City of Tacoma
Department of Public Utilities, Light Division (dba Tacoma Power)
Cowlitz River Project
FERC No. 2016

Settlement Agreement, License Article 7

FINAL
Hatchery Complex Remodel and Phase-In Plan

I. INTRODUCTION

This Hatchery Complex Remodel and Phase-In Plan is prepared in compliance with the requirements of Settlement Agreement License Article 7 of the Cowlitz River Project FERC license. The intent of this Plan is to be used as a guide throughout the development of design and construction details for remodel of the Cowlitz hatcheries. This Plan presents remodel concepts and components that will require further design in order to construct and implement.

1.1 COWLITZ PROJECT DESCRIPTION

The Cowlitz Project (FERC No. 2016) is Tacoma Power's largest electricity generating facility and is located on the Cowlitz River in Lewis County, Washington. The Project consists of two dams, the Mayfield Dam at river mile (RM) 52 and Mossyrock Dam, upstream at RM 65 (see map in Appendix No. 1 – Existing Cowlitz Hatchery Complex). In addition to the project generating electricity and providing flood control, Tacoma operates 3 major parks, manages approximately 14,000 acres of wildlife lands, and owns and funds operation of the Cowlitz Salmon Hatchery (RM 50) and the Cowlitz Trout Hatchery (RM 42). The Barrier Dam, associated with the Cowlitz Salmon Hatchery, is located at RM 49.6. The original 50-year license for the Cowlitz Project was issued on December 28, 1951. A new thirty-five year license was issued March 13, 2003, and became effective on July 18, 2003. (See Map in Appendix No. 1 – Existing Cowlitz Hatchery Complex).

The Mayfield development completed in 1963 includes a 250'-high, 850'-long, concrete arch and gravity dam that impounds Mayfield Lake, which has a maximum surface area of 2,250 acres. In addition to the Cowlitz River, inflows from the Tilton River also contribute to Mayfield Lake, which supports public and private recreational facilities. An 854'-long power tunnel passes through the right abutment of the dam and terminates at a concrete forebay structure. Four penstocks continue from the forebay structure to the four generating units, which have an installed capacity of 162-megawatts (MW).

The Mossyrock development completed in 1968 includes a 606'-high double curvature concrete arch dam that creates Riffe Lake, a 23-mile long, 11,830-acre reservoir with 52 miles of shoreline. Riffe Lake supports several parks and other recreational facilities. Three penstocks, varying in length from 248 to 285 feet, extend down to the powerhouse, which is adjacent to the base of the dam. The powerhouse contains two generating units with room for a third, and has a total installed capacity of 300 MW. Transmission lines link the Mossyrock and Mayfield developments.

1.2 EXISTING COWLITZ HATCHERY COMPLEX

Tacoma Power has contracted with the Washington Department of Fish and Wildlife (WDFW) to operate their Cowlitz hatcheries through 2008 and provides on-site maintenance support. The Cowlitz Salmon Hatchery and Trout Hatchery are located approximately 2 miles and 10 miles downstream of the Mayfield Dam, respectively. The hatcheries were constructed from 1967-1969 to sustain the Cowlitz River salmon and steelhead runs as determined by the counts at Mayfield Dam since 1962 and from earlier fisheries studies conducted by the state and federal fishery agencies. At that time, the peak or average annual numbers of salmon recorded at Mayfield was 17,300 spring chinook, 8,300 fall chinook, and 25,000 coho. To return these numbers of fish to the river required a salmon hatchery with an incubation facility that was capable to produce 19 million migrants, consisting of 4 million spring chinook, 10 million fall chinook, and 5 million coho for the annual release into the Cowlitz River.

The Trout Hatchery annually released 650,000 steelhead and 600,000 sea-run cutthroat. The two hatcheries originally combined for a total annual release of approximately 800,000 lbs./year.

The existing Cowlitz Salmon Hatchery (CSH) consists of a fish barrier across the Cowlitz River, fish ladder, transportation channel, fish separation facilities, thirty six 21'w x 100'l x 10'd (structural dimensions) ponds, eighteen early rearing kettles, river water pumping plant, well water supply, pollution abatement ponds, residences, hatchery building with visitor facility, vehicle maintenance and garage building, and other miscellaneous structures (see site plan and flow diagrams in Appendix 1 – Existing Cowlitz Hatchery Complex). Based on present production, only five of the original fourteen dual-use, 21'w x 100'l ponds are required for adult holding. The Salmon Hatchery is challenged by multiple disease issues, as currently configured, and requires extensive labor to maintain and operate.

The existing Cowlitz Trout Hatchery (CTH) consists of a fish barrier across Blue Creek, a fish ladder, fish separation facilities, holding and rearing ponds, a pumping plant on Cowlitz River, well water supply, an ozone water treatment plant, pollution abatement ponds, residences, a hatchery building with visitor facility, a vehicle maintenance and garage building, and other miscellaneous structures (see site plan and flow diagrams in Appendix 1 – Existing Cowlitz Hatchery Complex). The trout hatchery was originally designed in 1966 with construction in 1967. Since the original construction, some features designed into the complex are no longer being used with others being added to meet operational requirements.

1.3 FERC LICENSE

Appendix A

Settlement Agreement License Articles

Article 7. Hatchery Complex Remodel and Phase-In Plan

> *"Within 18 months of license issuance the Licensee shall submit a plan for the Hatchery Complex remodel. The plan shall include: a) hatchery design drawings that include decreased rearing densities and innovative practices to replicate historic out-migration size and timing; b) plans for construction scheduling; c) provision for hatchery water supply that maximizes water from existing groundwater wells and, if necessary, provides for treatment of up to 10 cfs additional river water; and d) a plan for gradual transition to innovative rearing practices. The Licensee shall prepare the plan in collaboration with the Fisheries Technical Committee provided for in the August 2000 Settlement Agreement, or if the Settlement Agreement has become void, with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Washington Department of Fish and Wildlife and Washington Department of Ecology (referred to as "the FTC or agencies"). When a draft plan has been prepared, it shall be provided to all affected agencies and Tribes for 30-day review and comment. The Licensee shall include with the final plan documentation of consultation and copies of comments and recommendations, and specific descriptions of how the final plan accommodates all comments and recommendations. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based upon Project-specific information. The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the plan, including any changes required by the Commission. Following Commission approval, the plan becomes a requirement of the license, enforceable by the Commission."*

1.4 FUTURE OF COWLITZ HATCHERY COMPLEX

Article 5 of the Cowlitz Settlement Agreement (CSA) states, *"The remodeled hatchery complex will accommodate a range of possible production levels, up to 800,000 pounds, and the current upper bound permitted by the ESA of 771,500 pounds. The total production level within the remodeled hatchery complex will not exceed 650,000 pounds per year for all stocks until and unless a decision has been made pursuant to Article 3 to not construct volitional upstream passage during the remaining term of the license, at which time hatchery production may be considered as part of the plan to expend the funds in the escrow account for the purposes of protecting and promoting recovery of listed stocks."*

The Hatchery Complex Remodel designed by Tacoma Power will accommodate an 800,000 lb./year production level using the same rearing densities as practiced for 650,000 lb./year production by converting some of the new adult holding ponds into dual-use for juvenile rearing. If future decisions lead to increasing production beyond 650,000 lb./year, Tacoma Power will pursue an increase in river water, withdrawal right(s) if necessary and as required to maintain acceptable flow criteria. A reconfigured Salmon Hatchery is proposed that will consist of thirty six 10'w x 200'l x 8'd (approximate structural dimensions) juvenile ponds and nine 15'w x 75'l adult holding ponds. There are no proposed changes to the Trout Hatchery pond layout or its existing practice of reusing river water for juvenile rearing. As proposed, the existing water supply pumps and piping at both hatcheries will accommodate 800,000 lb./year production using Hatchery Operations Contract (HOC) flow criteria. However, to stay within existing water rights, the 800,000 lb./year scenario analyzed was based on lower flow per fish than HOC criteria for the fall chinook and coho species only. The higher flow indices are within Integrated Hatchery Operations Team (IHOT) guidelines and HOC flow criteria are still used for spring chinook, cutthroat, and all steelhead. Appendix 2– Article 5: 800,000 Lb./Year Bioprogramming includes total water supply and space details.

