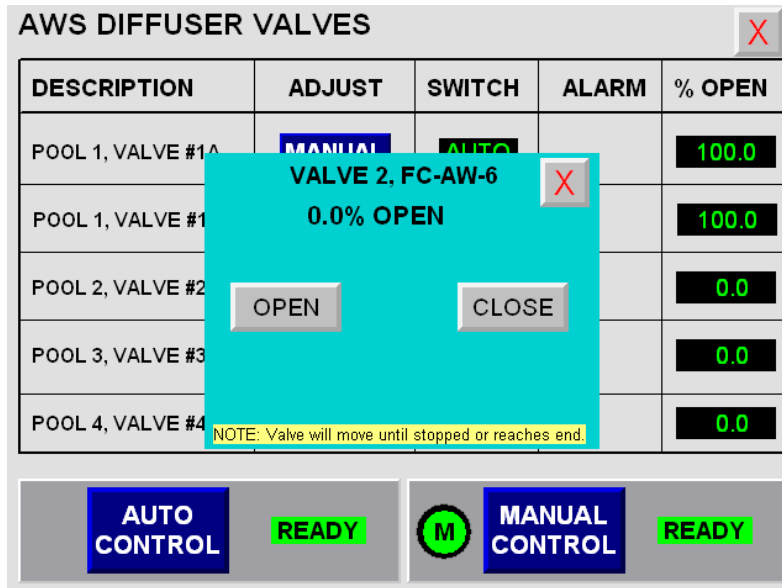


Figure 21 – Diffuser Valve Touch Screen (Manual Mode Operation)

The ENTRANCE GATE screen is shown in Figure 22. This screen permits manual and automatic control of the fish ladder entrance gate. The gate actuator “Local-Off-Remote” switch status, gate opening, and alarm information is also displayed.

The “AUTO CONTROL” push button sets the control mode for the entrance gate system. In automatic mode the gate position is adjusted by the controller. If the green “Ready” symbol above the blue push button is not visible then the system cannot be placed in “Auto”. The red “NOT READY” symbol indicates the gate actuator is not switched to “Remote”, has a network problem, or has an internal alarm. Other conditions causing “NOT READY” are AWS river level sensor trouble (LT.010), Ladder Pool #1 water level sensor trouble (LT.002), or analog positioning is disabled within the actuator.

- CO represents Controller Output, and should normally match the gate opening shown.
- SP is the differential head Set Point and is automatically determined.
- PV represents Process Variable and is the actual differential head measured.
- ER is the difference between SP and PV and is normally within +/- 0.15 Ft.

The maximum gate opening is 95%. The minimum gate opening is determined as follows:

- 10% open when no AWS pumps are running
- $20\% + 0.80 * (LT.010 - 1250.0)$ open when any AWS pump runs.
- 30% open any other time.

The “MANUAL CONTROL” push button sets the control mode for the entrance gate system. In manual mode the gate position is adjusted through the “Key Pad” setting. The “Key Pad” gate position setting must be between minimum and 95% of maximum as described above. If the green “READY” symbol near the button is not visible then no actuators can be remotely controlled. A “NOT READY” symbol indicates the actuator is not switched to “Remote”, the unit is unpowered, a network problem exists, or there is an internal actuator alarm or fault.

SCADA ALARMS: “GATE SYSTEM FAILED TO MANUAL – NOTIFY OPERATOR.” Indicates the gate system jumped from automatic control to manual control due to gate actuator trouble, network trouble, actuator switch not in “remote”, or level sensor trouble.

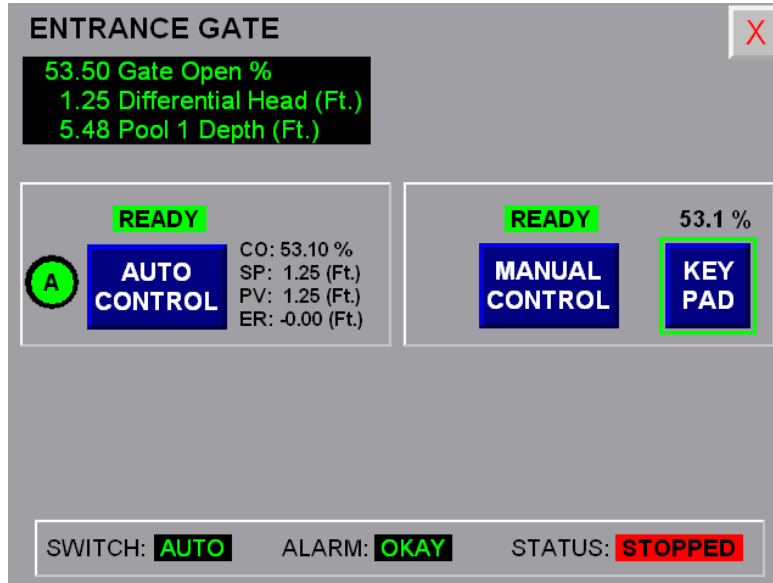


Figure 22 – Entrance Gate Touch Screen

The ALARM HISTORY screen is shown in Figure 23, and is used to acknowledge, clear, and sort system alarms. Note that the “clear all” button will clear all alarms, even if the alarm is still active.

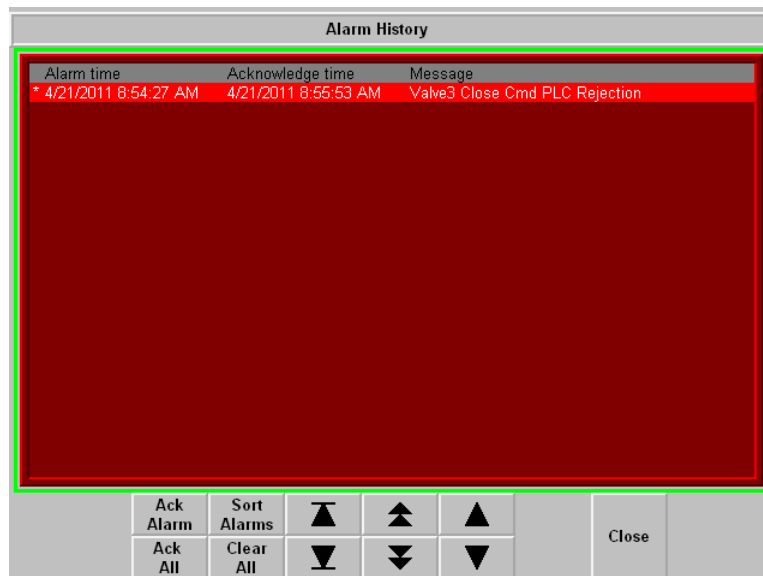


Figure 23 – Alarm History Touch Screen

The ALARM STATUS screen is used to display active alarms and shown in Figure 24. The “reset status” button restarts the accumulated time shown. The touch screen does not have a horn to silence.

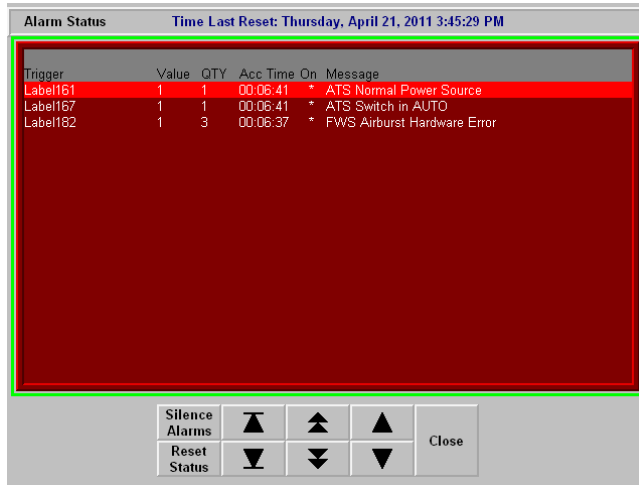


Figure 24 – Alarm Status Touch Screen

The AIRBURST screen is shown in Figure 25. The screen permits a manually triggered cleaning cycle start, and provides general status of the AWS and FWS screen cleaner systems. Any display showing -99.9 indicates sensor trouble. The “Reset Counter” pushbutton will zero the cleaning cycle counter.

“Ready for Auto Operation” should normally be displayed as shown below. If not visible then one or more of the following has occurred.

1. The selector switch on the control cabinet is not set to “Auto.”
2. The air tank pressure is below 95PSI,
3. An airburst cleaning cycle is in-progress.
4. A required sensor is not functioning, as indicated by -99.9 on screen.
5. A PLC network or hardware error exists.

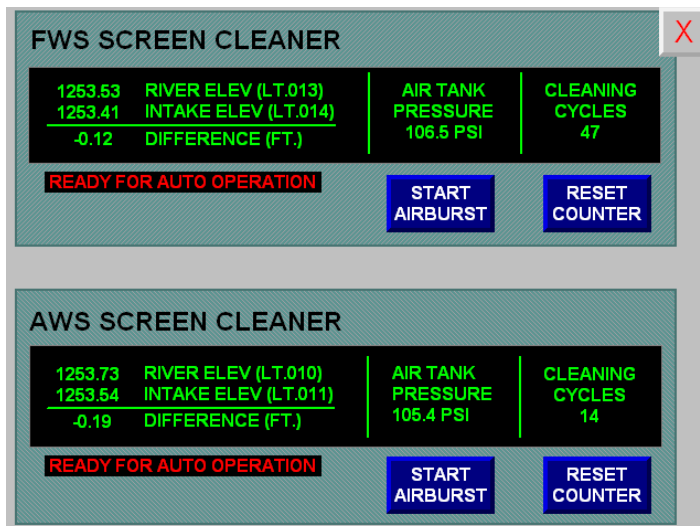


Figure 25 – Airburst Screen Cleaners Touch Screen

The power meters screen is shown in Figure 26. Real time power consumption as measured from the FWS motor control center and AWS motor control center is displayed. Any cell displaying -99.9 indicates meter trouble or loss of communications.

