
HATCHERY EVALUATION REPORT

**Abernathy Salmon Culture Technology Center - Tule
Fall Chinook**

December 1996

Integrated Hatchery Operations Team (IHOT)

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Abernathy Salmon Culture Technology Center - Tule Fall Chinook

**An Independent Audit Based on Integrated Hatchery Operations Team
(IHOT) Performance Measures**

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Executive Summary

This report presents the findings of the independent audit of the Abernathy Salmon Culture Technology Center - Tule Fall Chinook program. The hatchery is located along Abernathy Creek, approximately 3 miles upstream from the creek's confluence with the Columbia River. The hatchery is used for adult collection, incubation, and rearing of tule fall chinook.

The audit was conducted in 1996-1997 as part of a 2-year effort that will include 67 hatcheries and satellite facilities located on the Columbia and Snake River system in Idaho, Oregon, and Washington. The hatchery operating agencies include the U.S Fish and Wildlife Service, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife.

Background

The audit is being conducted as a requirement of the Northwest Power Planning Council (NPPC) "Strategy for Salmon" and the Columbia River Basin Fish and Wildlife Program. Under the audit, the hatcheries are evaluated against policies and related performance measures developed by the Integrated Hatchery Operations Team (IHOT). IHOT is a multi-agency group established by the NPPC to direct the development of new basinwide standards for managing and operating fish hatcheries. The Bonneville Power Administration (BPA) contracted with Montgomery Watson to act as an independent contractor for the audit.

IHOT has established five basic policies that cover: (1) hatchery coordination, (2) hatchery performance standards, (3) fish health, (4) ecological interaction, and (5) genetics. The audit focuses on all these policies, with the exception of hatchery coordination. These policies are set forth in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries (IHOT 1995)*. That document is the source for the performance measures that are the basis of this audit.

The Audit Process

The audit was based on the facility management's response to a 109-page questionnaire. This audit form was completed through a five-step process in which:

- Information was obtained from headquarters.
- The hatchery manager was asked to fill out and return the audit form.
- A 1-2 day site audit visit was conducted to inspect facilities, review hatchery records, discuss audit form responses, and develop remedial action plans.
- A compliance report was developed to document the compliance status of each performance measure. This report was then shared with the hatchery manager and IHOT representative.
- This hatchery evaluation report was written to document compliance with IHOT performance measures and develop cost estimates for remedial actions when needed.

Abernathy Salmon Culture Technology Center - Tule Fall Chinook Results

The Abernathy facility includes 1 pond for adult holding, 12 concrete raceways, 92 circular starter tanks, 6 troughs, and incubation facilities. The facility was originally established as a National Fish Hatchery under provisions of the Mitchell Act -- a program to provide for the conservation of Columbia River fishery resources. In 1961, research activities at the Salmon Culture Laboratory in Entiat, Washington were transferred to Abernathy to expand the laboratory's research program to include fall chinook.

The Abernathy Salmon Culture Technology Center - Tule Fall Chinook program was in general compliance with most of the performance measures. In the area of program objectives, the hatchery was not meeting its adult return goal. The audit found that the hatchery was not in compliance with the water temperature criteria for spawning and rearing, alkalinity and hardness criteria, water chemistry (copper, zinc, and iron), turbidity, contaminant monitoring requirement, and pathology-free water criteria for early rearing, which are all facilities requirements. The hatchery needs to develop a smoltification monitoring program, review the release size goal, and assess if it is possible to acclimate all the fish on creek water. The hatchery was not in full compliance with all the alarm and training requirements. The hatchery did not have a Genetics Monitoring and Evaluation Program in place.

The specific areas in which the Abernathy Salmon Culture Technology Center - Tule Fall Chinook program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Develop alarm log
- Develop approved genetics M&E program
- Develop pathogen-free water supply for early rearing
- Develop exchange training details between other hatcheries and agencies
- Develop specific incubation standards for the IHOT Operations Plan
- Follow IHOT protocols for checking flow alarms daily and other alarms weekly
- Follow IHOT protocols for equipment and rain gear utilized in broodstock handling or spawning sanitized prior to its use elsewhere in the hatchery
- Follow IHOT temperature criteria for rearing
- Increase alkalinity and hardness or blend in well water to meet criteria
- Measure smoltification
- Review IHOT spawning temperature criteria
- Review program and/or assess ability to acclimate all fish on creek water prior to release
- Review release size goal or change program
- Run analysis for turbidity; contaminants in well water
- Treat well water to remove copper, zinc, and iron

Non-compliance issues resulting from items beyond human control or Performance Measures not relevant to this hatchery (Type 1 in Table 3, Section 4 of this report) were not listed above.