Article 6 of the CSA charged the Cowlitz Fisheries Technical Committee (FTC) with developing a plan for the production of hatchery fish, the use of the hatcheries, and a fisheries management system for the purpose of restoring and recovering wild, indigenous salmonid runs in the Cowlitz River to harvestable levels. Tacoma Power began working on this plan in September 2000 and the FTC began work on the Fish Hatchery Management Plan (FHMP) in January 2001. The final FHMP, with Tacoma's response to comments, was filed with the Federal Energy Regulatory Commission (FERC) on August 18, 2004. The current draft of the FHMP specifies the following annual smolt production goals: 967,000 spring chinook, 4,000,000 fall chinook, 2,310,000 coho, 450,000 late winter steelhead, 200,000 early winter steelhead, 450,000 summer steelhead and 50,000 sea run cutthroat trout. These quantities will yield a total annual production of approximately 570,000 lb./year (For a further breakdown of FHMP production levels, including total water supply and space details, see data in Appendix No. 3 – Article 6: 570,000 Lb./Year FHMP Bioprogramming).

Article 7 of the CSA requires Tacoma Power to submit a plan for the Hatchery Complex remodel that includes the following:

"a. hatchery design drawings that include decreased rearing densities and innovative practices to replicate historic out-migration size and timing."

The conceptual drawings submitted with this Cowlitz Hatchery Complex Remodel Plan will accommodate a mix of species at site-specific densities developed at the Cowlitz Complex to a total of 650,000 pounds of annual production (For a further breakdown of this production level, see total water supply and space details in Appendix No. 4 – Article 5: 650,000 Lb./Year Bioprogramming).

The final draft of the FHMP proposes an annual production limitation of 570,000 pounds necessary to meet the benchmark values, provide fish for harvest, and to accommodate the rebuilding of the hatchery complex. These production levels are lower than the existing production of 682,400 Lb./Year and the construction of the new adult holding ponds has freed more space for juvenile rearing. The new juvenile pond design at Salmon Hatchery will also improve rearing conditions by reducing the exposure to diseases and converting from a circular flow pattern to a flow-through design, with no change in site-specific flow indices.

The additional innovative practices proposed include replicated tests of juvenile salmonids grown in raceways that are partially shaded, volitional release from ponds, non-traditional feeding methods and growth programming, incubation improvements, and target release sizes that replicate historic out-migrant sizes and timing. Historical data sets are available from studies conducted at the Mayfield dam site prior to construction in the 1950's, and from studies conducted in Mayfield Lake after dam construction. In addition, data sets from downstream migrants collected at the Cowlitz Falls Fish Collection Facility yield current size and migration timing.

"b. plans for construction scheduling"

During construction, fish will be reared at the Cowlitz Salmon and Trout hatcheries with the intent to maintain current fish production levels. A phased construction schedule has been developed for the Cowlitz hatcheries to make this possible. To be able to maintain current fish production, it is critical that construction proceeds as scheduled and not be delayed.

There are five (5) major construction phases for the Cowlitz Salmon Hatchery (CSH) which is interdependent with timing of hatchery operations. In addition to these phases, there are several construction components at the salmon and trout hatcheries that are not interdependent with phasing or operations. These components may be constructed before, during or after the construction phases. The five major construction phases are as follows:

1. Construction of the new adult holding and handling facilities
2. Modifications to the adult separation facility
3. Modifications to the main hatchery building, including new provisions for incubation and early rearing
4. Demolition and rebuild of the north juvenile rearing ponds
5. Demolition and rebuild of the south juvenile rearing ponds

The phased construction schedule is designed to maintain fish production and timed to work with the hatchery schedule for fish spawning, egg incubation, juvenile rearing, pond demand, release of smolts, and adults returning to the hatchery. For a breakdown of the proposed construction schedule, see Appendix No. 5 – Plans for Construction.

All data in Appendix 5 – Plans for Construction is based on existing production levels. Currently, the Cowlitz Salmon Hatchery raises and annually releases the following salmon stocks into the Cowlitz River above the Barrier Dam:

- 3,200,000 coho at 15 fish per pound released in late May
- 5,000,000 fall chinook at 80 fish per pound released in early June
- 1,267,000 spring chinook:
  - 255,000 at 5 fish per pound released in April
  - 457,000 at 8 fish per pound released in April (includes 55,000 that are sent to Friends of Cowlitz net pens at approx. 22 fish per pound in September or October)
  - 255,000 at 16 fish per pound released in April
  - 300,000 sub-yearlings at 110 fish per pound released in May (upper Cowlitz River basin only)

To maintain current salmon production it is critical that the pond construction in phases 4 and 5, be completed while demand for ponds is low. This period starts in the spring after the smolts have been released and ends in late fall when the spring chinook and fall chinook fry emerge and are ready to pond. The solution for managing these ponds has been developed and is detailed in Appendix No. 5 – Plans for Construction. The pond management proposed requires that the phased construction plan be implemented and constructed as shown. Work must start as scheduled or there will be a one-year delay due to the construction timing required to maintain current production levels. Note: There are no construction or timing constraints that affect fish production at the Cowlitz Trout Hatchery.

Assuming the FERC approves the Plan in a timely manner, Tacoma Power could endeavor to finalize hatchery rebuild drawings, obtain required permits, and award a contract to modify and reconstruct the Cowlitz Hatchery Complex by fall of 2006. The construction period is currently assumed to be 15 months, therefore the hatchery rebuild could be completed by January 2008.

"c. provision for hatchery water supply that maximizes water from existing groundwater wells and, if necessary, provides for treatment of up to 10 cfs additional river water; and"

Through extensive studies conducted since 2002, Tacoma Power has determined that existing well water systems at the Cowlitz Salmon and Trout hatcheries are not adequate to reliably serve desired hatchery demands (e.g. incubation of all species, early rearing of steelhead and spring chinook) as currently configured. The existing well water systems are poorly controlled with a significant amount of pumped water overflowing to river without ever being used. Tacoma Power's plan to maximize available well water plus provide additional treated water includes the following:

- Improved control of existing well water supply systems to minimize overflow to drains. This will include variable frequency drive(s) on primary well pump(s) and level control in head tank(s) and sump(s) to yield the following:

  Salmon Hatchery

  The existing C wells should be able to reliably supply 3.5 cfs as it has been confirmed that they are recharged by the river and this is their design capacity. The 1-3 cfs available from the existing PW wells is less reliable as they appear to be primarily recharged by rainfall. However, the PW wells may be kept in reserve to ensure a reliable well water supply of 4+ cfs during peak demand periods.

  Trout Hatchery

  The existing South wells have been confirmed to be recharged by rainfall only and, thus, the combined total capacity of approximately 5.5 cfs is finite. Improved control of this resource will extend operation during dry periods.

- Move all incubation, early rearing, and adult holding of steelhead and cutthroat to the Cowlitz Salmon Hatchery. This consolidation will improve the reliability of the water supply for these functions and allow the South wells to be dedicated to the supply of the Trout Hatchery's F-series ponds when the late winter steelhead are initially ponded.
- At Salmon Hatchery's denitrogen tower, any excess well water available is proposed to be additive to two adult holding ponds to provide a pathogen-light water supply. This may reduce formalin treatments required for sensitive stocks such as spring chinook. Note: Incubation and early rearing are the priority for this resource so an excess would occur only after these demands have been satisfied.
- Recirculation loops that are proposed as an innovative rearing practice (see Section IV – 4.3 and Section VI – 6.1F) will reduce demand for well water as they are estimated to require no more than 10% makeup water.
- An additional 2 cfs treated water supply (e.g. ozone, UV) has been identified as required to reliably serve the initial months of spring chinook early rearing to 200 fish/lb. This additional flow requirement was based on an equal combination of 4 fish/pound and 8 fish/pound release sizes for this species (see Treated Water Demand Table at end of

Appendix 4 – Article 5: 650,000 Lb./Year Bioprogramming). Depending on future research results, operating experience with recirculation systems, and the availability of well water, Tacoma Power may need to install additional water treatment capacity in the future to satisfy the 200 fish/lb. criteria for spring chinook early rearing.