AWS METERING		METER STATUS: OKAY		
POWER	KW	KVAR	KVA	HZ
	85.6	15.6	87.4	60.0
AMPS	L1	L2	L3	%THD
	104.5	109.4	100.2	8.7
VOLTS	L1-L2	L2-L3	L3-L1	%THD
	476.5	479.4	476.0	1.4

FWS METERING		METER STATUS: OKAY		
POWER	KW	KVAR	KVA	HZ
	101.9	20.3	105.2	60.0
AMPS	L1	L2	L3	%THD
	130.4	128.9	121.8	6.7
VOLTS	L1-L2	L2-L3	L3-L1	%THD
	475.1	478.3	474.6	1.5

Figure 26- Power Meter Touch Screen for AWS and FWS Pumps

3.5.7.8. SCADA

LOCATIONS: Cougar and Lookout point Control Rooms

DESCRIPTION:

SCADA screens are used to monitor various hardware and systems of the Fish Collection Facility. The screens include real-time data for the AWS/FWS pump systems, Water level sensors, Diffuser valves, Screen cleaner systems, Fish ladder entrance gate, Primary feeder circuit breakers, Genset/ATS position, AWS/FWS digital power values, and Alarm status.

ALARM STATUS SCREEN:

The FCF Alarm Status screen is shown in Figure 27 and can be used to disable alarms during off-season when the system is not running. Flashing red text indicates a new alarm that has not yet been acknowledged. Solid red text indicates an alarm persists following acknowledgement. Solid black text indicates a normal condition. A disabled alarm will not appear in the alarm summary object located in the header bar, but will still appear on the alarm status screen shown below if active. Purple colored text indicates the alarm status is unknown due to a communications problem. Any loss of communications should be investigated and corrected without delay.

ACK	Time Last	Tagname	Description	CGR & BLU		[Icons]					
✓	10:16:07.828	FCF_FWS_ALM4	FCF FWS STORAGE ROOM DOOR OPEN	ACK ALL	FCF ALARM STATUS						
✓	10:06:15.050	BLUAN1116	BLU DIESEL CALL FOR START	ALM TEST							
✓	10:05:51.050	BLUAN1117	BLUE RIVER HAS 115VAC OUTLET POWER	SUMMARY	SECURITY						
✓	08:10:15.050	PIUAN1113	PI IF RIVER SECURITY ALARM			REMOTE 6/14/2011 10:17:41 AM					

COUGAR FISH TRAP ALARM STATUS			
ENABLED ALARM?	DESCRIPTION: BLACK = OKAY, RED = ALARM, FLASH = NEW	ENABLED ALARM?	DESCRIPTION: BLACK = OKAY, RED = ALARM, FLASH = NEW
YES	FCF VALVE 1A ACTUATOR NETWORK ERROR	YES	FCF AWS AIR TANK PRESSURE VERY LOW
YES	FCF VALVE 1A ACTUATOR INTERNAL ALARM	YES	FCF AWS AIR TANK PRESSURE LOW
YES	FCF VALVE 1A ACTUATOR SW NOT IN REMOTE	YES	FCF AWS SCREEN I/O HARDWARE ERROR
YES	FCF VALVE 1B ACTUATOR NETWORK ERROR	YES	FCF AWS SCREEN LEVEL SENSOR OUT OF RANGE
YES	FCF VALVE 1B ACTUATOR INTERNAL ALARM	YES	FCF AWS SCREEN DIRTY AFTER AUTO CLEAN CY
YES	FCF VALVE 1B ACTUATOR SW NOT IN REMOTE	YES	FCF AWS SCREEN DIRTY FOR EXTENDED PERIOD
YES	FCF VALVE 2 ACTUATOR NETWORK ERROR	YES	FCF AWS INCOMPLETE SEQUENCE
YES	FCF VALVE 2 ACTUATOR INTERNAL ALARM	YES	FCF AWS CLEANING CYCLE ABORTED
YES	FCF VALVE 2 ACTUATOR SW NOT IN REMOTE	YES	FCF AWS SCREEN CLEANER NOT IN AUTO
YES	FCF VALVE 3 ACTUATOR NETWORK ERROR	YES	FCF FWS AIR TANK PRESSURE VERY LOW
YES	FCF VALVE 3 ACTUATOR INTERNAL ALARM	YES	FCF FWS AIR TANK PRESSURE LOW
YES	FCF VALVE 3 ACTUATOR SW NOT IN REMOTE	YES	FCF FWS SCREEN I/O HARDWARE ERROR
YES	FCF VALVE 4 ACTUATOR NETWORK ERROR	YES	FCF FWS SCREEN LEVEL SENSOR OUT OF RANGE
YES	FCF VALVE 4 ACTUATOR INTERNAL ALARM	YES	FCF FWS SCREEN DIRTY AFTER AUTO CLEAN CY
YES	FCF VALVE 4 ACTUATOR SW NOT IN REMOTE	YES	FCF FWS SCREEN DIRTY FOR EXTENDED PERIOD
YES	FCF GATE ACTUATOR NETWORK ERROR	YES	FCF FWS INCOMPLETE SEQUENCE
YES	FCF GATE ACTUATOR INTERNAL ALARM	YES	FCF FWS CLEANING CYCLE ABORTED
YES	FCF GATE ACTUATOR SW NOT IN REMOTE	YES	FCF FWS SCREEN CLEANER NOT IN AUTO
YES	FCF AWS NO PUMPS RUNNING	YES	FCF VALVE SYS FAILED TO MAN. NOTIFY OPER
YES	FCF AWS ELECT ROOM DOOR OPEN	YES	FCF FWS VFD1 NETWORK ERROR
YES	FCF AWS SYS FAILED TO MAN. NOTIFY OPER	YES	FCF FWS VFD1 INTERNAL ALM OR FAULT
YES	FCF FWS LESS THAN TWO PUMPS RUNNING	YES	FCF FWS VFD1 DISABLED OR SW NOT REMOTE
YES	FCF FWS NO PUMPS RUNNING	YES	FCF FWS VFD2 NETWORK ERROR
YES	FCF FWS ELECT ROOM DOOR OPEN	YES	FCF FWS VFD2 INTERNAL ALM OR FAULT
YES	FCF FWS MECH ROOM DOOR OPEN	YES	FCF FWS VFD2 DISABLED OR SW NOT REMOTE
YES	FCF FWS STORAGE ROOM DOOR OPEN	YES	FCF FWS VFD3 NETWORK ERROR
YES	FCF FWS PLC UPS OR BATTERY TROUBLE	YES	FCF FWS VFD3 INTERNAL ALM OR FAULT
YES	FCF FWS 24VDC POWER SUPPLY TROUBLE	YES	FCF FWS VFD3 DISABLED OR SW NOT REMOTE
YES	FCF FWS SYS FAILED TO MAN. NOTIFY OPER	YES	FCF AWS VFD1 NETWORK ERROR
YES	FCF GATE SYS FAILED TO MAN. NOTIFY OPER	YES	FCF AWS VFD1 INTERNAL ALM OR FAULT
YES	FCF GEN E-STOP & SHUNT TRIP	YES	FCF AWS VFD2 NETWORK ERROR
YES	FCF GEN RUNNING	YES	FCF AWS VFD2 INTERNAL ALM OR FAULT
YES	FCF GEN NOT IN AUTO	YES	FCF AWS VFD2 DISABLED OR SW NOT REMOTE
YES	FCF GEN BATTERY CHARGER NO AC PWR	YES	FCF AWS VFD3 NETWORK ERROR
YES	FCF GEN OIL PRESSURE LOW	YES	FCF AWS VFD3 INTERNAL ALM OR FAULT
YES	FCF GEN WATER TEMP HIGH	YES	FCF AWS VFD3 DISABLED OR SW NOT REMOTE
YES	FCF GEN WATER TEMP LOW	YES	FCF PLC OR NETWORK IDLE
YES	FCF GEN LOW FUEL	YES	FCF LEVEL SENSOR LT.002 POOL 1
YES	FCF GEN BATTERY VOLTS LOW	YES	FCF LEVEL SENSOR LT.010 AWS RIVER
YES	FCF GEN BATTERY VOLTS HIGH	YES	FCF LEVEL SENSOR LT.011 AWS INTAKE
YES	FCF GEN TRANSFER SW GENSET	YES	FCF LEVEL SENSOR LT.012 POOL 31
YES	FCF GEN TRANSFER SW NORMAL	YES	FCF LEVEL SENSOR LT.013 FWS RIVER
YES	FCF GEN REMOTE STOP FAILURE	YES	FCF LEVEL SENSOR LT.014 FWS INTAKE
YES	FCF GEN REMOTE START FAILURE	YES	FCF AWS AIR TANK SENSOR PIT002
YES	FCF GEN HMI CMD REJECTED	YES	FCF FWS AIR TANK SENSOR PIT001
YES	FCF ATS SWITCH IN OFF	YES	FCF AWS FLOW SENSOR FIT001
YES	FCF ATS SWITCH IN AUTO	YES	FCF TRANSFORMER PAD HIGH LIQUID LEVEL
YES	FCF ATS INVALID STATE IO ERROR	YES	

Figure 27 – FCS Alarm Status Screen

OVERVIEW SCREEN:

The FCF System Overview screen is shown in Figure 28 and is primarily used to monitor various hardware and systems. The data displayed is similar to the local touch-screen(s), except remote control of the FCF is not permitted. The only remote operation permitted from a SCADA terminal is switching specific systems into AUTOMATIC & MANUAL control modes, and operating XJF1 and XJF2 breakers.

