LICENSE ARTICLE 407

FLOW CONTINUATION STUDY AND FACILITIES PLAN

BAKER RIVER HYDROELECTRIC PROJECT
FERC No. 2150

Puget Sound Energy
Bellevue, Washington

June 2010

CONTENTS

List of Figures

1.0 Introduction

In October 2008, Puget Sound Energy (PSE) received a new Federal Energy Regulatory Commission (FERC) license for the Baker River Hydroelectric Project. Settlement agreement article 106 (SA 106) of the Baker license requires PSE to achieve specific ramping and minimum flow criteria though the installation of a new 30 MW powerhouse containing two units with a capacity of 750 cfs each. PSE plans to construct this powerhouse within five years of license issuance to use instream flow releases for renewable power generation.

During relicensing, the question about the need for flow continuation facilities at the new powerhouse was inadvertently left unresolved by the settlement agreement. As a consequence, the FERC included license article 407 (LA 407) in the new license, instructing PSE to conduct this study to address the question.

2.0 Summary

PSE has conducted an evaluation of the economic and environmental considerations associated with the inclusion of a flow continuation valve (synchronous bypass valve or SBV) with the construction of the new powerhouse.

Based on the considered economic benefits and an SBV's ability to address infrequent outage events, PSE recommends that an SBV be installed during construction of this new powerhouse. PSE is currently proceeding with plans to include this valve. This decision is not based solely on past outage history, as the low frequency and magnitude of outages would not economically justify the installation of an SBV.

The location of the powerhouse has been modified since license issuance to avoid potentially unstable slopes, complicated access logistics, and additional construction costs and risks. The new powerhouse will be sited to the south of the existing Unit 3 powerhouse in an easily-accessible location, and a tunnel will be constructed to connect the powerhouse to the existing surge tank. This location will not be able to use the existing penstock configuration that facilitated the concept of the twin 750 cfs units. Therefore, the new connection tunnel and a single penstock will supply the new powerhouse. A single Francis turbine and generator at the proposed site is far more economical than twin 750 cfs units. As the functional capability of the twin and single units is essentially the same — especially with an SBV to offset any interruption of generation capacity — the powerhouse design can be modified easily to permit a single unit of 1,500 cfs rather than the two 750 cfs units specified in the license. By adding a valve to the powerhouse design and implementing a number of powerhouse siting improvements developed since license issuance, PSE will achieve ancillary economic benefits.

2.1 License Article 407

The purpose of this document is to fulfill the requirements of LA 407, as quoted below, to conduct a study:

> **Article 407.** **Flow Continuation Study and Facilities Plan**. Within one year of license issuance[1], the licensee shall file, for Commission approval, a flow continuation study and facilities plan that: (1) evaluates whether valves or other measures (flow continuation facilities) should be used to provide reasonable assurance of flow continuation during project outages, and (2) recommends installing flow continuation facilities if warranted. This plan shall include at a minimum:
>
> (1) an evaluation of the project's ability to meet required minimum flows with and without flow continuation facilities;
>
> (2) an evaluation of river stages in the Baker and Skagit Rivers downstream with and without flow continuation facilities;
>
> (3) the anticipated environmental benefits of installing flow continuation facilities; and
>
> (4) the estimated costs of installing flow continuation facilities and of making any operational changes.
>
> The licensee shall include in the above plan, for Commission approval, a recommendation and schedule to install flow continuation facilities at the Lower Baker development or the licensee's reasons why such facilities are not warranted.

Note the four areas of consideration mandated by LA 407. The four sections of the following study (3.1 through 3.4) examine each of these four areas. The sections of the study appear in the order listed in LA 407.

3.0 Flow Continuation Study

3.1 Meeting Required Minimum Flows With and Without Flow Continuation Facilities

Flow to reaches of the Baker River below Lower Baker Dam is available from three primary sources: powerhouse generation discharge, a small amount of dam leakage, and occasional spill over the dam. Dam leakage, while contributing to overall minimum instream flow in the Baker River, is generally constant (except for small fluctuations due to head), limited in volume, and not influenced by project operations. Interruption of flow from the other two sources, spill and generation, is caused by either an inability to spill or by the voluntary or involuntary termination of water passage through the powerhouse.

Spill volume and timing is controlled by reservoir elevation[2] combined with spill gate activation. Spill is available as a flow source whenever the reservoir elevation is above the spillway crest and spill can be scheduled. In general, the ramping rate prescriptions

[1] On October 8, 2009, the FERC granted an extension to October 1, 2012.

[2] PSE operates the reservoir to meet power production objectives while complying with environmental constraints.

of SA 106 can be met by normal project operations without special flow continuation facilities.