"d. a plan for gradual transition to innovative rearing practices."

The innovative rearing practices described later will need to be evaluated in the rebuilt hatcheries. In addition, the production component of the hatchery program will need to be maintained. Therefore, a series of replicated experiments using tagged or marked and tagged fish will be used to evaluate the benefits of using innovative practices and aid in the transition to innovative rearing. One measure of success will be an improvement in the contribution rate of adults produced from hatchery releases to common property fisheries and to escapement.

The initial replicated experiments could commence as early as 2008, however, results will not be available for one or more generations depending upon the species tested. Program evaluation may not be completed until 2013, although returns and contributions of younger age classes will give indications of the degree of success for the innovative practices implemented prior to that year.

1.5 BIOPROGRAMMING

The objective of the bioprogamming model for the Cowlitz hatcheries is to make recommendations for the full use of flow and space in the rebuilt hatcheries. The model evaluates reference standards such as Integrated Hatchery Operations Team (IHOT) and existing site-specific criteria to maximize the production of quality spring chinook, fall chinook, coho, steelhead, and cutthroat in the proposed hatcheries. Model runs have been completed with most rearing lots at or below the reference standards (collectively referred to as criteria).

The theoretical basis for a hatchery bioprogramming model is that as fish grow larger the demand for food, space and oxygen increases. Oxygen and feed consumption are related to growth and are influenced by water temperature. In order to meet the density and flow criteria established for the Cowlitz hatcheries, each rearing vessel population must be managed throughout their growth cycle to prevent exceedance of reference standards at any time. Fish management may be accomplished by splitting populations and by increasing the volume of the rearing vessel. Model runs yield the weekly volume requirement and the total number of hatchery rearing vessels needed for proper fish management. The Salmon Hatchery layout presented in this plan has been validated as able to meet production requirements through bioprogramming model runs. Bioprogramming is discussed in further detail, including calculation methods, in Appendix 2 – Article 5: 800,000 lb./year Bioprogramming.

The combined design production assumed for both the Cowlitz Salmon Hatchery (CSH) and the Cowlitz Trout Hatchery (CTH) is to raise 650,000 pounds of fish per year. To reach 650,000 pounds per year production, the proposed hatchery complex remodel was bioprogrammed for a juvenile planting goal of 2,700,000 coho, 967,000 spring chinook, 4,600,000 fall chinook, 520,000 summer steelhead, 300,000 early winter steelhead, 500,000 late winter steelhead, and 60,000 sea-run cutthroat. For further breakdown of this production goal, including total water supply and space requirements, see Appendix No. 4 – Article 5: 650,000 Lbs./Year Bioprogramming.

1.6 CONSULTATION

The Cowlitz Fisheries Technical Committee (FTC) was sent 10%, 50%, and 100% complete versions of this Plan in 2004. WDFW submitted the only written comments on Plan dated November 23, 2004 (see Tacoma Power's response in Appendix 6 – Consultation). Tacoma

Power will continue to develop design and construction details with interested agencies in 2005 and 2006. This Plan will be used as a guide throughout on-going collaboration on design and during remodel of both Cowlitz hatcheries.

This Hatchery Complex Plan summarizes the consensus reached thus far on the primary remodel components, responds to comments received, includes total water supply and space details, and provides a construction schedule. Production of fish in raceways can be limited by several factors, such as low dissolved oxygen (DO), the accumulation of metabolic waste products, high temperature, disease, predation, unfavorable water chemistry, feeding rate, and fish behavior. The remodel components selected address these factors as well as provide for innovative rearing practices and increased availability of treated water.

II. CONTEMPORARY HATCHERY DESIGN PRACTICES

Through extensive consultation with FishPro (see Appendix No. 6 - Consultation), a list of contemporary hatchery design practices and specifications were created. The following listing provided the appropriate guidelines to develop a conceptual layout for the Salmon Hatchery (see drawings in Appendix No. 7 – Salmon Hatchery Remodel Components) and establishes design parameters that will be followed throughout the Hatchery Complex Remodel:

A. Per FishPro, minimum outflow dissolved oxygen level of 7 mg/L for all ponds.

B. FishPro recommends a minimum pond bottom slope of 0.5% towards the outlet.

C. Where possible, the ratio of tube center-line radius of curvature to tube diameter (R/D) for fish transfer tubes shall be greater than or equal to 5 (e.g. long radius bends preferred). The minimum inside width (or diameter) of the distribution flumes shall be 15 inches per NOAA guidelines.

D. Screen openings for juveniles shall not exceed 0.25 inches in the narrow direction and the screen material shall provide a minimum of 40% open area.

E. Per WDFW's current standards, screen openings for fry shall not exceed:

- O.125" for salmon smaller than 200 fish per pound in raceways.
- 0.0625" initially with a change to 0.125" at 1,000 fish per pound for steelhead and cutthroat in starter troughs.

F. Per FishPro and WDFW, physical separation of a minimum of 20 feet between the adult and juvenile ponds is desired to reduce the risk of disease transfer (see Appendix No. 6 - Consultation). The adult drain water is kept downstream of juvenile and fry drain outlets to prevent potential for cross-contamination. Additionally, measures are taken to avoid disease transfer through water supply system.

G. Minimize handling (e.g. crowding, pumping, etc.) of fry and juvenile to reduce stress unless required by innovative rearing or marking practices.

H. FishPro recommends that juvenile/fry ponds with vertical sidewalls have at least 18 inches of freeboard and a minimum and maximum water depth of 3 feet and 6 feet, respectively. In addition, FishPro recommended a minimum space of 3 feet between the screen(s) and stop log guides and a minimum stop log width of 3 feet at the drain end of the pond.

I. Any holding areas used for smolt collection (e.g. transfer or marking via pumps) will have a minimum water depth of 2.5 feet. Water depth in kettle areas may exceed 6 feet during normal operations.

J. Adult holding ponds shall have the following characteristics:

1. Vertical sidewalls.
2. A minimum of 5 feet of jump protection above water surface (freeboard plus perimeter fence height) and a minimum water depth of 5 feet.
3. Minimize any audio or visual disturbance of adult fish by visitors and hatchery personnel. Sprinkler systems utilized for each pond to keep fish calm.
4. Crowding will be towards a grated upwell water supply in pond floor.

K. Low pollution discharge with total suspended solids controlled and monitored in compliance with NPDES discharge requirements.

L. Exclusionary bird netting over juvenile raceways with a clear span underneath and structurally designed to accommodate snow and/or ice loading.

M. Walkway access along all ponds with entrance gates at end of ponds.

N. Incubation in double-stack, vertical incubators with 16-trays.

III. ADDITIONAL PARAMETERS THAT IMPACT HATCHERY COMPLEX REMODEL

This section lists hatchery parameters that are desirable due to site-specific concerns rather than contemporary hatchery design practices. Tacoma Power's Hatchery Complex Remodel and Phase-In Plan endeavored to satisfy the following preferences to the maximum extent possible within project constraints:

A. WDFW preference for 10' wide juvenile ponds to provide program flexibility, ability to evaluate innovative rearing practices, and ease of cleaning when using vacuum methods.

B. WDFW preference for Hatchery Operations Contract (HOC) density and flow criteria to be applied to the new design of adult and juvenile ponds for all production levels rather than criteria from FishPro or the Integrated Hatchery Operations Team (IHOT). The Cowlitz HOC criteria is as follows:

1. Maximum density and minimum flow indices for each species in adult holding ponds:

	Raceway Density (lbs./cu. ft.)	Raceway Loading (lbs./gpm)
Spring Chinook:	1.88	3.5
Fall Chinook:	2.14	3.5
Coho:	2.0	4.0
Steelhead:	2.0	4.0
Cutthroat:	3.2	4.0

2. Maximum density and target flow indices for each species in juvenile ponds:

	Raceway Density (lbs./cu. ft./inch)	Raceway Loading (lbs./gpm/inch)
Spring Chinook:	0.1	0.6
Fall Chinook:	0.2	1.0
Coho:	0.3	1.0
Steelhead:	0.25	1.0
Cutthroat:	0.25	1.0

3. Maximum density for juvenile trout in the 5 acre lakes of 0.005 lbs./cu. ft./inch.

C. Minimize flow areas that can be plugged w/debris (inlet/outlet screens, manifolds, etc.).

D. Utilize existing concrete walls within ring header to provide for quick phase-in of complex remodel and reduced stress on hatchery fish during construction.