The AWS Diffuser Valves System, AWS Pump System, FWS Pump System, and Entrance Gate System can be remotely placed in MANUAL or returned to AUTO if necessary by pressing the correct blue push-buttons on the screen. Note that individual gate, pump or valve control is not permitted through SCADA and must be done at the Fish Collection Facility.

Circuit breakers XJF1 & XJF2 can be operated from a SCADA terminal by clicking on the rectangular object from the main cougar control screen (not shown). Switching from one circuit breaker to another will disrupt power to the Fish Collection Facility since both circuit breakers cannot be closed simultaneously. Prior to opening XJF1 or XJF2 the Fish Collection Facility control systems should be placed in manual from any touch screen, and all pumps (variable frequency drives) should be stopped. An orderly system shutdown will prevent abrupt removal of power to the equipment while loaded, and

should prevent damage to VFD power electronics. After closing XJ1F or XJ2F all pumps should be restarted from the local touch screen, and all control systems returned to automatic.

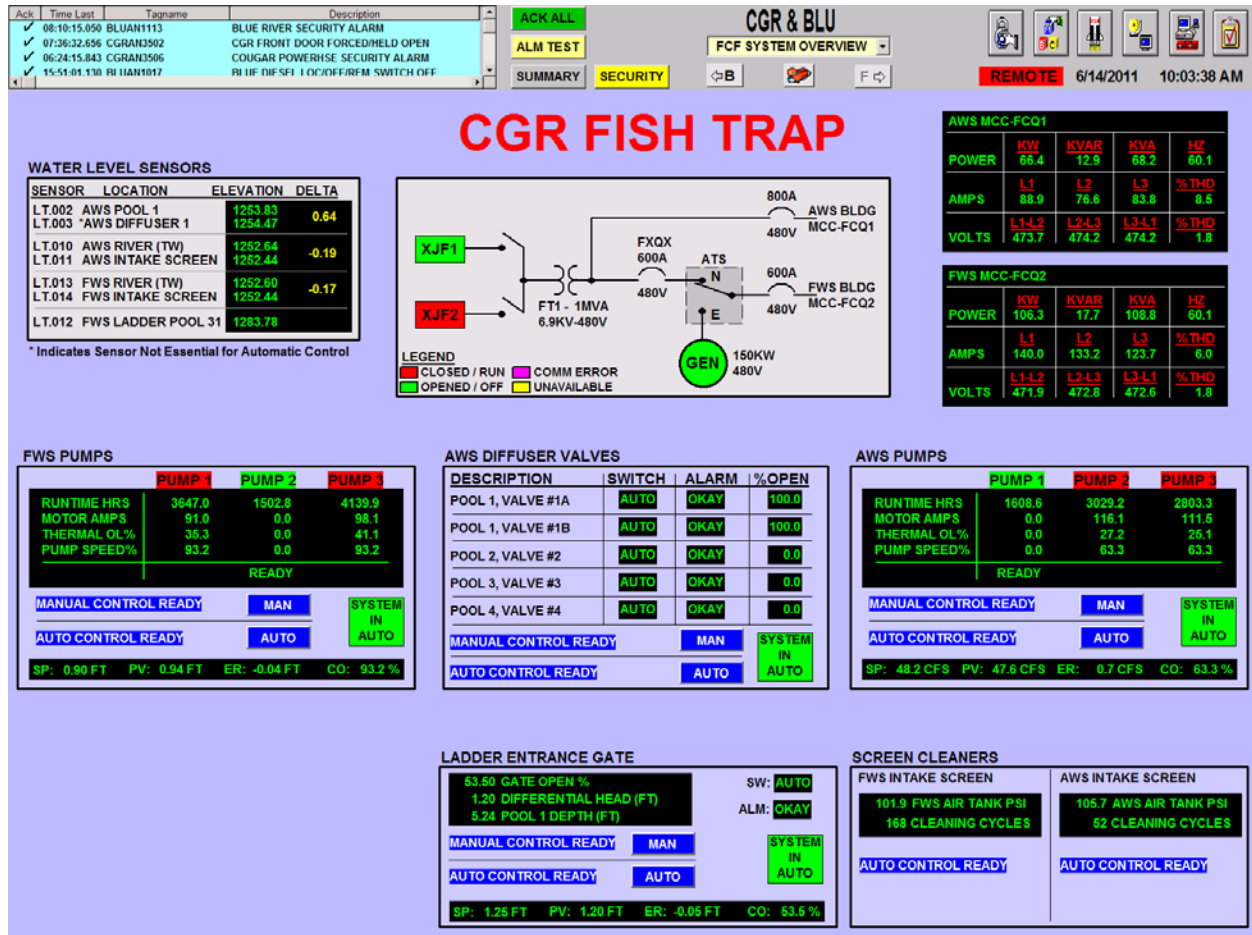


Figure 28 – FCF Overview Screen

POWER METER SCREEN:

The power meter screen for XJ1F and XJF2 feeders is shown in Figure 29. Real time power data and energy consumption is displayed for each feeder.

Hourly energy use for the entire fish collection facility is displayed for BPA reporting. Note that hour number 25 in the table is only used during day light saving time in the fall. Question marks will appear in the table following a SCADA server restart, indicating MWH values are unknown. However; the question marks will automatically change to data following a normal hourly update, or when the update button is pressed.