Facility Description

Name:	Abernathy Salmon Culture Technology Center
Stock/Species:	Tule Fall Chinook
Operating Agency:	U.S. Fish and Wildlife Service
Funding Agency:	Mitchell Act (NMFS)
Location:	The hatchery is located along Abernathy Creek, approximately 3 miles upstream from the creek's confluence with the Columbia River.
Address:	1440 Abernathy Road Longview, Washington 98632
Hatchery Manager:	Mr. Carl Burger
Phone:	(360) 425-6072
Fax:	(360) 636-1855
Purpose:	The facility was originally established as a National Fish Hatchery under provisions of the Mitchell Act -- a program to provide for the conservation of Columbia River fishery resources. Abernathy began operations in 1960 and in 1961, fall chinook research activities at the Salmon Culture Laboratory in Entiat, Washington were transferred to Abernathy.
Production Goal:	Tule Fall Chinook Produce 1.5 million subyearling tule fall chinook for on-station release
Water Supply:	Water rights total 20,600 gpm from Abernathy Creek and one well. Actual water use averages about 6,000 gpm from Abernathy Creek and 300 gpm from the well.
Facilities:	
Adult Holding:	1 concrete adult holding pond - 6,314 cf
Incubation:	30 - 16 stack vertical incubators (480 trays)
Early Rearing:	32 steel circular starter tanks

	60 fiberglass circular starter tanks
	6 fiberglass troughs
Raceways:	12 concrete raceways - 1,500 cf each
Rearing Ponds:	None
Satellite Facilities:	None

Section 3

Compliance Status

The hatchery audits are based on compliance with written IHOT performance measures. These performance measures are documented in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (referred to as *IHOT 1995* in this report).¹ The purpose of the performance measures is to implement new basinwide policies that provide regional guidelines for operating anadromous hatcheries in the Columbia Basin.

The audit focuses on performance measures for IHOT policies that cover (1) hatchery performance standards, (2) fish health, (3) ecological interaction, and (4) genetics. These performance measures are intended to guide hatchery operations once production is established. For that reason, the hatchery operations audit included broodstock collection, spawning, incubation of eggs, fish rearing and feeding, fish release, equipment maintenance and operations, and personnel training. Production priorities are beyond the scope of this audit.

Based on *IHOT 1995*, a detailed 109-page audit form was developed. The audit form divided the performance measures into six major sections along major program and technical criteria areas. Two additional sections (sections 1 and 8) include general information and expenditure information needed for this Hatchery Evaluation Report and blank forms for additional comments. The following is the basic structure of the IHOT audit form:

Section 1	Performance Measures for General Information and Expenditure Information (PMs General 1-2)
Section 2	Performance Measures for Program Objectives (PMs 1-4)
Section 3	Performance Measures for Facility Requirements (PMs 5-15)
Section 4	Performance Measures for Hatchery Practices (PMs 16-25)
Section 5	Performance Measures for Fish Health Policy (PMs 26-34)
Section 6	Performance Measures for Ecological Interactions (PMs 35-38)
Section 7	Performance Measures for Genetics Policy (PMs 39-43)
Section 8	Blank Forms for Additional Comments

Several performance measures are repeated in various sections of the audit form. These performance measures overlap in *IHOT 1995* and were retained to allow individuals interested in specific portions of the audit (such as Genetics or Fish Health) to determine the compliance status of all performance measures for a given topic in one location. A repeated performance measure is indicated by shaded text.

The Hatchery Audit Process

The hatchery audit will be conducted over a 2-year period that concludes in 1997. At each hatchery, a five-step process was used to complete the overall hatchery audit. This process

¹Integrated Hatchery Operations Team (IHOT) 1995. *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries*, Bonneville Power Administration, Portland, Oregon.

consisted of research and onsite visits. The site visit at the Abernathy Salmon Culture Technology Center was conducted on November 18, 1996.

The following is the five-step audit process:

1. Information was obtained from headquarters.
2. The hatchery manager was asked to fill out and return the **Audit Form**.
3. A 1-2 day site audit visit was conducted at each hatchery. During that visit an audit team inspected facilities, reviewed hatchery records, discussed audit form responses, and developed remedial action plans when appropriate.
4. During the site visit, the compliance status of each performance measure was discussed with the hatchery manager and IHOT representative. A portion of the Hatchery Evaluation Report was sent to the hatchery manager following the audit visit as a **Compliance Report**. That Compliance Report is Table 2 of this report.
5. Information from steps 1-4 was used to prepare a draft **Hatchery Evaluation Report**. This draft report was submitted to the operating agencies for review of the information used to determine compliance. Based on review and comments, a final Hatchery Evaluation Report was developed. The final report documents the compliance of a particular hatchery with the IHOT performance measures and presents cost estimates to correct any deficiencies.

Compliance Status of Abernathy Salmon Culture Technology Center - Tule Fall Chinook

The following table includes information on life-stages that are held on this facility for some portion of their rearing cycle (Table 1). For multi-facility programs, summary cost and contribution data is presented at the facility where rearing occurs. For the compliance status relating to performance measures that do not occur at this hatchery, please refer to the Hatchery Evaluation Reports for the hatcheries and stocks listed in Table 1. A check mark (✓) indicates that the specific life-stage is held at this facility.

This section documents the compliance status of the Abernathy Salmon Culture Technology Center - Tule Fall Chinook program. Each performance measure is presented in a table taken from the audit form (Table 2). The compliance status is identified by the following categories:

- **N/A** (not applicable)
- **Yes** (in compliance)
- **?** (unknown; generally due to unavailability of information to determine compliance)
- **No** (not in compliance).

Remedial actions are suggested for performance measures not in compliance. These remedial actions are grouped into categories and listed in Section 4 of this report, where the cost of the required remedial actions is also presented.