E. Improved monitoring and control of water flow to each pond. A design goal is to maintain even flow distribution at all pond inlets regardless of how many ponds are operating (frequent flow adjustment of operating ponds should not be required due to changes in overall hatchery demand). The target pressure at all supply manifolds will be approximately 10 feet (4 psi). It is also desirable for flow monitoring and control to be at same end of pond to facilitate easy adjustment.

F. When possible, maintain high velocities in all water supply pipes (above 2 fps) to reduce risk of sand deposits plugging lines. Where practical, provide means to sluice or flush sand out of all piping used.

G. Improved ergonomics and reduced handling for the majority of repetitive tasks (i.e. sorting, handling, cleaning, feeding, crowding, marking, maintenance, etc.). A design goal is to reduce the stress on the fish as well as hatchery personnel. A smooth sequence of operations from beginning (adult sorting) to end (volitional release of smolts) is desirable.

H. Provide flexibility and improved ergonomics for all adult handling operations.

I. Minimize disease issues by maximizing well and/or treated water available for incubation, starter troughs, and early rearing of spring chinook up to 200 fish/pound in raceways. When these demands are satisfied, it is desired that any excess well water available be supplied to one or two adult holding ponds.

J. Juvenile collection area(s) located at downstream end of ponds (e.g. kettles) is desired by on-site WDFW staff.

K. Provision for centralized monitoring, alarm, control, and/or fish management system(s).

L. Worker access to pond screens and stop logs for their installation and removal.

M. New feed handling and dry storage to facilitate improved ergonomics for workers and allow for more detailed feed inventory.

N. All visitor facilities kept on West-side of Salmon Hatchery to minimize interference with normal hatchery operations.

Most of these are discussed in more detail within the following sections.

IV. INNOVATIVE REARING PRACTICES

Tacoma Power proposes to implement and evaluate the innovative rearing practices presented below to varying degrees, depending upon success, at both hatcheries. The overall cumulative effect of all innovative measures compared to a baseline will be useful for those practices that do not allow for cost-effective, individual evaluation.
This Plan proposes these rearing practices but the FHMP will define how and when they will be used as well as specifying the appropriate measure of success. Tacoma Power is now working on the Adaptive Management Plan called for in the FHMP which will provide more specifics on the evaluation method(s) and implementation schedule(s) for these innovative rearing practices.

4.1 VOLITIONAL RELEASE OF ALL JUVENILES

All ponds at the Salmon Hatchery will be constructed to allow volitional release of juveniles via removal of outlet drain screen and appropriate stop logs. The outlet design is proposed to be similar to the existing Bonneville Power Administration (BPA) stress relief ponds at the CSH.

The fish and drain water will flow in the existing 4' wide drain channel and a new 48" drain pipe to a location immediately below the Barrier Dam when volitional release of juveniles is occurring. At all times, it is planned to have approximately half of the hatchery drain water discharge into the river above the Barrier Dam to maintain desired fish ladder attraction.

Tacoma Power also proposes outlet improvements to utilized lake(s) at Trout Hatchery to provide volitional release of juvenile trout from these areas (see some details in Appendix 8 – Trout Hatchery Remodel Components and Concepts).

4.2 COVER/SHADE

One of the goals of the remodel is a more natural environment in the ponds to closely mimic nature. After reviewing the methods researched to date, Tacoma Power proposes that pond cover and shading techniques could be expected to yield the best rearing improvements. The initial evaluation(s) proposed include camouflage net, PVC lattice, and/or wood logs that are allowed to float on the surface of pond(s).

4.3 ADJUSTED TIMING OF RELEASE

Hatchery programming will establish the release timing of the juvenile fish produced at the CSH, however, information on the timing of naturally-produced out-migrants of the same species collected at Cowlitz Falls and Mayfield dams will be used to mimic the out-migration period. Weekly transport flows will be incorporated into the Mayfield Dam flow regime to assist in juvenile fish out-migration from March through June annually.

Regulation of incubation water supply temperature via a new cooling/heating system will also be used to control egg incubation rate and subsequent time of ponding. The proposed chiller or heat pump system will recirculate and retreat chilled water with makeup water provided by groundwater system(s). To provide desired release timing, ponding times will be spread out. Initial rearing of fry in starter troughs, feeding adjustments, and/or the sectioning ability of ponds may be used to assist with timing of release. The goal of these measures is to allow the fish to be released over a longer period of time that is more consistent with natural out-migration.

4.4 FEEDING METHODS

There are several innovative systems possible for feed delivery (e.g. demand feeders, distribution via blowers). Tacoma Power proposes that the most promising method(s) be researched. Different feed types and/or adjustments to feed schedule are also proposed to be evaluated.

4.5 INCUBATION IMPROVEMENTS

The current practice of treating eggs daily with formalin may be determined to be unnecessary after new recirculation systems are installed under the Hatchery Complex Remodel. Tacoma Power proposes that the reduction (i.e. weekly) and/or elimination of chemical treatment during incubation be fully evaluated for its effects on rearing.

At some hatcheries, incubation in jars has significantly improved egg survival compared to hatching in trays. At Mokulemne Fish Hatchery in California, all incubation is currently done in jars. Tacoma Power proposes that this be evaluated for several species of fish. This incubation approach appears to have the following advantages:

A. Does not require formalin treatment and delivery system.

B. Easier transfer of fry to starter troughs including volitional release. Less egg handling.
C. Potential for higher success rate.
D. More conducive to large egg batches (50,000 eggs/jar).
E. Starter troughs that would accommodate incubation jars are proposed in this Plan.

V. CONSOLIDATION OF ADULT HOLDING, INCUBATION, AND STARTER TROUGHS

Tacoma Power proposes that adult holding, incubation, and starter troughs for steelhead and cutthroat be added to Cowlitz Salmon Hatchery (CSH). A separate incubation and starter trough area, 3 adult holding ponds, and the required handling facilities (i.e. sorting, spawning, truck loading, egg treatment, etc.) would be added to allow trout activities to occur solely at CSH. Under this proposal, steelhead and cutthroat fry would be transported to Cowlitz Trout Hatchery (CTH) in tanker trucks when they are at 200 fish/lb. and are ready for planting in A, B, C, or F series ponds. The CTH would be utilized solely for the juvenile rearing of trout. See FishPro, October 5, 2004, comments in Appendix No. 6 - Consultation.

The following benefits of this proposal have been identified:

- Adult sorting, holding, handling, and trucking all consolidated to one location. CTH does not have established truck loading or sorting infrastructure provided by CSH's separation facility. Allows capital improvements that impact adult fish to be focused which should yield superior designs.
- This is a step towards consolidating all formalin use to the Salmon Hatchery which is a remodel goal.
- Less handling of adults as they would no longer need to be trucked from CSH to CTH.
- More pathogen-free water available at Trout Hatchery which could be used to improve juvenile rearing (i.e. late winter steelhead). When not necessary for improved rearing, the available well water could be a backup for ozone plant or a supplement that reduces treated water requirements.
- New starter troughs can be deeper than shallow troughs currently used at Trout Hatchery which may provide improved rearing.
- Reduced labor and O&M costs. Efficient use of manpower by combining similar work activities.
- Allows for restoration of Blue Creek.
- Allows for single development of modern facilities to include new water treatment system and temperature control of incubation and starter trough water supplies.

VI. REMODEL COMPONENTS FOR THE COWLITZ SALMON HATCHERY

A Salmon Hatchery conceptual layout has been prepared including three sectional views of ponds and two separation facility views so that the impact of each of the proposed remodel components may be best considered (see Appendix No. 7 – Salmon Hatchery Remodel Components). This section summarizes the consensus reached with WDFW and identifies the remodel components that have been selected for the Salmon Hatchery.