3.1.1 Interruption of Powerhouse Water Supply and Minimum Flow

Several events can potentially disrupt minimum instream flows (MIF): interruption of intake water supply through planned outage or failure of the penstock or headgates that supply water to the powerhouse, mechanical or electrical failure in one or more turbine/generating units, or a failure of the electrical transmission system precipitating a powerhouse load rejection shutdown.

3.1.2 Planned Outages

The supply of water to the powerhouse is periodically interrupted to permit inspection of the intake, tunnel, penstock, and associated equipment that is usually watered-up. These interruptions are infrequent — annual at most — and a flow continuation valve will not operate while the tunnel is dewatered. However, unless dewatering were to occur in response to an emergency, such outages can be scheduled to permit the minimum instream flow to be achieved via operation of the spillgates.

3.1.3 Machine Source Interruptions

The need for flow continuation facilities is limited to a combination of several specific and infrequent conditions associated with the inability to pass flow through the powerhouses in sufficient quantity to meet MIF or ramp rate constraints.

For example, if a machine malfunction occurs while the elevation of Lake Shannon is below the spillway crest, MIF is unobtainable through spill. Such a condition would occur if Unit 3 were inoperable and a malfunction — typically a load rejection — prevented the new powerhouse from passing flow above no-load conditions. There are no other conditions, other than operator error or catastrophic tunnel or penstock failure, that can precipitate a flow reduction below minimum flow or in excess of ramp rate constraints.

Based on the operating record, this scenario of load rejection or machine trip with a low reservoir is estimated to occur less than once annually.

3.2 Baker River and Skagit River Stages With and Without Flow Continuation Facilities

3.2.1 Gaging and Gage Relationships

Flows in the Skagit and Baker Rivers are measured by a network of USGS gages. However, two major USGS gages are used to monitor Skagit and Baker river flows relative to stage change. Figure 1 shows the location of these gages.

The Baker River flows into the Skagit River near the town of Concrete. Alterations of flow in the Baker River are recorded in downstream gages on the Skagit River, though effects are moderated and attenuated by the ambient flow of the Skagit and distance of the gages from the confluence.

However, the relationship between Baker River and Skagit River stages is not entirely predictable, as the Skagit River stage is also affected by the discharge regime from the comparatively larger Skagit River Project upstream. Therefore, flows are more variable temporally and seasonally than would occur in an unregulated environment. Consequently, the permitted rates of stage change in the Skagit River as a function of changes in the Baker (ramping rates) were determined for the license and included in SA 106 figures A and B. These figures were based on the stage-discharge relationship between the Skagit River gage (No. 12194000, Skagit River Near Concrete) and the Baker River gage (No.12193400, Baker River at Henry Thompson Bridge at Concrete, WA), as extrapolated to a location in the Skagit River upstream of the Skagit River Near Concrete gage referred to as Transect 1. SA 106 figures A and B specify how this relationship would be exercised following completion of the new powerhouse and implementation of associated of minimum instream flow and ramp rates. In this case, only the Baker River gage (Baker River at Henry Thompson Bridge at Concrete, WA) will be used to measure the ramp rates identified in SA 106 figures A and B. Compliance of Project ramping to the stage changes in those tables is deemed to achieve the appropriate seasonal ramp rate constraints on the Skagit River irrespective of Skagit River changes resulting from other variables.

Analysis was conducted for LA 407 to illustrate the relationship between the two gages and the ability of the Project to achieve the prescribed stage change rates.

The Baker River gage is downstream of the dam and powerhouse by about 0.5 miles. The distance between the two subject gages is about 3 miles. Water passing the Baker gage generally takes from about 45 minutes to an hour to reach the Skagit gage, depending on overall system flows. This determination was made by evaluating the effects of flow rate changes on the respective gages over the course of the calendar year 2009.