Table 1 Summary Program Information for Abernathy Salmon Culture Technology Center - Tule Fall Chinook

Component	Location of Adult Holding, Spawning, Incubation, and Rearing					
	Abernathy Salmon Culture Technology Center					
Adult Collection	✓					
Adult Holding	✓					
Spawning	✓					
Fertilization	✓					
Incubation						
green-to-eyed	✓					
eyed-to-hatch	✓					
Rearing						
fry	✓					
fingerlings	✓					
smolts	✓					
Acclimation/release	✓					

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
the hatchery programs outlined in a subbasin management plan?		✓			Columbia Basin System Planning Production Plan and Columbia River Fish Management Plan	
the hatchery operating under a current hatchery operational plan?		✓			IHOT Operations Plan	
is it understood by staff?		✓				
is it being followed?				✓	IHOT Operations Plan is not used for day-to-day operations	None: this is a research facility
hatchery monitoring and evaluation plan in place?						
do you have a written monitoring and evaluation plan?		✓			CWT for Missing Production Group Program	
adult contribution to fisheries, spawning grounds, and hatchery		✓			Tagging started with 1989 broodstock	
adult pre-spawning survival as compared with established goal		✓			Review of records; in compliance 5 out of last 5 years	
adult take as compared with established hatchery goal				✓	Review of records; in compliance 5 out of last 8 years	Improve adult returns
embryo to eyed-egg survival as compared with established goal		✓			Review of records; in compliance 5 out of last 5 years	
eyed-egg to fry survival as compared with established goal		✓			Review of records; in compliance 5 out of last 5 years	
smolt to smolt survival as compared with established goal		✓			Review of records; in compliance 5 out of last 5 years	
adult production as compared with established goal				✓	Review of records; in compliance 2 out of last 5 years	Improve adult returns
adult survival (smolt to adult) as compared with established goal				✓	Review of records; in compliance 0 out of last 1 years (only 1 year's data is available at this time)	Improve adult returns
number of eggs, fry, fingerlings, smolts, and/or adults meet basinwide needs	✓				Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Temperature						
Does your water temperature meet the criteria for spawning?				✓	No excessive pre-spawning mortality	Review IHOT spawning temperature criteria
Does your water temperature meet the criteria for incubation?		✓			Review of records/Discussion	
Does your water temperature meet the criteria for rearing?				✓	Well water ok; creek water can be colder or warmer than criteria. Is not thought to be a problem	
Dissolved gases						
Is the oxygen level near saturation?		✓			Review of records/Discussion	
Is the dissolved nitrogen level less than saturation?		✓			Review of records/Discussion	
Chemistry						
Ammonia (un-ionized)		✓			Review of records/Discussion	Treat well water to remove copper
Carbon Dioxide		✓			Review of records/Discussion	
Chlorine		✓			Review of records/Discussion	
H		✓			Review of records/Discussion	
Copper				✓	Review of records/Discussion	
Hydrogen Sulfide		✓			Review of records/Discussion	
Iron				✓	Review of records/Discussion	Treat well water to remove iron
Zinc				✓	Review of records/Discussion	Treat well water to remove zinc
Turbidity						
Does your turbidity meet the criteria?			✓		No data	Monitor turbidity.