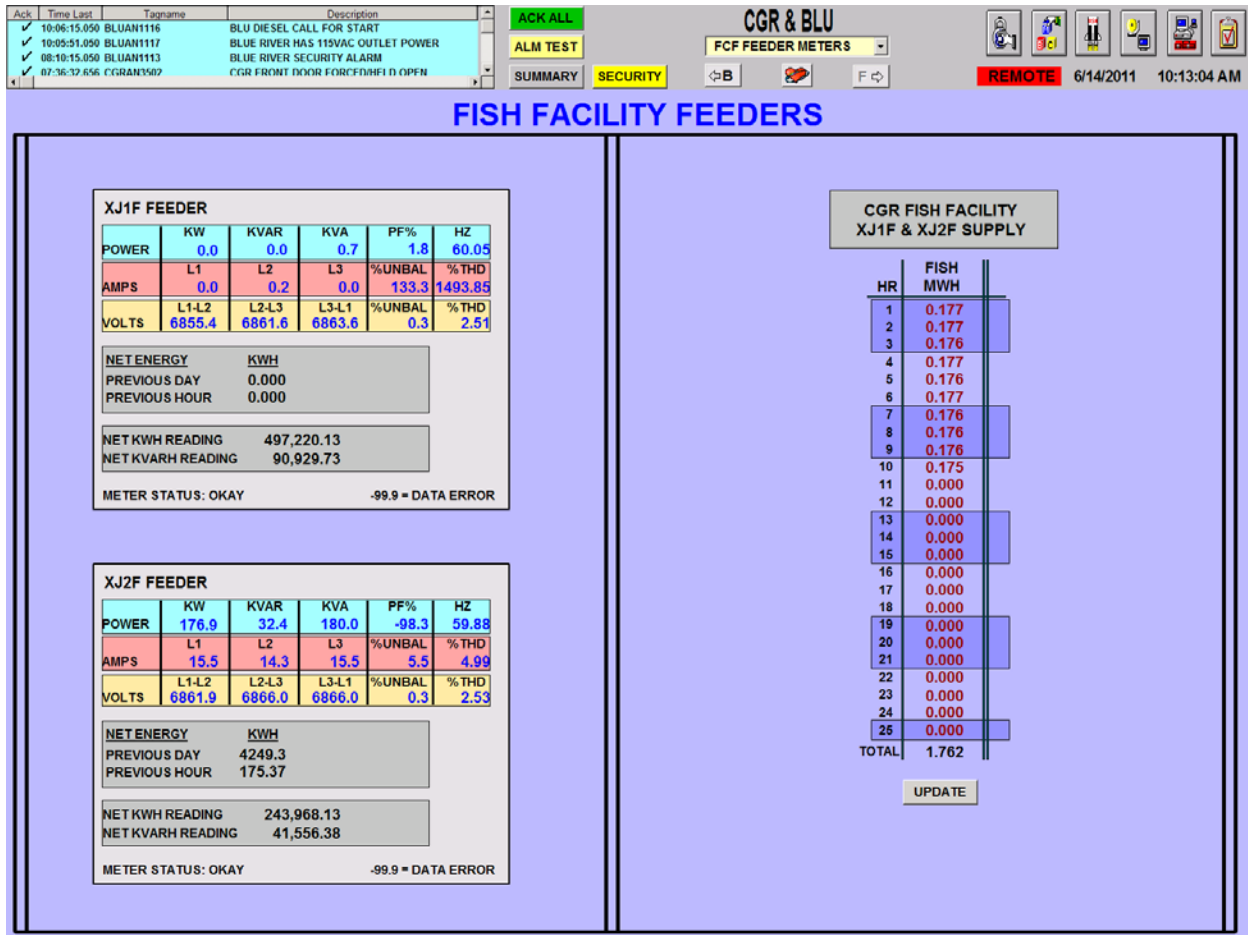


Figure 29 - Power Meter Screen for XJ1F and XJ2F Feeders

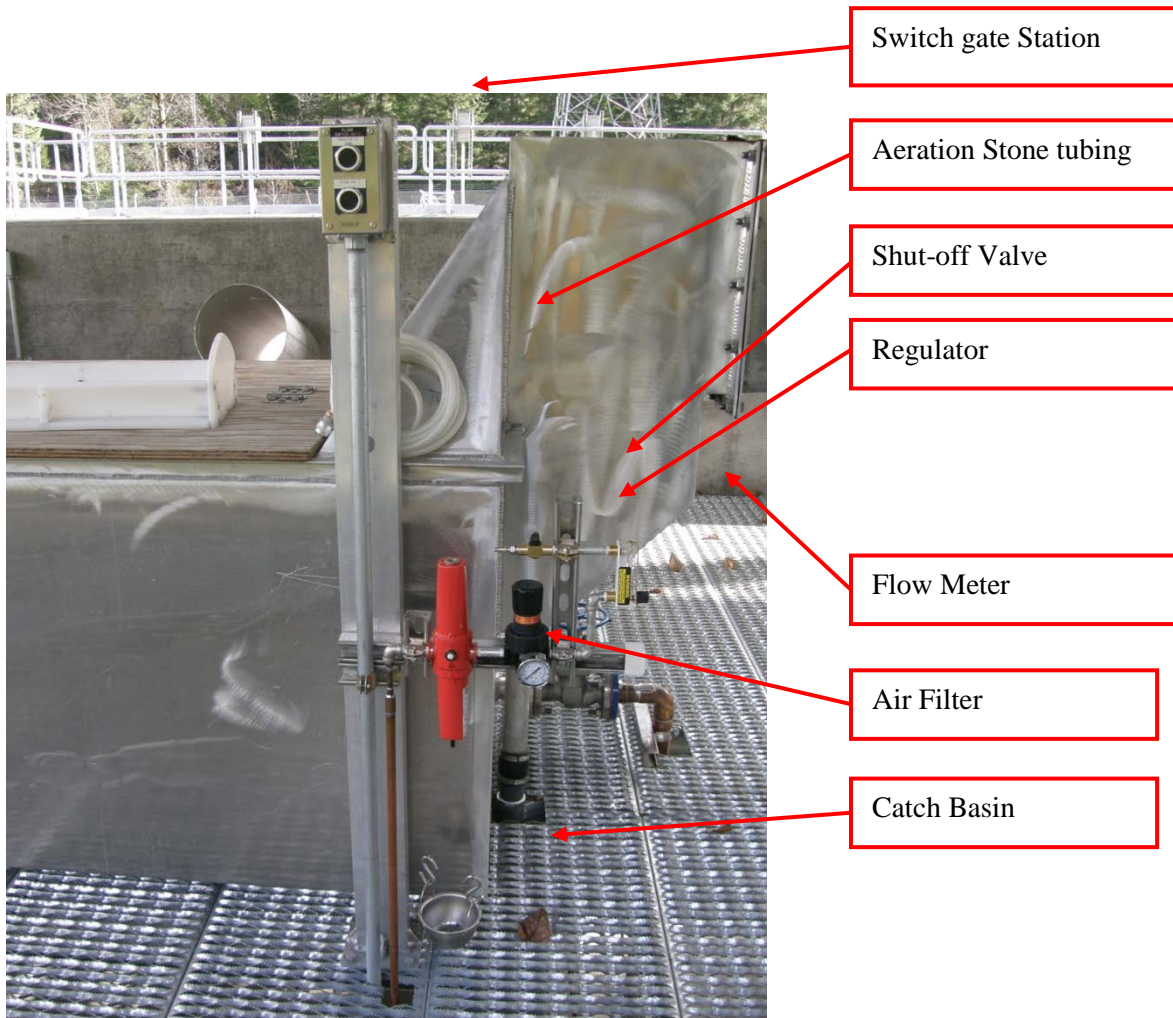
3.5.8. Aeration System

OPERATION:

The aeration system uses filtered compressed air and an aeration stone to oxygenate the water. A biologist will determine the rate of infusion and when to use the system. To operate the system the following items must be done:

- Ensure Shut-off Valve is closed
- Attach the Aeration Stone tubing
- Set the air pressure regulator to the aeration stone's recommended operation pressure
- Ensure the flow meter is at 0 flow
- Open the shut-off valve
- A biologist will determine when it is necessary to use the equipment.

CAUTION: Do not over pressurize the system. Match system pressure to the aeration stone limit.



3.6. TROUBLESHOOTING

3.6.1. AWS Pumps

Problem 1: At AWS pump startup, the AWS pump operation remains at 100% Max RPM, and this problem is caused by the failure of the AWS to properly establish a siphon by failing to sweep residual air out of the AWS Pipeline system. The discharge is essentially open channel flow with air running along the top of the pipeline. With air in the system, the flow meter will not read accurately and will persistently read lower than the PLC target discharge. If the discharge reading fails to reach the target PLC discharge rate, the AWS pumps will run continuously at 100% max RPM in attempt to reach the unattainable target discharge rate. To correct the problem, the siphon in the AWS system must be established.

1. Check to see if any actuators for Air vacuum/ Air Release (AV) Valves for the AWS (not FWS) pumps are open
 - a. If so, close any open AWS air valves.

- b. Observe pump operations, noise should improve back to normal
 - c. If it does not, then Go to Step 2
2. Close all diffuser valves EXCEPT 1-A and 1-B
 - a. Go to touch screen in FWS building
 - i. if necessary, touch screen to bring out of sleep mode
 - b. Go to “Diffuser Valves” screen
 - i. Select “Manual” operation on “diffuser Valve” screen
 - ii. Close all diffuser valves except 1-A and 1-B (if tailwater is lower than 1252 feet, may need to close 1-B as well)
 - iii. Go back to home screen by touching ‘X’
 - c. Go to “AWS Pumps” and observe data
 - i. Are the pumps now running below 100% max RPM and is the AWS discharge within reasonable parameters?
 - ii. IF YES, then return the ‘diffuser valve’ screen and select ‘Automatic’ operation
 - iii. IF NO, then go to step 3
3. Open Air Vacuum (AV) Valves and force air from system
 - a. Open AV valves located on top of each AWS pump can and below the air valve assembly (These are manual valves that are just above grating).
 - b. Rotate valve actuator until the pointer on the unit says “open”
 - c. Close all diffuser valves except Valve 1-A
 - d. Manually increase AWS Pump Speed to 95-99% to force air out of system both vertically through AV or out end of pipe at valve 1-A.
 - e. Observe the top of the vacuum breaker/air release valves while depressing the hexagonal shaft located at the top of the valve and wait for water to come up to the top and rotate valve actuator until the pointer on the valve says “close” (water may not always reach top of air valve in a particular can, but still OK to close valve)
 - f. Repeat operation for all three AV valve/pump combinations
 - g. If the problem persists, Go to Step 4:
 - h.
4. Check for air leaks at all of the piping joints (This may be indicated by water leakage or hissing sounds). The AWS system will be routinely operating under a siphon. If air is allowed into the system, the siphon will break and flow meter will not function properly. If an air leak is detected, the leak needs to be sealed. The pumps will experience long term wear if this problem is not attended to as soon as possible.

Problem 2: AWS Pumps become noisier with gravelly or popping noises (indicating cavitation and/or increased vibrations), imbalanced and high amperage rates observed between the two operating pumps. The cause of this problem is similar to Problem 1, where the siphon in the AWS pipe system has failed and the discharge in the AWS pipes is running open channel (with air running above the water level in the pipe) instead of full flow.

1. Check to see if any actuators for Air vacuum/ Air Release (AV) Valves for the AWS (not FWS) pumps are open
 - a. If so, close any open AWS air valves.

- b. Observe pump operations, noise should improve back to normal
 - c. If it does not, then Go to Step 2
2. Check to see if the pumps and diffuser valves are being operated per 3 (or Table 6)
 - a. If not, correct the operation (Automatic control should follow those tables.)
 - b. If Yes, Check to see if the entrance gate is operating in criteria (pool 1 \geq 5 feet and entrance head between 1.1 -1.4 feet)
 - i. If Not, Correct the entrance gate operation (Automatic control should keep it in the criteria)
 - c. If Yes to all above. there are two choices:
 - i. Interim (quick) adjustment: Try changing pumps. (Please report the specific pump that must be removed from operation to Mechanical Design in Robert Duncan Plaza.)
 - ii. More permanent solution: Go to Step 3 (AWS piping system needs to have trapped air removed from system)
 3. Open Air Vacuum (AV) Valves and force air from system
 - a. Open AV valves located on top of each AWS pump can and below the air valve assembly (These are manual valves that are just above grating).
 - b. Rotate valve actuator until the pointer on the unit says “open”
 - c. Close all diffuser valves except Valve 1-A
 - d. Increase AWS Pump Speed to 95-99% to force air out of system both vertically through AV or out end of pipe at valve 1-A.
 - e. Observe the top of the vacuum breaker/air release valves while depressing the hexagonal shaft located at the top of the valve and wait for water to come up to the top and rotate valve actuator until the pointer on the valve says “close” (water may not always reach top of air valve in a particular can, but still OK to close valve)
 - f. Repeat operation for all three AV valve/pump combinations
 - g. Pump noise will be initially high and then will quiet down within 2- 5 minutes.
 - h. If the problem persists, Go to Step 4:
 4. Check for air leaks at all of the piping joints (This may be indicated by water leakage or hissing sounds). The AWS system will be routinely operating under a siphon. If air is allowed into the system, the siphon will break and the pumps will not operate smoothly. If an air leak is detected, the leak needs to be sealed. The pumps will experience long term wear if this problem is not attended to as soon as possible.