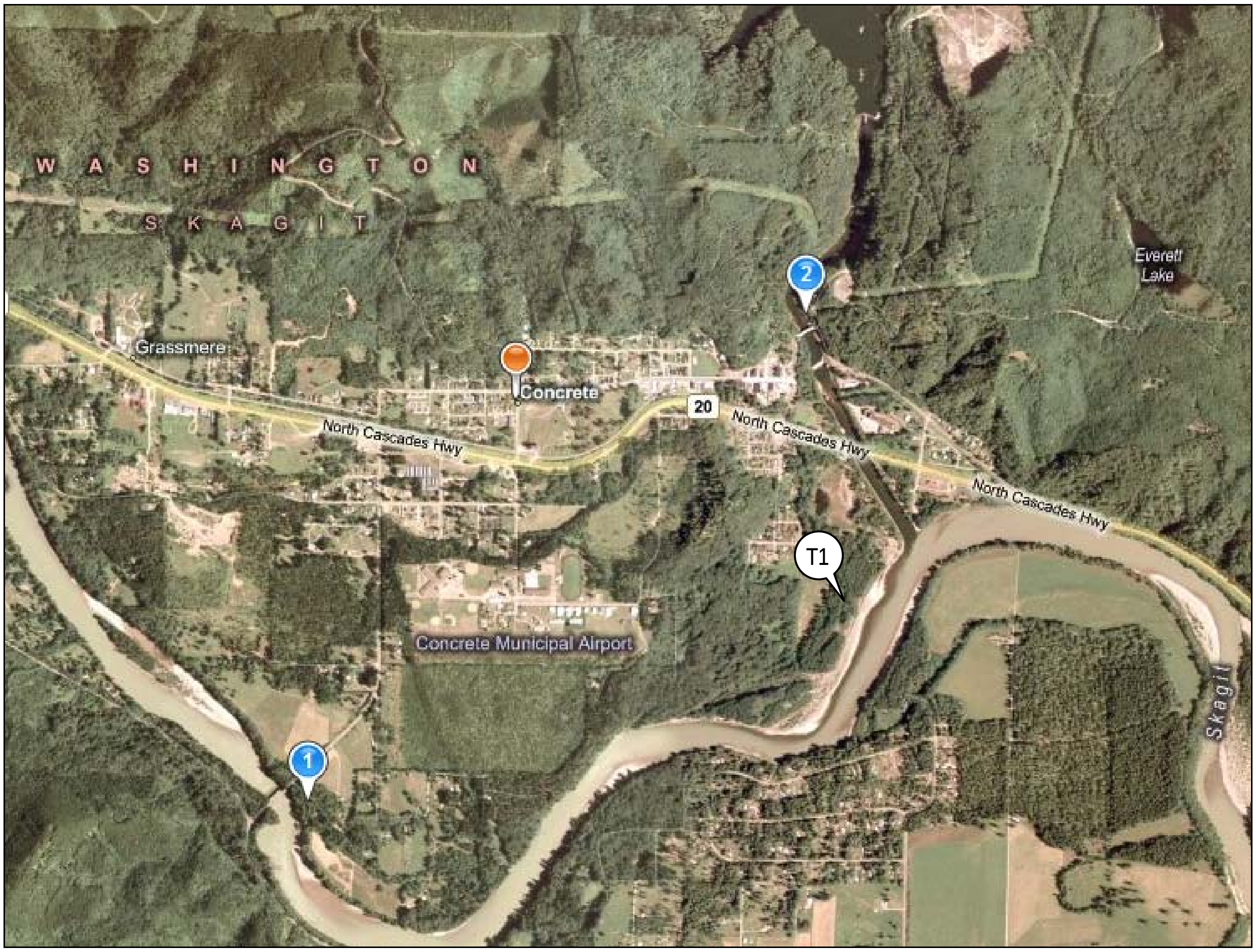

Figure 1. Location of (1) the Skagit River Near Concrete gage (No. 12194000) and (2) the Baker River at Henry Thompson Bridge at Concrete gage (No. 12193400).

The Skagit River stage downstream of Lower Baker Dam fluctuates greatly based upon seasonal weather patterns, snowpack, and discharge from the Skagit River and Baker River projects. The lowest 7-day flow ever recorded at the Skagit gage was 2,400 cfs in 1925. The 90% exceedance for this gage is 6,700 cfs over the life of the gage, and only seldom does the flow drop below 4,000 cfs. Average flow at the gage is 15,000 cfs.

3.2.2 Baker River Project Effects on Flows

At the Lower Baker Development, generation from Unit 3 discharges up to 4,700 cfs, while the new powerhouse will have a capacity of 1,500 cfs. In addition to spill and powerhouse discharge, leakage of 80 cfs or more constantly discharges from Lower Baker Dam. Under normal operations, PSE will employ different combinations of flow from the existing Unit 3 and the new powerhouse to address stage change constraints.

PSE evaluated how the downramping rates in Aquatics Table 1 of the license (SA 106, figures A and B) can be achieved, and whether additional facilities for flow continuation would be necessary to achieve compliance. Ramping rates vary seasonally from 2 inches per hour during a portion of the year to 1 inch per hour for a different portion of the year. At certain times of the year, no ramping is permitted during daylight hours. Each rate must be achievable during the worst-case conditions (the lowest Skagit flow and a high Baker discharge) for the respective ramping rate.