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Alkalinity and hardness Does your alkalinity and hardness meet the criteria? Creek water Well water		✓		✓	Both alkalinity and hardness are less than the criteria	Increase alkalinity and hardness or blend in well water to meet criteria
Nitrite Does your nitrite meet the criteria?		✓			Review of records/Discussion	
Pesticides Aldrin Dieldrin Dieldrin Heptachlor Chlordane Methoxychlor Lindane Malathion Dithion			✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓		Well ok; no data on creek See above See above See above See above See above See above See above See above	Run analysis on creek water See above See above See above See above See above See above See above See above
Diseases What portions of the hatchery have disease-free water? Adult holding Incubation Early rearing Early rearing (reuse system) Rearing Rearing (reuse system)		✓		✓ ✓ ✓ ✓ ✓	Creek water Well water Creek water Well water + reuse water Creek water Well water + reuse water	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Alarm Systems						
Do the following areas have alarms?						
Intake		✓			Inspection of facilities/Discussion	
Large rearing ponds and adult holding ponds		✓			Inspection of facilities/Discussion	
Raceway headboxes and rearing ponds		✓			Inspection of facilities/Discussion	
Incubation facilities		✓			Inspection of facilities/Discussion	
Quarantine areas and facilities	✓				None	
Water treatment systems		✓			Inspection of facilities/Discussion	
Security		✓			Inspection of facilities/Discussion	
Are there outside systems and buzzers in onsite residences?		✓			Discussion	
Are water flow alarms checked daily?				✓	Checked every two weeks	Follow IHOT protocols for checking flow alarms daily and other alarm weekly
Are all other alarms checked weekly?				✓	Checked every two weeks	See above
Is there a log of alarms for emergencies, tests, and maintenance requirements?				✓	Review of records/Discussion	Develop alarm log
Are telephone pagers used?		✓			Discussion	
Adult collection and holding facilities						
Do you meet the adult holding criteria?		✓			Need a new adult holding facility; walls are coming apart	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>Abatement facilities</p> <p>Type 1: <u>Heath trays</u> Do you have an adequate number of units for the overall program?</p> <p>Type 2: _____ Do you have an adequate number of units for the overall program?</p>		✓			Units are old and need to be replaced	
<p>Trapping facilities</p> <p>Type 1: Raceways Do you have an adequate number of units for the overall program?</p> <p>Type 2: Raceways - reuse system Do you have an adequate number of units for the overall program?</p> <p>Type 3: _____ Do you have an adequate number of units for the overall program?</p>		✓			Inspection of facilities/Discussion	
<p>Screening facilities</p> <p>Do you meet the approach velocity criteria?</p> <p>Are the fish screens regularly cleaned?</p> <p>Does the screen mesh meet screen opening criteria?</p> <p>Are rearing containers double screened for fish that should not be released to adjacent water?</p>		✓			Inspection of facilities/Discussion	
<p>Predator control facilities</p> <p>Are your predation control facilities effective?</p>		✓			Inspection of facilities/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
d storage facilities and quality control						
Does the storage of dry/semi-moist/moist foods (dry <12%; semi-moist 12-20%; moist >20% moisture) follow food manufacturer's recommendations?		✓			Discussion	
Does a regional quality control officer oversee production procedures and monitor:						
Verification by feed manufacturer that ingredients meet specifications?		✓			Discussion	
Ensure feed does not contain unwanted drugs or other additives?		✓			Discussion	
Analyze ingredients contained in the final food product to ensure that feed specifications have been met?		✓			Discussion	
Are the foods stored and handled according to the following criteria?						
Moist pellets should not exceed 10 °F at point of delivery.		✓			Discussion	
Moist pellets should be removed from freezer just prior to feeding.		✓			Discussion	
Do not leave buckets of feed or feed containers outside exposed to light or heat.		✓			Discussion	
Open bags of feed should be fed within 1 to 2 days except when feeding small groups of fish.		✓			Discussion	
Automatic feeder hoppers and bulk storage facilities should be insulated against excessive temperatures (80 °F and above).		✓			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Release facilities						
Do the release facilities ensure that fish are not subjected to adverse conditions?		✓			Inspection of facilities/Discussion	
Pollution abatement facilities						
Do the pollution abatement facilities meet all federal and state regulations (or good engineering practice)?		✓			Inspection of facilities/Discussion	
Are pollution abatement facilities operated correctly?		✓			Discussion	
Transportation facilities						
Are the transport systems adequate to meet IHOT performance measures for transportation practices?	✓				No transportation	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Broodstock selection practices						
Is the donor selection process document attached? (PM #40a)	✓				Existing program; does not apply	
Was the donor selection outline followed in selecting the hatchery broodstock? (PM #40b-c)	✓				Existing program; does not apply	
Spawning practices						
Were the appropriate number of spawners, male/female ratios, and fertilization protocols used? (PM #42c-g)		✓			Review of records/Discussion	
Incubation practices						
Are specific incubation standards listed in the hatchery operations plan?		✓			Reviewed Hatchery Operations Plan	Develop specific incubation standards for the IHOT Operations Plan
Are incubation practices written?		✓				
Incubation Type 1: <u>Heath Tray</u> (see PM #8) - do you meet the loading and flow criteria?				✓	Use less eggs and lower flow; no problems observed	None
Incubation Type 2: _____ (see PM #8) - do you meet the loading and flow criteria?	✓					

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
rearing practices						
specific rearing standards listed in the hatchery rearing plan?				✓	This facility is conducting research on density and therefore does not have written standards	None
rearing practices written?				✓	See above	None
Rearing Unit Type 1: <u>Creek Raceways</u> (see PM #9)						
Do you meet the density and DI criteria?			✓		See above	None
Do you meet the Loading and FI criteria?			✓		See above	None
Rearing Unit Type 2; Reuse Raceways (see PM #9)						
Do you meet the density and DI criteria?			✓		See above	None
Do you meet the Loading and FI criteria?			✓		See above	None
Rearing Unit Type 3: _____ (see PM #9)						
Do you meet the density and DI criteria?	✓					
Do you meet the Loading and FI criteria?	✓					
smolt quality						
Do you produce a high quality smolt?		✓			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Health management practices						
Are the monthly hatchery monitoring visits being conducted? (PM #26)		✓			Review of records/Discussion	
Are the annual broodstock inspections being conducted? (PM #27)		✓			Review of records/Discussion	
Is there pathogen-free water (PM #5h) and are the sanitation procedures being followed? (PM #28)		✓			Review of records/Discussion	
Are the following water quality parameters within criteria? (PM #5a-5g)						
Water temperature				✓	Review of records/Discussion	See PM #5a
Dissolved gases		✓			Review of records/Discussion	
Chemistry				✓	Review of records/Discussion	See PM #5c
Turbidity		✓			Review of records/Discussion	
Alkalinity and hardness				✓	Review of records/Discussion	See PM #5e
Nitrite		✓			Review of records/Discussion	
Contaminants			✓		Review of records/Discussion	See PM #5g
Are rearing standards being followed? (PM #19)				✓	Review of records/Discussion	See PM #19
Are egg and fish transfer/release requirements met? (PM #31)		✓			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>Do hatchery performance meet requirements defined in the regional hatchery policies and in basin and hatchery plans for the following areas?</p> <p>Percent smoltification</p> <p>Do you measure percent smoltification?</p> <p>Did you meet the smoltification criteria?</p>				<p>✓</p> <p>✓</p>	<p>Discussion</p> <p>Discussion</p>	<p>Measure smoltification</p> <p>See above</p>
<p>Rearing density (prior to release)</p> <p>Did you meet the rearing density criteria just prior to release?</p>			✓		No standard density criteria because of research work	None
<p>Disease condition (at release)</p> <p>Did you meet all disease regulations just prior to release?</p>		✓			Review of records/Discussion	
<p>Release number (at release)</p> <p>Did you meet the release number goal?</p>				✓	In compliance 1 out 2 last years	Improve adult returns
<p>Release size (at release)</p> <p>Did you meet the size goal?</p>				✓	Review of records/Discussion	Review release size goal
<p>Release dates of release</p> <p>Did you meet the release date goal?</p>		✓			Review of records/Discussion	
<p>Release location of release</p> <p>Did you release the fish at the specified location?</p>		✓			Review of records/Discussion	
<p>Acclimation of fish reared in the subbasin or acclimated in the basin?</p> <p>Are the fish reared in the subbasin?</p> <p>Are the fish acclimated in the subbasin?</p>		✓		✓	<p>Discussion</p> <p>50% of fish acclimated on well water prior to release</p>	Review program and/or assess ability to acclimate all fish on creek water prior to release
<p>Is the release strategy appropriate for the program?</p>				✓	Discussion. See PM #22b	See PM #22b