6.1 WATER SUPPLY SYSTEMS

A. Variable Frequency Drives for Pump Stations

1. Juvenile and Adult Water Supply

To maintain a constant water supply pressure, minimize overflow to river, and capture available energy savings, Tacoma Power may propose that a medium-voltage variable frequency drive (VFD) be installed on one of the 600 hp primary pumps. The primary goal of the pump control will be to maintain the water level in the denitrogen tower tank that provides for the best water distribution characteristics at ponds. As adult and juvenile pond(s) are shut off or turned on, this VFD will attempt to reduce impact on operating ponds so that the flow adjustments required at pond(s) are minimized.

2. Fish Ladder Water Supply

VFD(s) are proposed for the 200 hp fish ladder pump(s) which are operated by 480V motors. Similar to No. 1 above, the new VFD(s) would minimize overflow to river at fish ladder, improve control options, and maximize energy savings.

3. Well Water Supply

Improved regulation of the existing well field and any new treated water supply is proposed to be accomplished via installation of VFD(s) that maintain water level set point(s) in denitrogen tower supply sump(s). This improvement will prevent excessive overflow of well or treated water back to river and maximize the pathogen-free water available for hatchery uses.

Tacoma Power plans to analyze the benefits and necessity of combining these water sources in a common denitrogen tower (i.e. Total Dissolved Gas regulation, redundancy, etc.).

B. Water Distribution Systems

The following remodel components have been identified for the water distribution systems:

1. Primary Ring Header

The conceptual layout proposed (see Appendix No. 7 – Salmon Hatchery Remodel Components) utilizes the entire 48" ring header during peak water supply operations and will maintain the ability to isolate half of the ring header during periods of reduced demand. By focusing all flow through half of the ring header during off peak periods, pipe velocities will be increased and sand deposits should be minimized. A new 48" valve may be installed on West side of ring header to allow its further division. Note: It may be possible to annually flush any sand that has settled in the ring header into pollution abatement ponds.

2. Secondary Ring Header

The secondary ring header that currently supplies the BPA stress relief ponds is a 12" asbestos cement pipe supplied by Tacoma Power's 18" branch line off of the 60" primary river water supply. The recommended conceptual layout supplies the BPA ponds via a new intertie with the 48" ring header. The 12" secondary ring header is proposed to be retained and utilized for supplying well, and/or treated water for early rearing of spring chinook (initial months only). This header could also serve as a backup to the well water supplied to the Hatchery Building, providing some redundancy.

C. Pond Supply Method / Inlet Configuration

A desired feature of the individual pond supplies is to avoid the need for inlet screens which would add to required maintenance (i.e. cleaning), reduces pond volume, and may inhibit proper distribution. As proposed in previous plans, the juvenile ponds are planned to be supplied above pond level via a full width manifold and the adult ponds will be provided with grated upwell supplies located across width of ponds in floor. The supply manifold at juvenile ponds may be similar to the design currently used at CTH's F-series ponds to minimize fish jumping concerns. Capped tee(s) will be provided in the supply piping to the adult ponds that may become dual-use in future to allow for the potential addition of above pond level manifolds.

D. Denitrogen/Aeration Method

The purpose of the existing denitrogen tower is to remove excess nitrogen and/or to aerate the water supply prior to entering the hatchery water supply system. Currently, the denitrogen tower is switched from bypass to upwell operation whenever there is a chance that Mayfield or Mossyrock Dams will spill and cause harmful total dissolved gas levels in water supply. The dissolved oxygen (DO) at inlet to CSH ponds ranges from 9 to 11 mg/L throughout the year regardless of tower bypass or upwell operating mode. The degassing tower will only be operated in upwell mode during spills at dams. If additional aeration is needed at pond(s), there will be several methods available that may be used to increase dissolved oxygen (e.g. new pond supply configuration, maintaining two water levels in pond via placement of intermediate stop logs).

E. Additional Water Treatment System

A water treatment system is proposed to provide 2 cfs of treated water for early rearing of spring chinook up to 200 fish/pound and as a backup for the existing well water system. The recommended system may be based on UV (ultraviolet) sterilization. When compared to an ozone plant, the capital cost, installation and operation of a UV plant appears more economical. The water treatment system proposed would include filtration of water supply and turbidity monitoring. If river water isn't supplied to this system at the denitrogen tower, Tacoma Power's proposal may be to modify BPA's 8 cfs pump station to support this water supply upgrade. The secondary ring header would be used to transfer pathogen-free water to spring chinook ponds or to supplement well water system in an emergency.

After the evaluation of spring chinook release sizes (4 fish/lb., 8 fish/lb., and 16 fish/lb.) is completed, additional water treatment requirements may be identified. The 2 cfs water treatment system proposed is based on the presumption that spring chinook will be released in an equal combination of 4 fish/lb. and 8 fish/lb. sizes (see Treated Water Demand Table at end of Appendix 4 – Article 5: 650,000 Lb./Year Bioprogramming).

If future research determines that different release sizes are more appropriate and that an additional treated water demand is required, Tacoma Power will address this need with additional recirculation loops for incubation (e.g. fall chinook and coho), new groundwater wells, and/or increasing the capacity of new water treatment system. During the spring chinook research period, operating and maintenance experience with the new water treatment system, recirculation systems used for starter troughs and incubation, and ground water wells will help identify the most appropriate means to expand pathogen-free water supply; if needed. Tacoma Power will design and construct new water treatment system to be expandable in 2 cfs increments and is committed to increasing available supply as needed to meet identified priorities.

F. Incubation/Early Rearing Water Supply

Recirculating water system(s) are proposed for some incubation and early rearing area(s). Well or treated water would supply head tank(s) in the incubation and early rearing area. Water from the head tanks would supply the incubation trays, starter troughs, and/or incubation jars. In a particular system, the recirculated water would be pumped through a low-head cleaning screen and degassing/aeration columns prior to returning to its dedicated head tank. As needed, the water will also pass through screening, aeration, biofiltration, ultraviolet disinfection, chiller, heat pump, and/or heat exchanger units to ensure water quality and temperature is maintained. These recirculation systems are required to economically adjust water temperature (see 4.3 Adjusted Timing of Release).

Tacoma Power proposes that three recirculation systems for late winter steelhead and spring chinook incubation be evaluated prior to installing recirculation systems for fall chinook or coho incubation. Sterilization of the recirculation loop(s) and associated head tanks would occur within the approximately 1 month downtime that occurs between these species. In addition, Tacoma Power proposes that recirculation loop(s) be installed for approximately 45 starter troughs that will be dedicated to providing treated and/or heated water to steelhead. When heating is required, waste heat from the CSH cold room's refrigeration system and any new chillers is planned to be utilized.

The recirculating water systems will be designed to minimize disease. The new systems will also allow for any formalin treatments required. When temperature adjustment of water supply is not required and sufficient well water is available, the systems will allow for terminating recirculation in favor of a first-pass water supply.

6.2 POND DRAINAGE METHOD / OUTLET CONFIGURATION

Primary mode of operation will be 100% surface drainage from juvenile, fry, and adult ponds (i.e. weir flow). Water is continuously drained from the pond through a calibrated weir that provides flow measurement, volitional exit, and surface drainage. Under the calibrated weir, stop logs will extend to the pond floor allowing complete pond drainage via their removal. Pond level is proposed to be measured within 20 feet of inlet so flow rate may be easily displayed next to pond's flow control valve. The outlet drain screens will be located 3 feet from pond end wall and will be designed to provide even flow distribution across them, thus reducing the potential for pond stratification. In addition, the 3-4 foot wide drain outlet will have a funnel-type configuration similar to what was recommended by FishPro for volitional release.

6.3 ADULT FACILITIES

A. Fish Separation Facility Improvements

The fish separation facility improvements proposed includes the following:

1. Existing holding pool crowder may be improved or replaced.
2. A new electroanesthesia (EA) system will be installed immediately downstream of existing false weir after a long radius turn is completed. Adults will be flumed into the two EA baskets planned by operation of the existing false weir. The appropriate dimensions of the EA basket(s) will be determined by desired batch size, length required to avoid potential fish injury (i.e. impact upon exiting flume), and any limitations of the EA technology.