Pumps should resume normal operations without vibrations after these procedures. If problem persists, contact Mechanical Design or Hydraulic Design at Robert Duncan Plaza.

3.6.2. Emergency Generator Charts and Alarms

TROUBLE SHOOTING

To identify faults, you may check the remote alarm panel inside the FWS building and/or remove the access door that covers the control panel inside the generator. On the generator select the faults screen to review any faults. The generator will not start if there is a fault present. Note that certain faults will shunt trip the generator breaker and it must be reclosed after the fault has been cleared.

Emergency Generator Troubleshooting Guide

PROBLEM	CAUSE	CORRECTION
Engine won't crank	<ol style="list-style-type: none"> 1. 15 amp fuse blown. 2. Loose or corroded or defective battery cables. 3. Defective starter contactor. 4. Defective starter motor. 5. Dead or Defective Battery. 6. 5 amp fuse blown. 	<ol style="list-style-type: none"> 1. Replace fuse. 2. Tighten, clean or replace. 3. Replace contactor. 4. Replace starter motor. 5. Remove, change or replace battery. 6. Replace fuse
Engine cranks but won't start	<ol style="list-style-type: none"> 1. Out of fuel. 2. Fuel solenoid (FS) is defective 3. Open wire #14A from Engine Control circuit board. 4. Spark plugs defective. 	<ol style="list-style-type: none"> 1. Replenish fuel 2. Replace solenoid. 3. Reconnect wire. 4. Clean, re-gap or replace plugs.
Engine starts hard, runs rough	<ol style="list-style-type: none"> 1. Flame arrestor (air cleaner) plugged or damaged. 2. Plugged fuel line 3. Defective spark plugs. 4. Fuel pressure incorrect. 	<ol style="list-style-type: none"> 1. Clean or replace as needed 2. Unclog fuel line. 3. Clean, re-gap or replace plugs. 4. Confirm fuel pressure to regulator is as recommended in SPECS
Engine starts then shuts down.	<ol style="list-style-type: none"> 1. Engine oil level is low. 2. Engine is overheated. 3. Defective low oil pressure switch 	<ol style="list-style-type: none"> 1. Check oil and add oil as needed. 2. Check cooling system for leaks. 3. Replace switch.
Engine starts then shuts down.	<ol style="list-style-type: none"> 1. Defective coolant temperature switch 2. Defective control module circuit board 3. Coolant level is low 4. Defective low coolant level switch 	<ol style="list-style-type: none"> 1. Replace switch 2. Replace board. 3. Repair leak - add coolant 4. Replace switch
AUTO/OFF/MANUAL Switch at OFF Engine continues to run	<ol style="list-style-type: none"> 1. Defective AUTO/OFF/MANUAL switch 2. Open/disconnected wire #15A between AUTO/OFF/MANUAL switch and Control Module circuit board. 3. Defective control Module circuit board 	<ol style="list-style-type: none"> 1. Replace switch 2. Reconnect/close wire. 3. Replace board.
No AC output from generator	<ol style="list-style-type: none"> 1. Check main line circuit breaker. 2. Check circuit breaker & fuses. 3. Transfer switch set to NORMAL position 4. Generator internal failure. 5. Thermal circuit breaker open. 	<ol style="list-style-type: none"> 1. Reset ON or CLOSED 2. Reset and replace, if necessary. 3. Set to GENERATOR position. 4. Contact nearest authorized dealer for assistance 5. Auto-reset – Wait 5 min. and attempt restart.

REMOTE ANNUNCIATION

The generator is provided with a remote annunciator located on the front of the PLC cabinet in the FWS electric room. Certain annunciator points are also tied to the PLC/SCADA system for monitoring from Lookout Point.

SCADA ALARMS

Automatic Transfer Switch

- ATS INVALID STATE IO ERROR
- ATS SWITCH IN AUTO
- ATS SWITCH IN OFF

Generator

- GEN TRANSFER SW NORMAL
- GEN TRANSFER SW GENSET
- GEN BATTERY VOLTS HIGH
- GEN BATTERY VOLTS LOW
- GEN LOW FUEL
- GEN WATER TEMP HIGH
- GEN WATER TEMP LOW
- GEN OIL PRESSURE LOW
- GEN BATTERY CHARGER NO AC PWR
- GEN NOT IN AUTO
- GEN RUNNING
- GEN E-STOP & SHUNT TRIP
- GEN HMI CMD REJECTED (Not Used)
- GEN REMOTE START FAILURE (Not Used)
- GEN REMOTE STOP FAILURE (Not Used)

3.6.3. Facility SCADA Alarms

See APPENDIX D-SCADA ALARMS for a table containing facility SCADA alarms with their associated priority level, possible causes, effects, and procedures to follow.

3.7. INTRUSION DETECTION

3.7.1. Security Switches

LOCATIONS: Various structures and rooms throughout facility.

DEVICE IDENTIFICATION: ZS-001, ZS-002, ZS-003, ZS-004

REFERENCE:

- Drawing E-406, sheet 13/54 shows physical location of FWS electric room switch.
- Drawing E-407, sheet 14/54 shows physical location of mechanical & storage room switches.
- Drawing E-409, sheet 16/54 shows physical location of AWS electric room switch.
- Drawing E-704, sheet 32/54 depicts security switch interface to PLC for FWS sorting facility.
- Drawing E-710, sheet 38/54 depicts security switch interface to PLC for AWS electric room.

- Drawing E-718, sheet 46/54 includes security switch schedule for entire project.

DESCRIPTION:

Security switches are installed at each door of the electrical, mechanical, and storage rooms. All switches are connected to the PLC/SCADA system for remote monitoring and historical data logging. Model GE 2507AD switches are installed, which are an industrial wide-gap surface mount type with dual SPDT reed contacts.

4. APPENDICIES

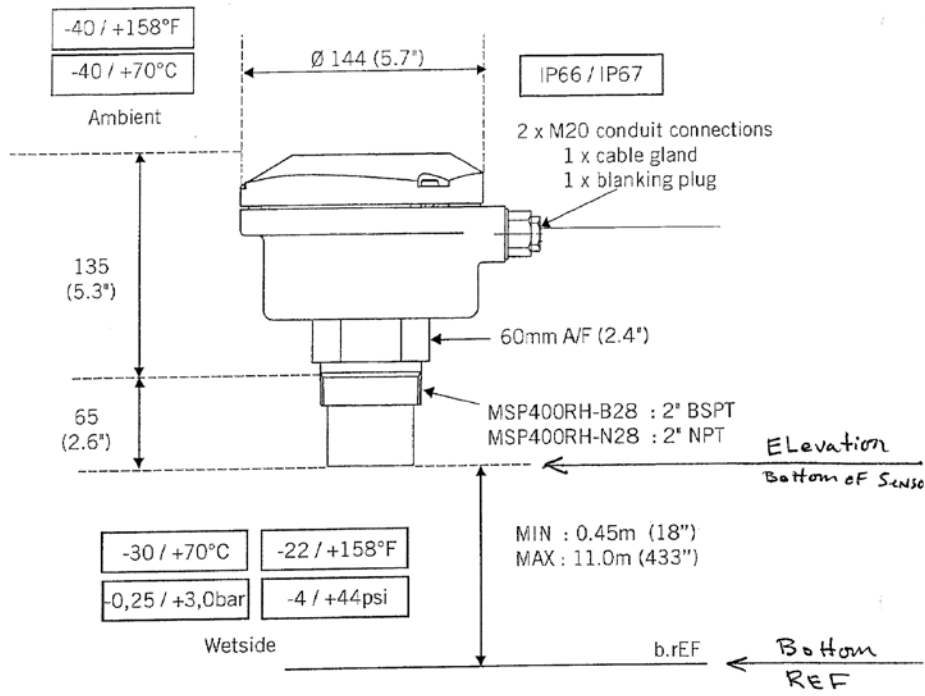
4.1. **APPENDIX A-PLATES**

Note: Plates are contract drawings, not as-constructed drawings, and should be replaced by as-constructed drawings when available.