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Transportation facilities						
Do transportation equipment and personnel receive disinfection before and after use?	✓				No transportation	
Is the fish tank interior disinfected using a solution of 200 ppm active chlorine for 30 minutes minimum or formaldehyde gas generation method (relative humidity of 60% for 2 hrs)?	✓				See above	
Is the exterior of the fish transport vehicle disinfected using high pressure steam (115-130°C), high temperature acid, or with 200 ppm chlorine for 30 minutes?	✓				See above	
Is the fish transport vehicle (cab) disinfected using 600 ppm quaternary ammonia compounds (1.5 ml of 50% stock solution/liter water)?	✓				See above	
Is other equipment disinfected including fish pumps, nets, egg sorters, waders, boots, rain gear, hoses and other equipment using one of the following solutions? 200 ppm chlorine for 30 minutes 600 ppm quaternary ammonia compound for 30 minutes 200 ppm iodophor solution for 10 minutes	✓				See above	
Do personnel wear protective garments when handling fish eggs or cultural water?	✓				See above	
Do the fish transport truck/chassis and tank/unit receive an inspection and service prior to the release season?	✓				See above	
Is a daily service inspection completed before starting up and leaving for the day?	✓				See above	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Transportation facilities						
Does the fish transport unit receive an inspection prior to loading?	✓				See above	
Does a pre-loading inspection covering tank water level, pumps or aerators, oxygen injection system settings, displacement gauge, and truck loading/hauling density tables checked and reviewed occur prior to loading fish in the transport unit?	✓				See above	
Do hauling criteria include checking the fish 45 minutes to 1 hour after loading?	✓				See above	
When fish are active and systems are functioning properly, is the oxygen concentration reduced and maintained at approximately 8 ppm?	✓				See above	
Is water temperature in the transportation unit maintained within the 42-48 °F range?	✓				See above	
Do fish releasing procedures include the following criteria?						
Releasing the fish at the correct release site or into the correct water body.	✓				See above	
Tempering or the difference between the liberation tank and the target water body should not exceed 10°F.	✓				See above	
The liberation hose should be angled so that fish gently hit the water. Using a tripod is a method of ensuring the hose will stay at the proper angle.	✓				See above	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Evaluation practices						
Has the hatchery conducted fishery contribution studies?						
Determine the requirements for evaluating and improving management programs?		✓			Contribute to Missing Production Group Reports	
Develop guidelines that define the geographical area and identify component stocks (hatchery and/or wild) that comprise the management unit?		✓			Discussion	
Develop guidelines that define if the proper stocks of fish are currently being used?		✓			Discussion	
Determine which management units contribute to a specific fishery and the time periods of those contributions?		✓			Discussion	
Determine the relative contributions of the various management units to a specific fishery over the different time periods?		✓			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
ining practices						
Does the hatchery have a training schedule for its staff?		✓			Review of records/Discussion	
Does each staff member have a personal training plan approved by a supervisor and reviewed annually?		✓			Review of records/Discussion	
Does the hatchery routinely exchange training details between other hatcheries and agencies?				✓	Review of records/Discussion	Develop exchange training details between other hatcheries and agencies
Does the hatchery encourage and reward off-duty training of staff?		✓			Review of records/Discussion	
Does the hatchery conduct monthly staff meetings?		✓			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>monthly hatchery monitoring visits being conducted by a qualified fish health specialist as described below?</p> <p>Conduct visit at least monthly</p> <p>Monitoring conducted by qualified fish health specialist</p> <p>Examine a representative sample of healthy and moribund fish from each lot.</p> <p>Review fish culture practices with hatchery manager.</p> <p>Report finding and results of necropsies on standard form.</p> <p>Recommend appropriate drug or chemical treatment.</p> <p>Summarize fish health status or stock prior to release or transfer to another facility.</p>		<p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p>			<p>Review of records/Discussion</p>	
<p>all of the functions of the hatchery yearly monitoring visits being completed as described below?</p> <p>Annually examine each broodstock for the presence of reportable viral pathogens.</p> <p>Annually screen each salmon broodstock for the presence of <i>Renibacterium salmoninarum</i>.</p> <p>Conduct inspection by or under the supervision of qualified fish health specialist.</p>		<p>✓</p> <p>✓</p> <p>✓</p>			<p>Review of records/Discussion</p> <p>Review of records/Discussion</p> <p>Review of records/Discussion</p>	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>Are hatchery following accepted sanitation procedures?</p> <p>Are there any sources of pathogen-free water, especially for incubation and early rearing?</p> <p>Are the hatchery sanitation procedures understood and being followed as described below?</p> <p>Disinfect/water harden eggs in iodophor?</p> <p>Are foot baths containing disinfectant placed at the incubation facility's entrance and exit?</p> <p>Is equipment and rain gear utilized in broodstock handling or spawning sanitized prior to its use elsewhere in the hatchery?</p> <p>Is equipment used to collect dead fish sanitized prior its use in another pond and/or lot of fish?</p> <p>Is equipment, including vehicles used to transfer fish between facilities, disinfected prior to use with any other fish lots or at any other location?</p> <p>Are rearing vessels sanitized after fish are removed and prior to introducing a new fish lot or stock?</p> <p>Are dead fish properly disposed of?</p>		<p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p>		<p>✓</p>	<p>Develop pathogen-free water supply for early rearing. Incubation ok.</p> <p>Inspection of facilities/Discussion</p> <p>Inspection of facilities/Discussion</p> <p>Inspection of facilities/Discussion</p> <p>Inspection of facilities/Discussion</p> <p>No transfers</p> <p>Inspection of facilities/Discussion</p> <p>Inspection of facilities/Discussion</p>	<p>Follow IHOT protocols for equipment and rain gear utilized in broodstock handling or spawning sanitized prior to its use elsewhere in the hatchery</p>