The following analyses illustrate the effects of discharge management from the Lower Baker Development. The assumed Skagit flow for both analyses is 2,400 cfs (the historical 7-day low flow) above the confluence of the Baker and Skagit rivers.

3.2.3 April Conditions

In April, the maximum allowable discharge from Lower Baker is 3,600 cfs (SA 106, aquatics table 1) From figure B in SA 106, a 3,600 cfs Baker River flow and a 6,000 cfs flow below the Skagit River confluence correspond to a 3-inch-per-hour allowable downramp in the Baker River. (This is equivalent to 2 inches per hour on the Skagit River at Transect 1). Figure 2 illustrates the flow management from the powerhouses needed to achieve the prescribed ramping rate, based on unit capacities.

At 3,600 cfs, the Baker River stage is 4.53 feet (figure 2). An hour later, the flow is 3,140 cfs, or a river stage of 4.28 feet. Similarly, at the start of the hour of downramping, the river begins at 3.29 feet with a flow of 1,680 cfs. After an hour, it is at 1,380 cfs and a stage of 3.05 feet. This is a drop of 0.24 feet in an hour, which is just less than three inches at the Baker River gage.

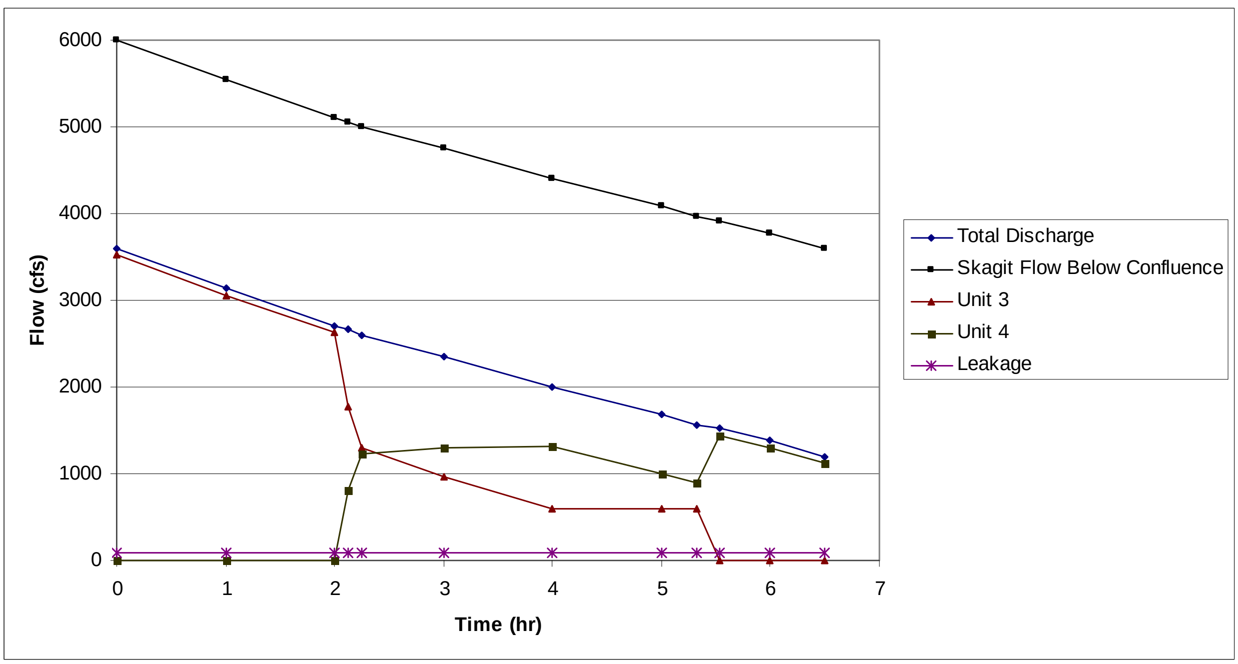

Figure 2. Plot of downramp at the Baker River Project using existing and proposed powerhouse configurations from 3,600 cfs to 1,200 cfs (minimum flow) during April, with extremely low flow on the Skagit River (ramp rate of 2 inches per hour).

3.2.4 September Conditions

Similarly, in figure 3, September conditions of 1 inch per hour (24 hours a day) are considered. The same 2,400 cfs above the confluence with the Skagit River is assumed, but the maximum allowable discharge from the Baker Project is 3,200 cfs. From figure A in SA 106, 1 inch per hour is the prescribed downramp rate for the Baker River —

corresponding to 1 inch per hour in the Skagit River. At the start of downramping, the 3,200 cfs flow corresponds to a Baker River stage of 4.32 feet. An hour later, the river is flowing at approximately 3,070 cfs and is at about river stage 4.24 feet (a ramping rate of 1 inch per hour). Ramping continues at this rate for approximately 20 hours to transition from the maximum release of 3,200 cfs to the minimum instream flow of 1,000 cfs.