3. After being anesthetized, the EA basket will be hoisted up to the level of a new high sorting table (See FishPro Report recommendations in Appendix 6 - Consultation). The high sorting table will primarily be used to separate the wild unclipped fish from the clipped hatchery fish prior to their transfer to a new lower sorting table. Both sorting tables are proposed to be designed with adjustable table height and to require minimal, if any, lifting. Note: Hatchery-origin steelhead and/or cutthroat may bypass low sorting table and be sent to an adult trout pond, surplus, a transfer tank at separation facility, or recycled back to river below Barrier Dam. To provide this flexibility, some sorting gates within open flume sections may be required.
4. A new wire tag detection system will be incorporated into each transfer tube that runs between the high and low sorting tables to allow segregation of tagged and untagged fish.
5. New 15" diameter fish transfer tubes are proposed to be installed from lower sorting table to each of the six holding/transfer tanks and to each of the nine adult holding ponds. From each side of lower sorting table, at least 3 transfer tanks will be easily accessible. In addition, two temporary storage tanks are proposed to be included within the lower sorting table area.
6. Access to both sorting tables via existing stairs without having to step over transfer tubes.
7. Orientation of lower sorting table minimizes distance and number of turns to adult holding ponds.
8. There will be seven (7) fish transfer tubes from lower sorting table to adult ponds. The unripe fish return tubes from adult handling facility will merge with and share lower portion of these tubes.
9. Visitor overlook of lower sorting table and electroanesthesia operations is planned. In addition, at least one camera system may be installed to provide monitor viewing of lower sorting table from visitor area(s).
10. The majority of the fish transfer tanks at separation facility are planned to remain uncovered for easy viewing of adult holding.
11. An integrated, electronic fish and mark inventory system to be located at low and high sorting tables as well as spawning table in adult handling building.
12. Automatic air hammer is being considered for surplus transfer tube to efficiently kill fish.
13. Ramp for worker access between low and high sorting tables may be installed.

For more details, see FishPro Report recommendations in Appendix No. 6 - Consultation, and the Fish Separation Facility's conceptual layout and logic charts shown in Appendix No. 7 – Salmon Hatchery Remodel Components. Tacoma Power proposes that the adult pond sorting tubes leave the separation facility from the North side and remain outside of transfer tank area to improve worker access and reduce length of runs.

B. Adult Holding Ponds and Handling Facilities

The adult facilities layout (see Section B, C, and Plan View in Appendix 7 – Salmon Hatchery Remodel Components) has some similarities to the method used at the Cole Rivers Hatchery in Oregon. Nine (9) 15'w x 75'l adult ponds are proposed to share an 8 foot wide common crowding channel via removable bulkheads.

A dedicated crowder is proposed to assist with the batching of adults into an electroanesthesia lift through a flap gate at the end of the crowding channel. After the fish are anesthetized, they may be lifted to the level of the spawning table in the new adult handing building.

From the spawning table inside the adult handling building, the operator will be able to return unripe fish to ponds, perform vaccinations, drain blood from fish, remove eggs and/or milt, deliver steelhead to recovery tanks, kill fish, and plate freeze carcasses. It may also be desirable to have the ability to temporarily store some fish in small tanks or load anesthetized adults into a tanker truck by lifting fish to a delivery chute above spawning table.

Adults will be delivered to holding ponds via 15" diameter transfer pipes which originate at either the separation or adult handling facilities. The crowding channel's dedicated crowder may also be provided with the ability to lift any of the pond bulkheads. The adult ponds are proposed to have a minimum of two portable crowders that may be moved from pond to pond using either a forklift or an overhead gantry system. Crowders used in adult trout ponds will not be used in adult salmon ponds to minimize spread of disease. In addition, the water surface elevation in crowding channel may be kept approximately 1 foot lower than water level of adult holding ponds.

The goals achieved by the proposed adult layout (see Appendix No. 7 – Salmon Hatchery Remodel Components) include the following:

1. Operation and maintenance access around majority of ponds.
2. Minimal disturbance of fish by workers and visitors.
3. Access road to fish ladder can remain.
4. Physical separation from juvenile ponds.
5. Shortest possible route for egg transfer to hatchery building.
6. Convenient visitor and truck access to adult handling area.
7. More pond volume provided than specified by IHOT criteria.
8. Shortest possible route for sorting tubes from separation facility.
9. Centralized formalin storage in new adult handling facility for treatment of all adult salmon and trout ponds.
10. Two ponds may be served by a pathogen light water supply (e.g. spring chinook).
11. Provision for approximately ten percent of the late winter steelhead adults used for hatchery broodstock to be live-spawned, reconditioned, and then released to the river.
12. No adult holding ponds are above hatchery's primary drain. This required the elimination of one residence and a trailer pad which may be replaced with the equivalent on East side of hatchery.
13. All drain water from new adult holding ponds will be discharged below the Barrier Dam through new 48" pipe. This change should reduce the potential for adult diseases to impact the hatchery's primary water supply.

C. Adult Handling Operations

During spawning operations, ripe fish are proposed to be killed using an air gun or air hammer with clubbing of fish only done as a backup. The pneumatic equipment is intended to minimize ergonomic issues and reduce overall mess of operations. Unripe fish will be returned to adult holding ponds via 15" diameter fish return tubes. It may also be desirable to have fish transfer tube that either returns fish to crowding channel or EA lift chamber. For all species and scenarios, coded wire tags (CWT) will be removed at the new adult handling facility. In addition, plate freezers are proposed for this facility to assist with management of carcasses. Visitors to the Salmon Hatchery will be able to view all spawning operations.

6.4 FRY / JUVENILE REARING PONDS

A total of thirty-six 10' x 200' raceways are planned to be used for rearing of salmon fry and juveniles. The 10' x 200' x 8'd (approximate structural dimensions) raceways would be composed of individual sections created by inserting pond screens in wall channels.

Sections are proposed to be fish grow-out units of 10 feet wide by 12 feet at both ends of each pond with 25 foot sections in between (average water depth of approximately 5.6 feet). The short 12 foot section on West side of each pond is proposed to be used for initial ponding of fry with grow out occurring from West to East in a direction that is counter to pond flow. This will prevent the need to clean areas of the pond that are unused and will allow for additional aeration of water supply (e.g. waterfall over stop logs at center of ponds).

Additional program flexibility may be provided by inclusion of a 12 to 25 foot long divider wall or screen down the center of each pond on the West end. This would allow the grow out of two separate batches of fry in the same pond, thus, providing the ability to catch one batch up to the other prior to ponding them together. Juvenile collection areas (10'w x 12'l kettles) at the downstream end of ponds are included in pond design (see Section A in Appendix No. 7 – Salmon Hatchery Remodel Components) and are expected to help with fish handling and pond cleaning. Besides at pond outlets, stop log guides will also be provided at least at the mid-point of ponds to allow two different pond levels when desired (e.g. mass marking, aeration of water supply).

6.5 BIRD PREDATION CONTROL

Several methods of preventing bird predation were investigated for juvenile raceways with the conclusion that exclusionary netting is the best practice. An exclusionary net structural detail (plan view) for Salmon Hatchery is shown in Appendix 7 – Salmon Hatchery Remodel Components. Note: More access doors may be provided when appropriate locations have been determined.

6.6 VOLITIONAL RELEASE

All juvenile ponds will have the ability to either drain above the Barrier Dam via existing route or below the dam via a new 48" diameter drain (see Appendix 7 –Salmon Hatchery Remodel Components). At all times, either the North or South half of the hatchery will be draining above the Barrier Dam to provide attraction flow to fish ladder.

To volitionally release fish from North or South ponds to below the Barrier Dam, the following operations would be completed in sequence shown:

A. New 48" drain valve opened to provide access to outlet below Barrier Dam.
B. New 4' wide knife gate closed to block end of existing drain channel that leads to new outlet.
C. Outlet drain screen removed from pond(s) for a time period to be determined. Over this volitional release period, each pond's stop logs may be progressively removed to drop pond level and encourage departure of fish. Besides flow ramping, the release may be aided by the addition of a flared outlet at top of stop logs or by progressively reducing the volume of the pond by repositioning pond screens. It may also be desirable to reduce feeding of these fish.
D. Vacuum cleaning of pond kettles as needed to maintain appropriate discharge conditions.
E. At end of volitional release period, all stop logs are removed down to floor of pond which completely drains pond. Alternately, it may be desirable to collect the fish that haven't left volitionally in the provided kettle.