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
water quality parameters being followed?						
Are the following water quality parameters within criteria? (PM #5a-5g)						
Water temperature		✓		✓	Review of records/Discussion	See PM #5a
Dissolved gases		✓			Review of records/Discussion	See PM #5c
Chemistry		✓		✓	Review of records/Discussion	See PM #5e
Turbidity		✓		✓	Review of records/Discussion	See PM #5g
Alkalinity and hardness		✓			Review of records/Discussion	
Nitrite		✓			Review of records/Discussion	
Contaminants			✓		Review of records/Discussion	
io to PM #21						
incubation and rearing standards being followed?						
Are the incubation practices following the IHOT incubation criteria? (PM #18)			✓		Review of records/Discussion	See PM #18
Are the rearing practices following the IHOT criteria? (PM #19)			✓		Review of records/Discussion	See PM #19
io to rearing practices PM #18-PM #19						
egg and fish transfer/release requirements met?		✓			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>Is the hatchery's program outlined in a subbasin management plan?</p> <p>Refer to subbasin plan PM #1</p>		✓			Columbia Basin System Planning Production Plan and Columbia Fish Management Plan	
<p>Is the hatchery operating under a current hatchery operational plan?</p> <p>Refer to operational plan PM #2</p>				✓	IHOT Operations Plan is not used for day-to-day operations	See PM #2
<p>Is hatchery monitoring and evaluation plan in place?</p> <p>Refer to hatchery monitoring and evaluation plan PM #3</p>		✓			CWT for Missing Production Group Program	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>Does the hatchery program meet requirements established in the regional hatchery policies and basin planning documents in the following areas: species, stock, broodstock collection location, broodstock numbers, broodstock collection strategy, spawning and egg-take protocols?</p> <p>Does the hatchery program meet the requirements for the following?</p>						
Species protocols (PM #4a)		✓			Review of records/Discussion	
Stock protocols (PM #4a)		✓			Review of records/Discussion	
Broodstock collection location protocols (PM #41b for existing program; PM #39b for new program)		✓			Review of records/Discussion	
Broodstock numbers protocols (PM #42c)		✓			Review of records/Discussion	
Broodstock collection strategy protocols (PM #41b-d for existing program; PM 39b-f for new program)		✓			Review of records/Discussion	
Spawning protocols (PM #42d-e)		✓			Review of records/Discussion	
Egg-take protocols (PM #42f-g)		✓			Review of records/Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Do the hatchery's performance meet requirements defined in the regional hatchery policies and in the basin and hatchery plans for the following areas: percent smoltification, rearing density, disease condition, and the number, size date(s), and location of release?						
Percent smoltification (PM #22a1)				✓	Review of records/Discussion	See PM #22a1
Rearing density (PM #22a2)			✓		Review of records/Discussion	See PM #22a2
Disease condition (PM #22a3)		✓			Review of records/Discussion	
Number at release (PM #22a4)				✓	Review of records/Discussion	See PM #22a4
Size at release (PM #22a5)				✓	Review of records/Discussion	See PM #22a5
Date of release (PM #22a6)		✓			Review of records/Discussion	
Location of release (PM #22a7)		✓			Review of records/Discussion	
Are fish reared in the subbasin or acclimated in the basin?				✓	50% are acclimated on well water prior to release	See PM #22b
PM #22b						
Is the release strategy appropriate for the program?				✓	Discussion	See PM #22b
PM #22c						