4.2. APPENDIX B-LOCATION INFORMATION FOR LEVEL TRANSMITTERS

Ultrasonic Level Sensor Locations		Cougar Adult Fish Facility		6-Jun-10
Drawing Label	Description	Elevation @ Nearest Horizontal surface above sensor	Elevation @ Horizontal surface directly below sensor	Elevation @ bottom of sensor
LT-002	Ultrasonic Sensor	1264.58	1248.59	1263.62
LT-003	Ultrasonic Sensor	1264.58	1249.37	1263.62
LT-010	Ultrasonic Sensor	1262.06	River Bottom	1261.58
LT-011	Ultrasonic Sensor	1262.05	1244.42	1260.37
LT-012	Ultrasonic Sensor	1288.54	1278.27	1287.94
LT-013	Ultrasonic Sensor	1256.98	River Bottom	1256.52
LT-014	Ultrasonic Sensor	1257.00	1244.98	1255.95
Additional Elevations		Notes: Weir 31 measurement was taken just down the ladder from LT-012. The pre-sort pool measurement was done at the top of the wall above the pool.		
Top of weir 31	1282.84			
Pre-sort Pool	1288.59			

Ultrasonic Sensor-Mobrey MSP400RH



PROJECT: Cougar Trap and Haul Facility	COMPUTED BY: Michael Crump	DATE: 6/9/2010
SUBJECT: Staff Gages Info	CHECKED BY:	SHT. OF
		PART:

GAGE PLACEMENT CHART			
GAGE NUMBER	GAGE LOCATION	ELEVATION VALUES	
		TOP OF GAGE	BOTTOM OF GAGE
1	POST SORT POOL NO. 1	1278.0	1270.5
2	POST SORT POOL NO. 2	1278.0	1270.5
3	POST SORT POOL NO. 3	1278.0	1270.5
4	PRE SORT POOL	7.0	2.0
5	UPPER FISH LADDER MONOLITH NO. 31	2.0	0.0
6	FISH LADDER POOL # 1 MONOLITH - INTERIOR "East"	1259.0	1250.0
7	FISH LADDER POOL # 1 MONOLITH - INTERIOR "West"	1259.0	1250.0
8	FISH LADDER POOL # 1 MONOLITH - EXTERIOR	1259.0	1250.0
9	FISH LADDER ENTRANCE MONOLITH - EXTERIOR	1259.0	1250.0

NOTES :

1. STAFF GAGES LOCATIONS IN THE VARIOUS PLACES ARE APPROXIMATE AND MAY BE SHIFTED SLIGHTLY FOR BETTER VISIBILITY UP ON GOVERNMENT APPROVAL.
2. NUMBERS SHOWN IN THE DETAILS ARE FOR ILLUSTRATIVE PURPOSES. ACTUAL NUMBERS SHALL BE AS SHOWN IN THE GAGE PLACEMENT CHART.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ACCURATELY PLACING THE STAFF GAGES AT THE ELEVATIONS SHOWN IN THE CHART WITHIN 1/4 INCH PLUS OR MINUS.
4. THE STAFF GAGE IN FISH LADDER POOL #31 SHALL BE PLACED SUCH THAT THE ZERO LEVEL IS AT THE LEVEL OF THE TOP OF THE OVERFLOW WEIR JUST DOWNSTREAM.
5. THE STAFF GAGE IN THE PRE-SORT POOL SHALL BE PLACED SUCH THAT THE 7.0 FT LEVEL IS PLACED THREE FEET DOWN FROM THE TOP OF THE ADJACENT PRE-SORT WALL..

4.3. APPENDIX C- HYDRAULIC DATA

1. Tailwater Rating Curve versus Powerhouse and Total Project Discharge

The following rating curves were developed from a calibrated HEC-RAS model (Ref. Cougar AFCF DDR Appendix H). Figure 30 covers the full range of Project operation between minimum discharge and 100-year Flood. Figure 31 covers the normal range of Project operation from normal minimum Powerhouse discharge (300 cfs) to maximum Powerhouse discharge (1350 cfs). The line in both figures represents Powerhouse discharge when there is no RO discharge. The points off the line represent powerhouse discharge (or no PH discharge) with RO discharge rate indicated by the legend.

Figure 30– Cougar Tailwater Elevation at AFCF Fish ladder Entrance Verses Powerhouse Discharge Rate (Minimum Discharge to 100 year Flood)

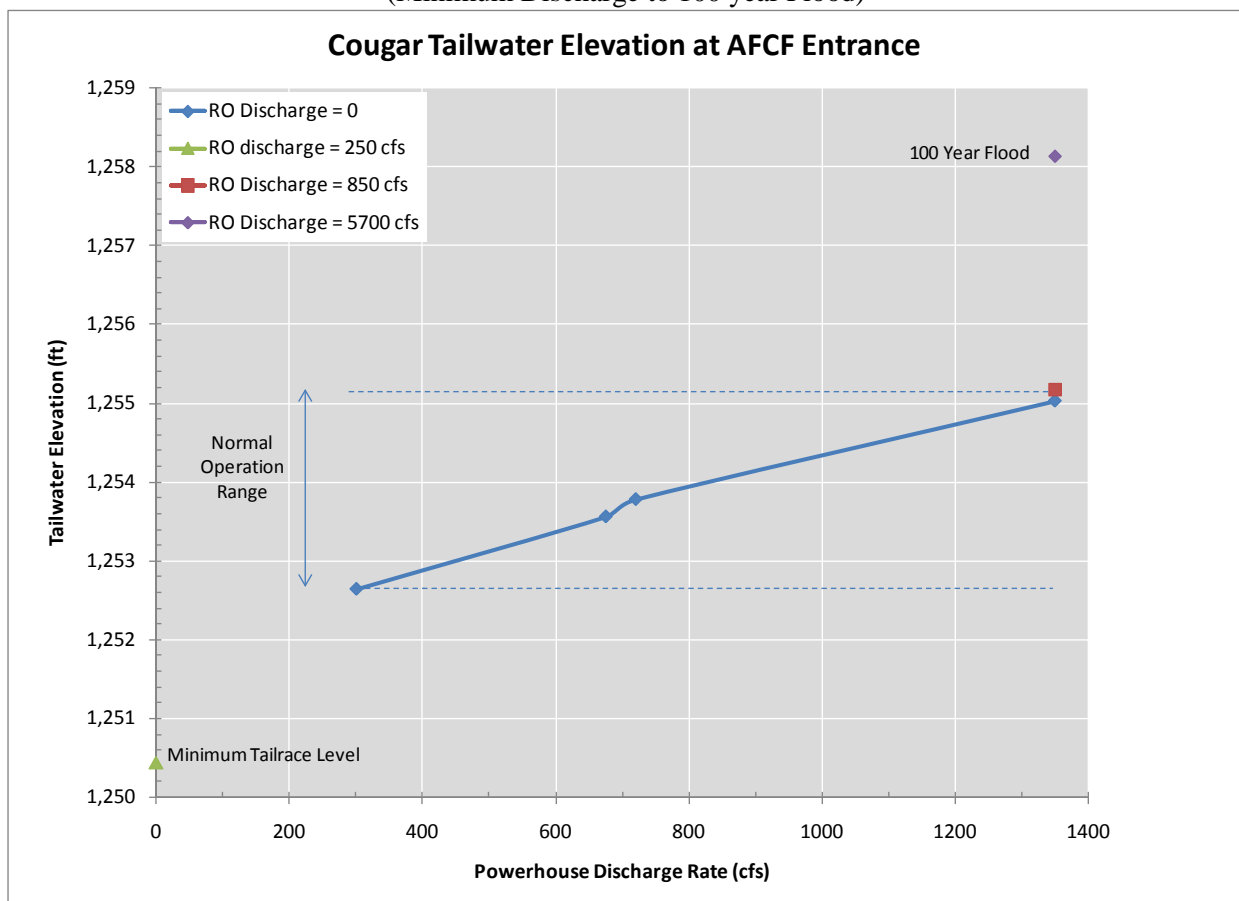


Figure 31 – Cougar Tailwater Elevation at AFCF Fish Ladder Entrance Verses Powerhouse Discharge Rate (Normal Operation Range)