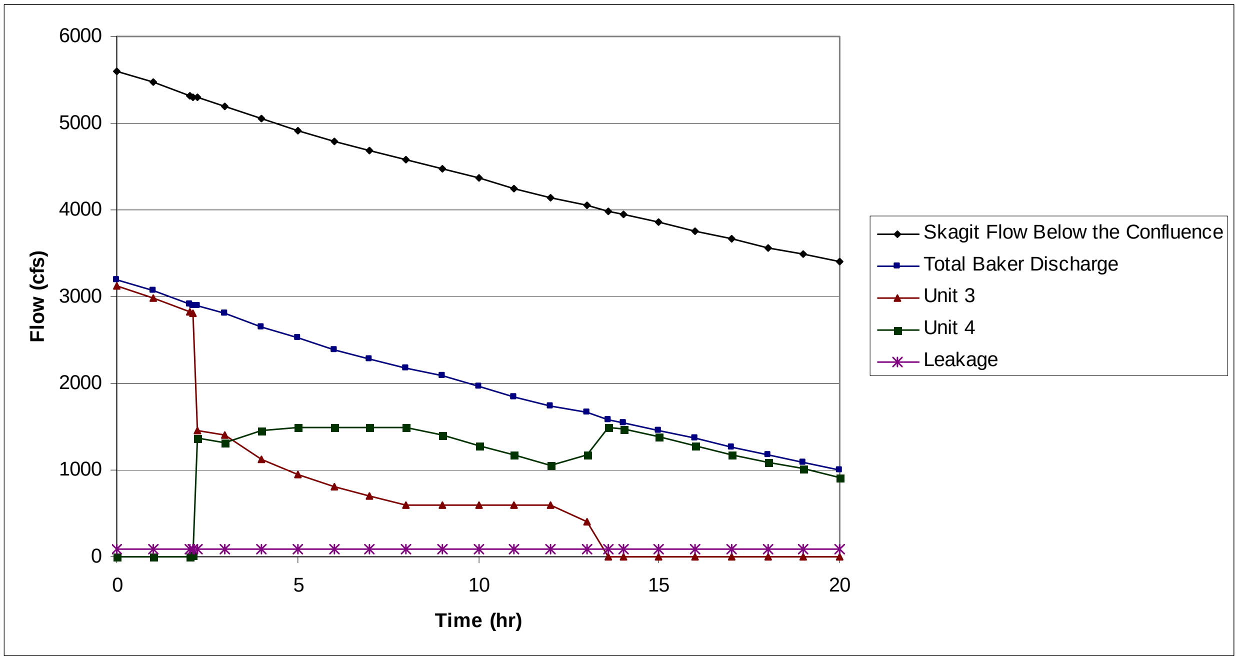

Figure 3: Plot of downramp at the Baker River Project using existing and proposed powerhouse configurations from 3,200 cfs to 1,000 cfs (minimum flow) during September, with extremely low flow on the Skagit River (ramp rate of 1 inch per hour).

Figures 2 and 3 illustrate that ramping constraints for the Baker River Project can be met through turbine discharges without the need for flow continuation facilities. Consequently, including flow continuation facilities would be superfluous to the analysis because they would not contribute to meeting ramping rate requirements.

Additionally, there is virtually no difference between two 750 cfs units and a single 1,500 cfs unit at the new powerhouse, because the same amount of water will be passed in both situations and similar operating constraints exist for the units.

While ramping is generally associated with powerhouse operations, ramping requirements can also be achieved by using spill as the primary water source and gradual spill gate operations to meter flow changes.

The only times when flow continuation facilities would come into play would be when the new powerhouse is forced offline, Unit 3 cannot be started to replace generation, and spill is not an option because Lake Shannon is below the spill crest. These situations are anticipated to occur less than once per year. See appendix A for a list of forced outages at Lower Baker Dam over the past few years.

3.3 Anticipated Environmental Benefits of Flow Continuation Facilities

The environmental benefits related to the installation of the flow continuation valve are based on the source and frequency of the events causing flow interruption.

As described in sections 3.1 and 3.2 above, the project can routinely meet minimum instream flow requirements and powerhouse flow reductions based on ramping rate prescriptions in SA 106 by using the existing and proposed generating unit configuration without flow continuation facilities.