6.7 FEEDING SYSTEM

In 2003, WDFW used 282,229 pounds of dry feed and 190,364 pounds of semi-moist feed at the Salmon Hatchery. All semi-moist feeds are stored in the Hatchery Building's cold room near the south-side, spring chinook ponds and dry feed is stored in the basement. Where semi-moist feed is not used (majority of north ponds), Tacoma Power proposes that manual feeding be focused on early rearing of salmonids and that centralized mechanical feeding be the primary method of feeding coho and fall chinook juveniles during final grow out.

A. Manual Feeding

The current practice at the Cowlitz Salmon Hatchery is to feed the fish manually by walking back and forth along the pond and hand tossing feed to the fish. It is very labor intensive as each pond gets 2 to 5 feedings a day, depending on fish size. However, it is the preferred method as it provides fish culturists with a visual of the overall health of fish and allows for good fish husbandry. The semi-moist feed used for spring chinook and the finer feed used for all fry may require this feeding method for reliable distribution.

B. Centralized Mechanical Feeding

A computer-regulated, central feed system is proposed where feed is held in central silo(s) and distributed by forced air to the appropriate pond. Each pond could have several ports to broadcast feed to the fish. This type of feed system would provide for easy adjustment of feeding frequency and can be programmed to self-adjust the amount of feed sent to a pond by the growth rate of the fish. The auto-programming could take into account the size of fish, age of fish, number of fish and water temperature for each pond. In addition, the dosing rate at each feed distributor could be overridden and reset manually at ponds by operators (e.g. via PocketPC) based on observed conditions. This type of system could be used to standardize feeding practice and improve feed management without compromising on fish husbandry.

Tacoma Power proposes that a centralized mechanical feeding system be initially installed for half of the juvenile ponds on the North-side of Hatchery Building. A conceptual layout for a feeding system is shown in Appendix 7 – Salmon Hatchery Remodel Components. The two most prominent companies that are being considered are AKVA Marina Central Feed system (see info in Appendix 7 – Salmon Hatchery Remodel Components) and Norcan Electrical Systems. Note: AKVA's cool air design significantly limits the production of fines and all piping can be kept away from walkways to avoid a trip hazard. If centralized mechanical feeding is found to be successful for final grow out of coho and fall chinook juveniles, Tacoma Power may propose to expand system to remaining North and/or South-side ponds.

C. Dry Feed Storage and Delivery

Tacoma Power proposes a new dry feed storage building which would replace inconvenient storage in basement of Hatchery Building and be located in area of existing NE parking lot (see on CSH Plan View in Appendix 7 – Salmon Hatchery Remodel Components). Rather than receiving pallets of 50 lb. feed bags, Tacoma Power proposes that dry feed is only received in 1 ton bulk bags. Inside the new storage building, forklifts and/or chain hoists could be used to stack 1 ton bulk bags and load storage silos of approximately 6 ton capacity each. The storage silos would allow for convenient filling of buckets and would support centralized mechanical feeding system discussed in B. above. Monitoring of feed removal from silos would also provide improved inventory and tracking of feed consumption.

6.8 POND CLEANING SYSTEM

The preferred pond cleaning system is to reuse the existing vacuum system to clean ponds approximately once per week. The use of baffle panels in ponds and/or the step down into pond kettles may compliment this cleaning method. Note: In case production levels are increased beyond 650,000 lb./year in the future, the hatchery design will include provisions to allow for a vacuum system at adult holding ponds that may become dual-use.

6.9 ELECTRICAL SYSTEM

There are three aspects of the electrical systems to be designed for the hatcheries remodel. The first is power system distribution through the facilities to ensure proper loading for normal and emergency generator power. The second is facilities electrical planning to ensure sufficient lighting, power distribution inside buildings, and coordination of power requirements for facilities equipment for emergency generator use. In addition, facilities electrical planning will ensure facilities meet local and national electrical code requirements. The third aspect is the Supervisory Control and Data Acquisition System (SCADA). The SCADA system will be designed to allow maximum physical data collection and plant control / alarming. The data collection system will include a database design to access real-time and historically collected plant wide data. Third party applications, such as fish management systems, will not only be able to access the plant data but also incorporate data entered by the plant personnel. For Control and Alarming a plant wide computer control system will include a Human Machine Interface (HMI) system. The HMI will provide detailed and accurate information to the plant personnel to facilitate the production of the various species of fish.

The planned SCADA system will allow hatchery personnel to view operating conditions in any given pond (e.g. DO, flow, temperature, feed cycle, etc.), receive alarm information remotely in the field and view all data from either the Salmon or Trout Hatcheries facility. Control functions will only be permitted at the local facility and not allowed via the remote viewing stations. Additionally, personnel security access levels will restrict access to essential personnel only.

The following details some key components of the proposed electrical system whose complexity is increased with the total number of ponds served (to be determined):

A. Control System

The Hatchery Control Systems will follow the standard design philosophy established for Tacoma Power's Generation Plants. The designs may be based on an Allen Bradley Programmable Logic Controller (PLC) utilizing Remote I/O (RIO) modules located at key control points.

Custom software development may be included as part of the control systems. Each facility may have an Intellution SCADA HMI system for monitoring and control of the automated systems. Overall data collection will be centralized at the Salmon Hatchery and provide collection of both hatchery facilities. Numerous locations will be provided for personnel access for data entry, control and monitoring.

B. Annunciator System

Alarm systems to monitor all critical flows and levels within the hatchery environment will be included in the hatchery remodel plan. Annunciation will be included in the SCADA HMI/PLC control system. Annunciation will also be by a plant horn and lights or other sound and visual type alarming device.

C. Security

Monitoring of buildings and doors may be incorporated with the SCADA/PLC Control System. Use of camera and video surveillance equipment will be investigated and designated as necessary.

D. Communication Systems

Refer to the Misc. Electrical Upgrades section below.

E. Repowering

Repowering the electrical systems and subsystems will be based on the equipment power requirements of each Hatchery area. Evaluation of the electrical equipment being installed as well as the existing systems to be reused will be completed prior to the first project start. This will ensure adequate power design for all phases of the project.

F. Miscellaneous Electrical Upgrades

Electrical upgrades of existing equipment will be evaluated on a phase by phase basis. Upgrades shall be based on increased efficiency, overall cost to benefit ratio and necessity and improved functionality over the older equipment.

6.10 HATCHERY BUILDING REMODEL

Based on the proposed location of the new adult handling facility, the following is being considered for the remodel of the hatchery building:

- The offices for hatchery management personnel and conference room(s) should be located where best reception of truck deliveries and visitors may be achieved. This goal is best realized outside of the hatchery building to minimize traffic in work areas and potential transfer of fish diseases in sensitive areas. Another goal of a new facility layout may be to improve communications between management, operations, and maintenance staff by sharing a centralized office building. See proposed location next to adult facilities in Plan view of Appendix 7 – Salmon Hatchery Remodel Components. Note: The number and location of offices shown on conceptual layout is very preliminary and may change significantly.
- Some hatchery building offices are envisioned for on-site operations staff and would be ideally located in the proximity of the laboratory.
- The basement and 2nd floor of hatchery building is proposed to be used primarily for mechanical and electrical equipment rooms. Equipment storage, chillers, and potential water to water transfer of steelhead fry to fish trucks may also be proposed for basement.
- All indoor early rearing is proposed to be located on the east end of hatchery building where the incubation room is currently located. The incubation activities are proposed to be moved closer to the new adult handling facility. This will allow up to 45 starter troughs to be located in this space for early rearing of steelhead and cutthroat. A transfer pipe from starter trough area to basement may be proposed to facilitate eventual loading of fish trucks and relocation of steelhead and cutthroat to the Trout Hatchery's A, B, C, and F series ponds when fry reach approx. 200 fish/lb. Alternately, a forklift may be utilized to load trucks from main floor.
- All incubation activities are proposed to be adjacent and located in the center and on the west end of existing hatchery building. The proposed incubation area is currently used for spawning activities and feed storage. Some additional starter troughs may be added to these areas for research activities if the periodic availability of the steelhead troughs is not sufficient. A permanent means to transfer these species to ponds is planned to replace current method which utilizes 4" irrigation pipe.