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>new programs, has a broodstock collection plan developed?</p> <p>Is the broodstock collection plan written?</p> <p>For a non-captive broodstock program:</p> <p>Was an unbiased, representative sample collected?</p> <p>Was the recommended number of broodstock collected?</p> <p>For a captive broodstock program:</p> <p>Were captive brood progeny excluded as donors for propagating the next generation of the captive broodstock program?</p> <p>Were full-sib crosses avoided?</p> <p>Is the broodstock collection plan understood and being followed by staff?</p>	<p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p>				<p>Existing Program; does not apply</p>	
<p>a new program, was the donor selection outline followed in selecting the hatchery broodstock?</p> <p>Is a donor selection plan written?</p> <p>Was the donor selection outline followed in selecting the broodstock?</p> <p>Was the target stock recommended in the donor selection process actually used?</p>	<p>✓</p> <p>✓</p> <p>✓</p>				<p>Existing Program; does not apply</p> <p>Existing Program; does not apply</p> <p>Existing Program; does not apply</p>	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>existing programs, were the broodstock collection procedures followed?</p> <p>Is the broodstock collection plan written?</p> <p>Does the broodstock collection plan follow the guideline:</p> <p>Was an unbiased, representative sample collected?</p> <p>Was the recommended number of broodstock collected?</p> <p>Were the broodstock collection procedures in hatchery operation plan understood and followed?</p>		<p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p>			<p>Review broodstock collection plan in IHOT Operations Plan</p> <p>Discussion</p> <p>Discussion</p> <p>Discussion</p>	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
Are the appropriate number of spawners, male/female ratios, and fertilization protocols used?						
Are the spawning protocols written?		✓			Review of plan	
Are daily or weekly spawning logs available?		✓			Review of records	
Was the appropriate number of spawners used?		✓			Discussion	
Did you attempt to spawn all collected broodstock and randomize mating with respect to age class, and other traits?		✓			Discussion	
Was the sex-ratio within the limits given in the performance standards?		✓			Discussion	
Were the fertilization protocols followed?		✓			Discussion	
If the hatchery needed to reduce the number of eggs retained, was this done by representative sampling of each male/female cross?		✓			Discussion	

Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
	N/A	Yes	?	No		
<p>Where is a genetics monitoring and evaluation program available?</p> <p>Does the plan address the following elements listed in HOT:</p> <p>Does the program have elements needed to meet evaluation goals 1-4?</p> <p>Has a qualified geneticist reviewed and endorsed the program (goal 5)?</p> <p>Will the program collect the data and maintain the records needed to evaluate compliance on an ongoing basis (goal 5)?</p> <p>Is the program understood and followed by staff?</p>				<p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p> <p>✓</p>	<p>Discussion</p> <p>Discussion</p> <p>Discussion</p> <p>Discussion</p> <p>Discussion</p>	<p>Develop approved genetics M&E plan</p> <p>See above</p> <p>See above</p> <p>See above</p> <p>See above</p>

Remedial Actions

Based on the compliance status for each performance measure, remedial actions were developed. The required remedial actions are organized into five categories. The types of categories range across a spectrum from those actions that are beyond human control, to those that require a change in agency policy or procedures, to those that involve a significant capital cost to put in place. The following are the five types of remedial actions identified under phase 1 of the audit:

The Five Types of Remedial Actions

Type	Description
1	Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery
2	Remedial actions requiring changes in agency policies or procedures
3	Remedial actions requiring changes in monitoring coverage or interval
4	Remedial actions requiring significant capital expenditures
5	Remedial actions that may require significant capital expenditures but are not clearly definable at this time

Remedial Actions at Abernathy Salmon Culture Technology Center - Tule Fall Chinook

This section presents the corrective actions required to bring the Abernathy Salmon Culture Technology Center - Tule Fall Chinook program into compliance with IHOT performance measures. The remedial actions suggested here are just that, suggestions developed by the Montgomery Watson Audit Team. For some non-compliance areas, other remedial actions could be proposed. The required remedial actions are cross-referenced to each IHOT performance measure that was not in compliance. Where appropriate, the costs associated with the remedial actions are also presented (Table 3).

The cost estimates presented in this section are based on professional experience from similar projects. In most cases, only a lump-sum figure is presented, and detailed take-off lists have not been prepared. The cost estimates are essentially order of magnitude estimates ($\pm 40\%$).

More importantly, the suggested remedial activities may also present several levels of action. Optional actions have been listed for several problems. These optional actions are desirable for either operational or safety considerations.

Table 3. Remedial Actions Required at Abernathy Salmon Culture Technology Center - Tule Fall Chinook

Remedial Action Required	Cost	PMs ¹
<p>Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery</p> <p>Improve adult returns</p>	----	4c, 4g, 4h, 22a4
<p>Type 2 - Remedial actions requiring changes in agency policies or procedures</p> <p>Review IHOT spawning temperature criteria</p> <p>Follow IHOT temperature criteria for rearing</p> <p>Follow IHOT protocols for checking flow alarms daily and other alarms weekly</p> <p>Develop alarm log</p> <p>Develop specific incubation standards for the IHOT Operations Plan</p> <p>Measure smoltification</p> <p>Review release size goal or change program</p> <p>Develop exchange training details between other hatcheries and agencies</p> <p>Follow IHOT protocols for equipment and rain gear utilized in broodstock handling or spawning sanitized prior to its use elsewhere in the hatchery</p> <p>Develop approved genetics M&E program</p>	<p>----</p>	<p>5a</p> <p>5a</p> <p>6</p> <p>6</p> <p>18</p> <p>22a1</p> <p>22a5</p> <p>25</p> <p>28</p>

¹ PMs are performance measures that were extracted from the IHOT 1995 report. The IHOT performance measures are listed in Table 2 (Section 3 of this report) in numerical order.