The environmental value of the flow continuation facilities is limited to a combination of several specific and infrequent or unlikely conditions involving the inability to pass flow through the powerhouse in sufficient volume to meet MIF or ramp rate constraints. For example, if the elevation of Lake Shannon is below the spill gate level and a machine malfunction or load rejection prevents the new powerhouse from passing flow above no-load conditions, then MIF and ramping constraints cannot be met. No other conditions aside from operator error or a catastrophic tunnel failure can precipitate a flow reduction below minimum flow or in excess of ramp rate constraints.

However, based on the operating record, a scenario of load rejection or machine trip with a low reservoir is estimated to occur less than once annually. See appendix A for a list of forced outages at Lower Baker Dam over the past few years. Consequently, the environmental benefit of the flow continuation valve under the most likely scenario requiring its use is minimal.

A flow continuation valve could, however, serve as a backup for other operational purposes. Releasing flow through a valve instead of an operating unit would permit work on a unit or reserving a unit's generating capacity for other purposes. In the latter case, using the unit for reserve generation instead of an equivalent thermal generating unit would provide an environmental benefit by improving air quality.

In summary, due to the infrequent need for an SBV and the availability of other means to provide similar functionality, environmental benefits alone do not provide a sufficient rationale to install a valve.

3.4 Estimated Cost of Installing Flow Continuation Facilities and Other Operational Changes

The May 2007 15% URS (formerly WGI) design report cost estimate for an SBV installed concurrently with Unit 4, is $1,026,000. See appendix B, which is an excerpt from the construction cost estimate. Given the current construction cost environment, we anticipate that 2010 costs would be similar to the 2007 estimates. Section 11 in the cost estimate table provides the estimated cost, with subsections 11.1 through 11.10 providing detailed costs that sum up to the total cost. PSE has considered the benefits of installation of the bypass valve, and we believe that the tangible operational benefits outweigh the approximately 1.5% additional cost to the project.

3.4.1 Economic Analysis Supporting Installation of Flow Continuation Facilities

PSE evaluated the benefits of a synchronous bypass valve in adding operational flexibility (upward and downward adjustments to generation) to the proposed powerhouse. It concluded that installation of an SBV would allow Unit 4 to follow load quickly and provide 30 MW of operational flexibility. It is estimated that such load balancing is required for approximately 100 hours a year in the near term, increasing in the future. These hours represent situations during which PSE's system is constrained by high wind variability, mid-Columbia restrictions, and unexpected outages. To value this ancillary benefit, the next- and least-cost alternative — a flexible simple cycle combustion turbine unit (CT unit) — was evaluated. We concluded that a CT unit operating over a 10-year period incurs a present value cost of $1,071,000 — essentially the equivalent of the initial investment of the bypass valve. It became clear that while PSE could use a CT unit to provide equivalent operational flexibility, the valve provides more long-term operational flexibility and thus more value for the same initial investment.

Based on this analysis, an SBV is justified as an operational alternative even if it is not solely justified environmentally or for compliance. Therefore, PSE is proposing installation of a synchronous bypass valve with a hydraulic capacity of 1,500 cfs, equivalent to the new powerhouse capacity. The SBV will be configured to allow for a full range of discharges.

3.4.2 Powerhouse Configuration Alternative to Two 750 cfs Units.

Although not part of this study, though closely linked, is the powerhouse siting evaluation. The site for the new powerhouse with two 750 cfs units contemplated at the time of license filing was selected to use certain existing facilities, such as penstocks and foundations, to restore the generating capacity that existed at Lower Baker Dam prior to 1965. However, construction costs and other factors not fully quantified at that time led to the selection of a new location.

This evaluation of alternative sites found several factors that contribute to increased costs at the location proposed in the license. These include unstable slope conditions above the new powerhouse construction area, significant logistical complications such as the need for temporary bridges, and the need to shore destabilized slopes in the excavated area of the powerhouse, and general costs of major construction in a very tight area of access. Thus, the site of the powerhouse was moved to the south of the existing Unit 3. This is a more open location, away from unstable slopes. However, this location requires extension of the tunnel and penstock to connect the powerhouse to the surge tank. The reduction of construction and slope stability risks led PSE to propose the new powerhouse location using a single penstock and turbine.

A single Francis turbine/generator at the new location is more economical than twin 750 cfs units. The functional capabilities of the twin and single units are essentially the same. With an SBV to offset any interruption of generation capacity, PSE determined that the powerhouse design could be modified be to permit a single unit of 1,500 cfs rather than two 750 cfs units as proposed in the license.