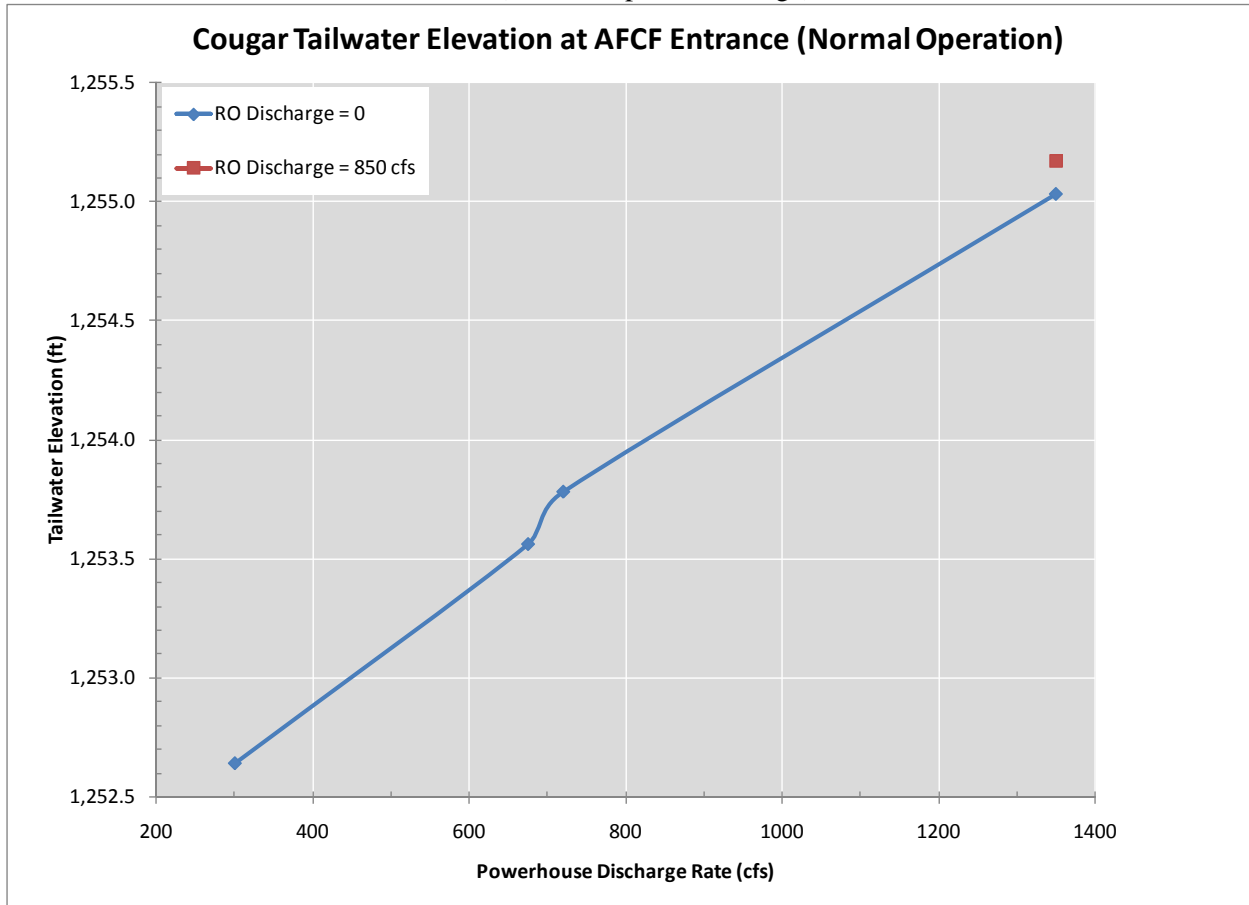


Table 8 – Percent of Maximum RPM for AWS Pumps versus Tailwater Elevation

Table for Percent of Max RPM for AWS pumps vs. Tailwater Elevation

Table 9 - Percent of Maximum RPM for FWS Pumps versus Tailwater Elevation required to meet 1-foot Ladder Head at Pool 31

Table for Percent of Max RPM for FWS vs. Tailwater Elevation Required to meet Ladder Head Criteria at Pool 31

4.4. APPENDIX D-SCADA ALARMS

SCADA ALARMS (CGR & LOP CONTROL ROOMS)
Draft Version 09_02_10

ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
1	FCF_ANL01	FCF LEVEL SENSOR LT.002 POOL 1	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto Entrance Gate Control.	Operate Entrance Gate in Manual.	
2	FCF_ANL09	FCF LEVEL SENSOR LT.010 AWS RIVER	Med	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto Entrance Gate Control. No Auto Diffuser Valve Control. No Auto AWS Airburst Operation.	Operate Entrance Gate in Manual. Operate Diffuser Valves in Manual. Manually activate screen cleaner as req'd.	
3	FCF_ANL10	FCF LEVEL SENSOR LT.011 AWS INTAKE	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto AWS Airburst Operation.	Manually activate screen cleaner as req'd.	
4	FCF_ANL11	FCF LEVEL SENSOR LT.012 POOL 31	Med	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Pump Control.	Manually control water level at Pool #31.	
5	FCF_ANL12	FCF LEVEL SENSOR LT.013 FWS RIVER	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Airburst Operation.	Manually activate screen cleaner as req'd.	
6	FCF_ANL13	FCF LEVEL SENSOR LT.014 FWS INTAKE	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Airburst Operation.	Manually activate screen cleaner as req'd.	
7	FCF_ANL14	FCF AWS AIR TANK SENSOR PIT002	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto AWS Airburst Operation.	Monitor Diff Press across screens & manually activate screen cleaner as req'd.	
8	FCF_ANL15	FCF FWS AIR TANK SENSOR PIT001	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto FWS Airburst Operation.	Monitor Diff Press across screens & manually activate screen cleaner as req'd.	
9	FCF_ANL16	FCF AWS FLOW SENSOR FIT001	Low	Device Trouble, No Power, Broken Wire	-99.9 Displayed at SCADA PC. No Auto AWS Pump Control.	Manually control AWS Pumps	
10	FCF_ACT0_ALM0	FCF VALVE 1A ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
11	FCF_ACT0_ALM1	FCF VALVE 1A ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
12	FCF_ACT0_ALM2	FCF VALVE 1A ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
13	FCF_ACT1_ALM0	FCF VALVE 1B ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
14	FCF_ACT1_ALM1	FCF VALVE 1B ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
15	FCF_ACT1_ALM2	FCF VALVE 1B ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
16	FCF_ACT2_ALM0	FCF VALVE 2 ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
17	FCF_ACT2_ALM1	FCF VALVE 2 ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
18	FCF_ACT2_ALM2	FCF VALVE 2 ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
19	FCF_ACT3_ALM0	FCF VALVE 3 ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
20	FCF_ACT3_ALM1	FCF VALVE 3 ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
21	FCF_ACT3_ALM2	FCF VALVE 3 ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
22	FCF_ACT4_ALM0	FCF VALVE 4 ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
23	FCF_ACT4_ALM1	FCF VALVE 4 ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
24	FCF_ACT4_ALM2	FCF VALVE 4 ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Diffuser Valve System Control	Operate All Diffuser Valves in Manual.	
25	FCF_ACT5_ALM0	FCF GATE ACTUATOR NETWORK ERROR	Low	Device Trouble, No Power, Broken Cable	No Auto Entrance Gate System Control	Operate Entrance Gate in Manual.	
26	FCF_ACT5_ALM1	FCF GATE ACTUATOR INTERNAL ALARM	Low	Device Trouble	No Auto Entrance Gate System Control	Operate Entrance Gate in Manual.	
27	FCF_ACT5_ALM2	FCF GATE ACTUATOR SW NOT IN REMOTE	Low	Device Switch in Local or Stop Position	No Auto Entrance Gate System Control	Operate Entrance Gate in Manual.	
28	FCF_GATE_ALM0	FCF GATE SYS FAILED TO MAN. NOTIFY OPER	Med	Entrance Gate System jumped from Auto to Manual control due to Equipment trouble, Network trouble, or Gate Actuator Switch not in Remote.	No Automatic Entrance Gate Control.	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	
29	FCF_AWS_ALM1	FCF AWS NO PUMPS RUNNING	Med	No AWS Power, Drive Trouble, Pump Trouble, VFD(s) manually turned off or switched to MAN, AWS pump system manually stopped.	Insufficient tailwater attraction flow at fish ladder entrance.	If power available, trouble shoot system ASAP.	
30	FCF_AWS_ALM7	FCF AWS SYS FAILED TO MAN. NOTIFY OPER	Med	AWS Pump System jumped from Auto to Manual control due to equipment trouble, network trouble or any AWS VFD being operated in Man.	No Automatic AWS Pump Control	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	