6.11 VISITOR INFORMATION AND TOURS

New visitor's facilities are proposed to be constructed on the West side of the hatchery as shown by conceptual layout in Appendix No. 7 – Salmon Hatchery Remodel Components. The goal of this proposal is to concentrate visitor activities to one side of hatchery in order to avoid potential conflicts with hatchery operations. A new visitor/office building and parking area, West of the Hatchery Building, is proposed to serve as the reception area for all hatchery activities. The new visitor facility would include a kiosk area designed to detail and explain the function of the hatchery and the role of Tacoma Power and contractors. In addition, the visitor area may have some small fish tank(s) that provide viewing and/or handling of a variety of hatchery fish. The new building is proposed to include offices for hatchery management, a conference room, and American Disability Act (ADA) bathrooms. Note: The size and space allocation shown on conceptual layout is very preliminary and may change significantly.

A small visitor area with viewing windows is proposed to be located next to the new adult handling building so that visitors may observe the egg taking process. In addition, cameras are proposed to supply the visitor area(s) with monitor viewing of separator facility and/or early rearing activities. An overhead viewing platform inside of separation facility is proposed to allow visitors to watch sorting table and EA lift operations (see Appendix 7 - Salmon Hatchery Remodel Components).

A small fish ladder viewing room is also proposed for the top of the fish ladder at the primary holding pool. A Plexiglas window could be installed in the side of the fish ladder to allow viewing of adult fish from an adjoining visitor dark room. If a side window is not provided, the current practice of viewing fish from above will be maintained.

VII. REMODEL COMPONENTS FOR THE COWLITZ TROUT HATCHERY

Several remodel components are proposed for the Cowlitz Trout Hatchery to improve ergonomics, reduce stress of the fish during movement, and improve water quality and supply. By means of rerouting 5-acre pond drains, it is also proposed that all returning steelhead and cutthroat now be collected at the Salmon Hatchery's separation facility to assist with consolidation plans discussed in Section V. Currently, all trout stocks return in adequate numbers to the Cowlitz Salmon Hatchery to meet broodstock needs. With this in mind, the following remodel components are proposed for Trout Hatchery:

7.1 SOUTH WELLS

Tacoma Power has studied the south well field aquifer since 2002 and has determined that it is recharged by rainfall only and is, therefore, a limited resource. The automation of this well water system is planned to provide the efficient control of water withdrawal and to achieve energy conservation. Through strict control of water pumped, the conservation of a limited resource will ensure adequate pathogen-free water is available when required for late winter steelhead in F-series ponds or as a backup for ozone plant.

7.2 REROUTE DRAINS

Presently, the outflow of the pollution abatement ponds and rearing ponds drains to the entrance of the fish ladder. This water is used as attraction water in approximately the last mile of Blue Creek. Tacoma Power proposes a new outlet into the Cowlitz River, thus eliminating the imprinting of fish on Blue Creek (see Appendix No. 8 - Trout Hatchery Remodel Components and Concepts). This would effectively eliminate the adult returns to the CTH.

All steelhead and cutthroat broodstock could be taken at the CSH separation facility instead. The new outlet design will include provision for trapping returning adults in case this feature is needed in future.

A test of this concept is proposed prior to final construction. Initially, the primary drain would be rerouted using a temporary method. If after several years of evaluation all parties agree to a permanent drain routing change, Tacoma Power would proceed with the proposed restoration of Blue Creek (see below).

7.3 BLUE CREEK RESTORATION

After validating that adult collection from Blue Creek is no longer necessary, Tacoma Power proposes that this creek be restored to its original condition. This would be accomplished by removing Blue Creek's barrier dam, fish ladder entrance, and water intake structures and rerouting the CTH drains as discussed in 7.2 above.

7.4 FISH TRANSPORT SYSTEM

A new 12" diameter fish transport system is proposed for the movement of fish from the A, B, and C raceways to the 5 acre rearing lake(s). This would replace the current practice of using tanker trucks for this transfer. The transport system would require a fish pump to initiate transfer from raceways. During transfer of fish, a flushing flow will be provided as necessary to ensure reliable transport to lakes. The new fish transport system is expected to reduce stress on the fish and require less time and manpower.

7.5 BIRD PREDATION CONTROL

Several methods of preventing bird predation were investigated for raceways and ponds with the conclusion that exclusionary netting is the best practice. Exclusionary netting is proposed for the A, B, C, and F series raceways and for half of one 5-acre lake. Tacoma Power proposes one of the options shown in Appendix 8 -Trout Hatchery Remodel Components and Concepts with lake netting protecting fish from birds that can dive. It may be found desirable to feed trout exclusively under netted areas.

7.6 VOLITIONAL RELEASE FROM 5-ACRE LAKE(S)

Tacoma Power is proposing improvements to the outlet of 5-acre lake(s) to improve volitional release of juvenile steelhead (see pictures and graph in Appendix 8 - Trout Hatchery Remodel Components and Concepts). With current outlet design, many juveniles never exit lake(s) when they are drawn down. As it has been observed that smolt swim around perimeter of lake(s), a new outlet was designed that captures them in their rotation and then progressively ramps up the drain velocity, thus, encouraging them to exit lake volitionally. This new outlet concept will be observed and installed on other lake(s) if it appears that an improvement in fish behavior can be realized.

7.7 FEED STORAGE

In 2003, WDFW used 218,285 pounds of dry feed at Cowlitz Trout Hatchery. Optional improvements to dry feed storage and management may be proposed where cost-effective.

VIII. CONCLUSION

If the proposed remodel components and construction schedule for the CTH and CSH are adopted, Tacoma Power believes that any disruption to normal hatchery operations can be minimized and, thus, current production levels can be maintained. The remodel of hatcheries will focus on conservation and efficient use of water/energy, more efficient fish movement (less stress on both fish and personnel), collection of all adult steelhead and cutthroat broodstock at CSH separation facility, volitional release of all juveniles, separation of adult holding and juvenile rearing ponds, new pond designs at CSH, exclusionary bird netting over rearing ponds, increasing pathogen-free water supply, moving steelhead and cutthroat incubation and starter troughs to CSH, and providing flexibility to implement and evaluate innovative rearing practices.

Tacoma Power proposes the conceptual layout detailed in Appendix No. 7 - Salmon Hatchery Remodel Components which includes:

A. New construction of adult holding ponds separate from juvenile rearing areas to reduce risk of disease transfer.
B. New adult handling facility and improvements to adult separation facility constructed, including new electroanesthesia lifts.
C. Provision for volitional release of juveniles below Barrier Dam added.
D. New steelhead and cutthroat incubation, starter trough, and adult facilities constructed.
E. Narrower/shallower 10'w x 200'l x 8'd (approximate structural dimensions) juvenile ponds constructed for ease of access and with sectioning ability for program flexibility and reduced handling of fish. Pond water supply will be changed to a flow-through design which drains at surface from the existing circular flow concept which utilizes floor drains.
F. Exclusionary bird netting added for all juvenile raceways.
G. New 2 cfs water treatment facility that provides treated water supply for early rearing of spring chinook up to 200 fish/pound or a backup of existing well system.
H. Remodel of hatchery building including new incubation and starter trough facilities.
I. New visitor and office facilities.
J. New dry feed storage building including a cold room and a centralized mechanical feeding system for fall chinook and coho at North-side juvenile ponds.
K. Recirculation systems for temperature control of late winter steelhead and spring chinook incubation as well as steelhead starter troughs.

Proposed work at the Trout Hatchery (see Appendix No. 8 - Trout Hatchery Remodel Components and Concepts) includes:

A. Improved control of all water supplies to maximize well water available and minimize energy consumption.
B. Relocate the drain and volitional release channel of the 5-acre lake(s) from Blue Creek to the Cowlitz River. Upon validating consolidation of all adult facilities at CSH, restore Blue Creek by removing all structures that block natural migration.
C. Provision for fish transport piping from vicinity of A, B, and C series raceways to 5-acre lakes, allowing for more efficient, low-stress transport of juvenile fish.
D. Installation of exclusionary netting over A, B, C, and F series raceways and half of one 5-acre lake. The lake(s) will also be provided with a new outlet design to improve volitional release of steelhead and cutthroat.

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