4.0 Conclusion

Puget Sound Energy evaluated flow and ramping conditions for the Baker River Project related to existing and proposed facilities to determine if flow continuation facilities were warranted. The results of the study indicate that all flow and ramping conditions could be met through a combination of power generation and spill, and that flow continuation facilities are not justified on merely an environmental basis. PSE determined that there were compelling economic reasons to install a flow continuation valve to serve as a backup for other possible operations, and to provide an alternative to non-renewable generation for spinning reserve and load-balancing requirements that continue to increase as wind and other non-firm generation is integrated into the regional system.

Consequently, in fulfillment of LA 407, PSE concludes that a flow continuation valve is justified.

Appendix A: Lower Baker Forced Outages, January 2005 Through November 2009

Month and Year	Start Date	Duration	Description	Follow-up
April '09				
	4/23	3:28	Loss of transmission lines — random car pole incident.	Low-probability event. Could meet instream flow with SBV.
January '09				
	1/7	3:05	Unit 3 tripped. Bump on distribution system probable cause. Road to power house blocked by a slide.	
October '08				
	10/21	55:00	Governor training class and also maintenance on Governor 3.	
	10/23	47:55	Governor 3 oil pump found to have a badly worn shaft on pump gears. Sent out for repair.	
May '08				
	5/1	134:50	Leak in penstock bypass valve pipe — same as 4/27 outage.	Outage caused by corroded pipe. Replaced by Matt McCartney, May '08
April '08				
	4/27	84:10	Leak in penstock at bypass valve pipe — continued into May.	Outage caused by corroded pipe. Replaced by Matt McCartney, May '08
March '08				
	3/9	5:25	Bad order 41 excitation relay (latching relay with a burned-out unlatching coil).	
	3/20	0:50	Rewired 41 excitation on 3/19/08. Relay would not latch on startup. Rewired to original configuration.	
January '08				
	1/2	0:45	Main 480 V emer. dist. breaker opened. Cause unknown. Crew looking at problem.	

Month and Year	Start Date	Duration	Description	Follow-up
November '07				
	11/6	0:35	Unit did not start. Operator paged. Cooling water low flow. Bled lines, cut in unit, and loaded to 40 MW	
January '07				
	1/16	0:20	Unit 3 tripped . Cause field over current. Bus voltage 13.9+ Vars 13+ field v 265 field amps 850	
December '06				
	12/14	42:45	High winds in area caused both Sedro/Baker lines to open, causing unit to trip.	Weather caused outage, usually in a position to spill to maintain flood control, could maintain instream flow with SBV.
November '06				
	11/15	41:00	Strong damaging winds took out both Sedro #1 and # 2 lines, causing Unit 3 to trip offline.	Weather caused outage, usually in a position to spill to maintain flood control, could maintain instream flow with SBV.
October '06				
	10/27	0:10	Stator high-temp trip while testing at 85 MW.	
May '06				
	5/22	0:55	Unit #3 tripped. Found cause to be low cooling water flow.	
April '06				
	4/25	69:00	Corrected failed secondary cables, changed fuse holders to a larger frame, and installed 50-amp fuses, cause for long outage.	
February '06				
	2/10	3:15	Electrician working behind board. Lifted positive lead on circuit #5, unit tripped offline.	
December '05				

Month and Year	Start Date	Duration	Description	Follow-up
	12/25	1:25	Unit 3 tripped . Baker-Sedro line #1 tripped. High winds caused outage.	Weather caused outage, usually in a position to spill to maintain flood control, could maintain instream flow with SBV.
July '05				
	7/9	504:00	Turbine guide bearing wiped, unit down, and reinstalled.	
March '05				
	3/9	10:50	Turbine bearing service and testing for return to service. Outage completed.	
February '05				
	2/18	2:05	Turbine guide bearing over-temperature trip. Normal S/D and lock-out.	
January '05				
	1/16	0:35	Cooling water low flow. Bled water lines, then started unit manually.	

Appendix B: Lower Baker Powerhouse Construction Cost Estimate Summary by Major Feature

PSE | Lower Baker 15% Design | Rev 3/7/07

LOWER BAKER PH REHAB - DETAILS OF 1,500 cfs PH SCHEME, ALT "C"
PRE-FEASIBILITY CONSTRUCTION COST ESTIMATE (Dec 2006 $)