Appendix D

ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
31	FCF_FWS_ALM0	FCF FWS LESS THAN TWO PUMPS RUNNING	High	No normal power to FWS, Drive Trouble, Pump Trouble, VFD(s) manually turned off or switched to MAN, emergency Generator supplying FWS Electrical Power.	With single FWS pump operating fish cannot ascend ladder or enter pre-sort pool.	If emergency genset supplying FWS power then condition normal. However; if normal power will be unavailable for 24 plus hours, fish should be evacuated from ladder & presort pool. Situation should be monitored very closely to ensure VFD's auto start following transition to/from genset power.	
32	FCF_FWS_ALM1	FCF FWS NO PUMPS RUNNING	High	No FWS Power, Drive Trouble, Pump Trouble, VFD(s) manually turned off or switched to MAN, FWS pump system manually stopped.	Without any FWS pumps operating, water will quickly drain from ladder, stranding fish.	Fish evacuation from pre-sort pool and ladder should occur immediately. Loss of normal power supply should start emergency genet. Trouble shoot system prior to attempting restart.	
33	FCF_FWS_ALM7	FCF FWS SYS FAILED TO MAN. NOTIFY OPER	Med	FWS Pump System jumped from Auto to Manual control due to equipment trouble, network trouble or any FWS VFD being operated in Man.	No Automatic FWS Pump Control	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	
34	FCF_GEN_ALM01	FCF GEN E-STOP & SHUNT TRIP	High	Emergency Generator Emergency Stop Activated with Breaker Shunt Trip	Emergency Generator Not Available	Trouble shoot emergency generator and return to service immediately.	
35	FCF_GEN_ALM02	FCF GEN RUNNING	High	Emergency Generator Running	Generator only powers 1 FWS Pump	Restore to Normal Power Supply ASAP	
36	FCF_GEN_ALM03	FCF GEN NOT IN AUTO	High	Emergency Generator Not In Automatic	Emergency Generator Not Available	Return to Automatic Immediately	
37	FCF_GEN_ALM04	FCF GEN BATTERY CHARGER NO AC PWR	Med	Emergency Genset Alarm	Genset Battery Charger not Charging	Troubleshoot ASAP.	
38	FCF_GEN_ALM05	FCF GEN OIL PRESSURE LOW	Med	Emergency Genset Alarm	Possible Equipment Damage if Operated	Troubleshoot ASAP.	
39	FCF_GEN_ALM06	FCF GEN WATER TEMP HIGH	Med	Emergency Genset Alarm	Possible Equipment Damage if Operated	Troubleshoot ASAP.	
40	FCF_GEN_ALM07	FCF GEN WATER TEMP LOW	Med	Emergency Genset Alarm	Possible Equipment Damage if Operated	Troubleshoot ASAP.	
41	FCF_GEN_ALM08	FCF GEN LOW FUEL	Med	Emergency Genset Alarm	Insufficient Fuel	Troubleshoot ASAP.	
42	FCF_GEN_ALM09	FCF GEN BATTERY VOLTS LOW	Med	Emergency Genset Alarm	Genset may not start or operate.	Troubleshoot ASAP.	
43	FCF_GEN_ALM10	FCF GEN BATTERY VOLTS HIGH	Med	Emergency Genset Alarm	Genset may not start or operate.	Troubleshoot ASAP.	
44	FCF_GEN_ALM11	FCF GEN TRANSFER SW GENSET	High	ATS Transfer to Genset Power Source	Limited Power from Genset Supply	Restore to Normal Power Supply ASAP	
45	FCF_GEN_ALM12	FCF GEN TRANSFER SW NORMAL	Low	ATS Transfer to Normal Power Source	None	None	
46	FCF_GEN_ALM13	FCF GEN REMOTE STOP FAILURE	Low	Genset Remote Stop Cmd Failed	N/A	Feature Not Used	
47	FCF_GEN_ALM14	FCF GEN REMOTE START FAILURE	Low	Genset Remote Start Cmd Failed	N/A	Feature Not Used	
48	FCF_GEN_ALM15	FCF GEN HMI CMD REJECTED	Low	Genset Remote Cmd Rejected by PLC	N/A	Feature Not Used	
49	FCF_GEN_ALM16	FCF ATS SWITCH IN OFF	High	Automatic Transfer Switched to OFF	ATS will not transfer to genset upon power loss	Place ATS Switch in AUTO position.	
50	FCF_GEN_ALM17	FCF ATS SWITCH IN AUTO	Low	Automatic Transfer Switched to AUTO	Normal	None	
51	FCF_GEN_ALM18	FCF ATS INVALID STATE IO ERROR	High	ATS Selector SW not in valid state	Unknown	Troubleshoot ASAP.	
52	FCF_SCA_ALM00	FCF AWS AIR TANK PRESSURE VERY LOW	Med	AWS Tank Pressure Below 75psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	
53	FCF_SCA_ALM01	FCF AWS AIR TANK PRESSURE LOW	Low	AWS Tank Pressure Below 95psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	
54	FCF_SCA_ALM02	FCF AWS SCREEN I/O HARDWARE ERROR	Low	AWS PLC Hardware Error	No Automatic Screen Cleaner Operation.	Troubleshoot AWS Remote I/O Cabinet.	
55	FCF_SCA_ALM03	FCF AWS SCREEN LEVEL SENSOR OUT OF RANGE	Med	Sensor LT.010 < 1250 or > 1259.0 Ft.	No Automatic Screen Cleaner Operation.	Troubleshoot LT.010 ASAP	
56	FCF_SCA_ALM04	FCF AWS SCREEN DIRTY AFTER AUTO CLEAN CY	Low	Differential head across screens > 0.6 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
57	FCF_SCA_ALM05	FCF AWS SCREEN DIRTY FOR EXTENDED PERIOD	Med	Differential head across screens > 1.0 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
58	FCF_SCA_ALM06	FCF AWS INCOMPLETE SEQUENCE	Low	Airburst Cycle could not complete due to low air pressure.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
59	FCF_SCA_ALM07	FCF AWS CLEANING CYCLE ABORTED	Low	SS moved from Auto during cleaning cycle. Hardware error occurred during cycle. Lt.010 out of range during cycle. Incomplete Sequence Occurred.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
60	FCF_SCA_ALM08	FCF AWS SCREEN CLEANER NOT IN AUTO	Med	Cabinet Selector Switch not in AUTO.	Airburst system not cleaning screens.	Return to Automatic Immediately	
61	FCF_SCF_ALM00	FCF FWS AIR TANK PRESSURE VERY LOW	Med	FWS Tank Pressure Below 75psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	

ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
62	FCF_SCF_ALM01	FCF FWS AIR TANK PRESSURE LOW	Low	FWS Tank Pressure Below 95psig	No Automatic Screen Cleaner Operation. Powerhouse Air System possibly drained.	Troubleshoot ASAP.	
63	FCF_SCF_ALM02	FCF FWS SCREEN I/O HARDWARE ERROR	Low	FWS PLC Hardware Error	No Automatic Screen Cleaner Operation.	Troubleshoot AWS Remote I/O Cabinet.	
64	FCF_SCF_ALM03	FCF FWS SCREEN LEVEL SENSOR OUT OF RANGE	Med	Sensor LT.013 < 1250 or > 1259.0 Ft.	No Automatic Screen Cleaner Operation.	Troubleshoot LT.013 ASAP	
65	FCF_SCF_ALM04	FCF FWS SCREEN DIRTY AFTER AUTO CLEAN CY	Low	Differential head across screens > 0.6 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
66	FCF_SCF_ALM05	FCF FWS SCREEN DIRTY FOR EXTENDED PERIOD	Med	Differential head across screens > 1.0 ft.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
67	FCF_SCF_ALM06	FCF FWS INCOMPLETE SEQUENCE	Low	Airburst Cycle could not complete due to low air pressure.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
68	FCF_SCF_ALM07	FCF FWS CLEANING CYCLE ABORTED	Low	SS moved from Auto during cleaning cycle. Hardware error occurred during cycle. Lt.013 out of range during cycle. Incomplete Sequence Occurred.	Airburst system not cleaning screens.	Troubleshoot ASAP.	
69	FCF_SCF_ALM08	FCF FWS SCREEN CLEANER NOT IN AUTO	Med	Cabinet Selector Switch not in AUTO.	Airburst system not cleaning screens.	Return to Automatic Immediately	
70	FCF_VALV_ALM0	FCF VALVE SYS FAILED TO MAN. NOTIFY OPER	Med	Entrance Gate System jumped from Auto to Manual control due to Equipment trouble, Network trouble, or Gate Actuator Switch not in Remote.	No Automatic Entrance Gate Control.	Document alarms causing jump to manual. System can be returned to Auto via touch screen or SCADA only when READY FOR AUTO indicator visible..	
71	FCF_VFD1_ALM0	FCF FWS VFD1 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
72	FCF_VFD1_ALM1	FCF FWS VFD1 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
73	FCF_VFD1_ALM2	FCF FWS VFD1 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
74	FCF_VFD2_ALM0	FCF FWS VFD2 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
75	FCF_VFD2_ALM1	FCF FWS VFD2 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
76	FCF_VFD2_ALM2	FCF FWS VFD2 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
77	FCF_VFD3_ALM0	FCF FWS VFD3 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
78	FCF_VFD3_ALM1	FCF FWS VFD3 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
79	FCF_VFD3_ALM2	FCF FWS VFD3 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
80	FCF_VFD4_ALM0	FCF AWS VFD1 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
81	FCF_VFD4_ALM1	FCF AWS VFD1 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
82	FCF_VFD4_ALM2	FCF AWS VFD1 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
83	FCF_VFD5_ALM0	FCF AWS VFD2 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
84	FCF_VFD5_ALM1	FCF AWS VFD2 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
85	FCF_VFD5_ALM2	FCF AWS VFD2 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
86	FCF_VFD6_ALM0	FCF AWS VFD3 NETWORK ERROR	Med	VFD Comm Trouble, No Power, Broken Cable	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	

Appendix D

ITEM	SCADA TAG	SCADA DESCRIPTION	PRIORITY	POSSIBLE CAUSE	EFFECT	PROCEDURE	CONTACT PERSON
87	FCF_VFD6_ALM1	FCF AWS VFD3 INTERNAL ALM OR FAULT	Med	VFD Internal Fault or Alarm. Includes Remote Disconnect SW, Pump Moisture Sensor, Pump Thermal SW, and Phase Monitor.	Pump not available or ready to operate automatically.	Troubleshoot ASAP. Maintain one backup pump at all times.	
88	FCF_VFD6_ALM2	FCF AWS VFD3 DISABLED OR SW NOT REMOTE	Med	VFD Not Enabled or Switch not in AUTO.	Pump not available or ready to operate automatically.	Return VFD to Automatic Immediately	
89	FCF_SYS_ALM0	FCF PLC OR NETWORK IDLE	High	Controller Logic Not Executing &/or Device Network Idle.	No Systems Operating in Auto and no data is updating. System is not being controlled.	Return PLC to RUN mode immediately. Operate system in manual until PLC operational.	
90	FCF_FWS_ALM2	FCF FWS ELECT ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
91	FCF_FWS_ALM3	FCF FWS MECH ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
92	FCF_FWS_ALM4	FCF FWS STORAGE ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
93	FCF_AWS_ALM2	FCF AWS ELECT ROOM DOOR OPEN	Low	Door Not Fully Closed.	None	None	
94	FCF_FWS_ALM5	FCF FWS PLC UPS OR BATTERY TROUBLE	Med	UPS Trouble or Failed Battery	System Controller & Network Switched not protected from loss of supply power.	Trouble shoot UPS ASAP.	
95	FCF_FWS_ALM6	FCF FWS 24VDC POWER SUPPLY TROUBLE	Med	Loss of FWS Cabinet PS-4 Power Supply	No Ethernet switch power. No Remote monitoring of system. No FWS Security, ATS, or UPS monitoring. No FWS Screen Cleaner Control.	Trouble shoot Power Supply ASAP.	

4.5. APPENDIX E-OPERATOR WALKTHROUGH POWERPOINT

4.6. APPENDIX F-DEVICENET CONFIGURATION AND EQUIPEMENT PARAMETERS