Remedial Action Required	Cost	PMS¹
Type 3 - Remedial actions requiring changes in monitoring coverage or interval Run analysis for turbidity; contaminants in well water	---	5d, 5g
Type 4 - Remedial actions requiring significant capital expenditures Increase alkalinity and hardness or blend in well water to meet criteria	\$3,000	5e
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time Treat well water to remove copper, zinc, and iron Review program and/or assess ability to acclimate all fish on creek water prior to release Develop pathogen-free water supply for early rearing	---	5c 22b, 22c 28

¹ PMS are performance measures that were extracted from the IHOT 1995 report. The IHOT performance measures are listed in Table 2 (Section 3 of this report) in numerical order.

Hatchery Contribution to Fisheries, Spawning Grounds, and Hatcheries

This section presents the audit findings for the Abernathy Salmon Culture Technology Center - Tule Fall Chinook program contribution of adult fish to fisheries, local fisheries, spawning grounds, and hatcheries. Data is reported by broodyear. A broodyear refers to the adult contribution from the eggs produced from a single group of spawning adults. For some species, this may include fish caught as 2-, 3-, 4-, 5-, and 6-year old fish. Because of the return distribution and data processing delays, the complete adult contribution for a given broodyear may not be available until 4 to 5 years after the fish have been released from the hatchery.

**Table 4. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries:
Abernathy Salmon Culture Technology Center - Tule Fall Chinook**

Year	Fisheries ¹ (Broodyear)	Spawning Grounds ¹ (Broodyear)	Hatchery ¹ (Broodyear)	Total Combined Contribution ² (Broodyear)	Smolt to Adult Survival (percent)
1981					
1982					
1983					
1984					
1985					
1986					
1987					
1988					
1989	2768	81	447		0.18
1990	Not complete	Not complete	Not complete	Not complete	Not complete
1991	Not complete	Not complete	Not complete	Not complete	Not complete
1992	Not complete	Not complete	Not complete	Not complete	Not complete

¹ Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

² Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

Annual Operating Expenditures

The level and detail of annual operating expenditures varies widely depending on hatchery, operating agency, and funding source. When provided, expenditures were presented in terms of personnel costs, operating costs (power, feed, supplies), capital costs, indirect costs charged to the federal government, third-party costs, and other costs. These cost components were summed to determine a total hatchery annual cost. Based on discussion with the hatchery manager, the percent of total hatchery costs allocated to a given program was estimated. The total hatchery costs and the percent of hatchery costs allocated to a given program were used to compute the cost of a given program. Table 5 shows the annual operating expenses for the Abernathy Salmon Culture Technology Center - Tule Fall Chinook program. For programs that occur at more than one facility (as shown on Table 1 in Section 3 of this report), the cost breakdown for the component(s) at each facility is presented in separate tables (Table 5a).

Table 5. Annual Operating Expenses: Abernathy Salmon Culture Technology Center - Tule Fall Chinook

Hatchery	1993	1994	1995
1. Abernathy SCTC	\$215,913	\$219,561	\$217,341
2.			
3.			
4.			
5.			
Total Program Costs	\$215,913	\$219,561	\$217,341

The total expenditures for the Abernathy Salmon Culture Technology Center are presented in Table 6 by program. The detailed breakdown of program expenditures at this hatchery are presented in separate tables (Table 6a).

Table 6. Annual Operating Expenses - Abernathy Salmon Culture Technology Center

Program	1993	1994	1995
1. Tule Fall Chinook	\$215,913	\$219,561	\$217,341
2.			
3.			
4.			
5.			
Total Hatchery Costs	\$215,913	\$219,561	\$217,341

Table 5a. Annual Operating Expenses: Abernathy Salmon Culture Technology Center - Tule Fall Chinook

Expenditure Occurring at Abernathy SCTC

Component	1993	1994	1995
Personnel Costs	\$156,535	\$152,482	\$121,292
Operational Costs	\$59,378	\$64,807	\$71,576
Capital Costs		\$2,272	\$24,473
Indirect Costs			
Lumped Hatchery Costs ¹			
Lumped Third-Party Costs			
Total Hatchery Costs	\$215,913	\$219,561	\$217,341
Source of Funds			
Mitchell Act	100%	100%	100%
Program Production (lb)			
Total Production (lb)			
Program as Percent of Total	100%	100%	100%
Program Costs	\$215,913	\$219,561	\$217,341

¹ When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

Table 6a. Detailed Expenditures at Abernathy Salmon Culture Technology Center by Program

Tule Fall Chinook

Component	1993	1994	1995
Personnel Costs	\$156,535	\$152,482	\$121,292
Operational Costs	\$59,378	\$64,807	\$71,576
Capital Costs		\$2,272	\$24,473
Indirect Costs			
Lumped Hatchery Costs ¹			
Lumped Third-Party Costs			
Total Hatchery Costs	\$215,913	\$219,561	\$217,341
Source of Funds			
Mitchell Act	100%	100%	100%
Program Production (lb)			
Total Production (lb)			
Program as Percent of Total	100%	100%	100%
Program Costs	\$215,913	\$219,561	\$217,341

¹ When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.