Ref Code	DESCRIPTION	SUMMARY PRICING QUANT	UNIT	UNIT PRICE	AMOUNT	CrewHr/ Unit	CREW LABOR Total Hrs	Hrly Rate	TOTAL Amt	PERM MAT'L per Unit	TOTAL Amt	EQUIPMENT per Hour	TOTAL Amt	CONTRTR'S OVRHEAD & PROFIT Amt	per Unit	TOTAL Amount	Prdct Rate	Wrk Hrs	No. Crews	No. Shfts	No. Days	Reference	Other Notes	No. Pcs Mob
10.11	Cable Trays and Supports	Included in LS Above																						
10.12	Conduits and Fixtures	Included in LS Above																						
10.13	Grounding System	Included in LS Above																						
10.14	Communication Equipment	Included in LS Above																						
10.15	Mics. Electrical	Included in LS Above																						
10.16	Main Step-up Transformer	Included in Item 8 above														0						Included above		
10.17	Equipment and structures	Included in LS Above														0								
10.18	HV connections (Transmission)					Not Included (by PSE)										0								
11	**Bypass & Instream Flow Valve**	1	LS		1,026,852																			
11.1	Concrete Valve Chamber	176	CY	subtotal																				
11.1.1	CIP Base Wall Supports	20	CY	508	10,160		Use "LB_PH_1500cfs.xls, Conc$$15" for unit pricing									10,160		71	1	7.1	7.1	See Calc Sheet		
11.1.2	CIP Valve Chamber Elev Slab (Bottom)	36	CY	1,358	48,888		See "LB_PH_1500cfs.xls, Conc$$14" for unit pricing									48,888		123	1	12.3	12.3	See Calc Sheet	Avg Prep & Placement Time	
11.1.3	CIP Valve Chamber Walls	84	CY	508	42,672		See "LB_PH_1500cfs.xls, Conc$$15" for unit pricing									42,672		71	1	7.1	7.1	See Calc Sheet	Avg Prep & Placement Time	
11.1.4	CIP Valve Chamber Elev Slab (Top)	36	CY	1,299	46,764		See "LB_PH_1500cfs.xls, Conc$$16" for unit pricing									46,764		123	1	12.3	12.3	See Calc Sheet	Avg Prep & Placement Time	
11.1.5	Steel Plate Liner of Valve Chamber	18,600	LBS	3.20	59,520	0.002	37.2	376	13,991	1.50	27,900	100	3,720	13,683	3	59,294	500	37	1	3.72	3.7	25 mT R/T Crane; 1 Crn Opr, 1 Oilr, 4 Irnwkr; 4 Sm Tls		
11.1.6	Steel Grating for VC Outlet	2,000	LBS	15.20	30,400	0.012	24.0	376	9,026	6.00	12,000	100	2,400	7,028	15	30,454	83	24	1	2.4	2.4	25 mT R/T Crane; 1 Crn Opr, 1 Oilr, 4 Irnwkr; 4 Sm Tls		
11.2	New 8' & 5' dia. Steel Pipe from 12' Dia Penstock to Valve																							
11.2.1	8' Dia, 3/8" Th, 60' Long	23,091	LBS	3.60	83,128	0.002	46	220	10,179	2.25	51,955	35	1,616	19,125	3.59	82,875	500	46	1	4.618	4.6	Welder, Case 580 Bkhoe w/Opr & 2 Lab, 1 Welder; Welding Supplies		
11.2.2	5' Dia, 1/4" Th, 30' Long	4,811	LBS	3.60	17,320	0.002	10	220	2,121	2.25	10,825	35	337	3,985	3.59	17,267	500	10	1	0.962	1.0	Welder, Case 580 Bkhoe w/Opr & 2 Lab, 1 Welder; Welding Supplies		
11.3	New 60" dia. Rotovalve Valve	1	LS	300,000	300,000											300,000						Quote from Rodney Hunt		
11.4	Installation of Rotovalve	1	LS	30,000	30,000											30,000								
11.5	New 60" dia. Fixed Cone Valve	1	LS	225,000	225,000											225,000						Steel Fab & Rodney Hunt quotes for 6' & 5' Dia Valves		
11.6	Installation of Fixed Cone Valve	1	LS	40,000	40,000											40,000								
11.7	Flow Meter (Accusonic)	1	LS	25,000	25,000											25,000								
11.8	Misc. Electrical Equipment and P	1	LS	20,000	20,000											20,000								
11.9	Mechanical Equipment				0											0								
11.9.1	Gen Mechanical	1	LS	20,000	20,000											20,000								
11.9.2	Sump Pump	1	ea	5,000	5,000											5,000								
11.9.3	Penstock Drain Valve	1	ea	5,000	5,000											5,000								
11.9.4	Misc. Mechanical	1	LS	8,000	8,000											8,000								
11.10	Misc Metals	1	LS	10,000	10,000											10,000								
12	**Support of Start-up & Testing**	1	LS		238,150																			
12.1	Startup & Testing Support	1	LS	238,150	238,150	450	450	282	126,945		0	125	56,250	54,959	238,154	238,154	0.00	450	1	45	45.0		1 Mlwrt, 2 Elect, 1 PE for 1.5 Months	
13	**Erosion & Sediment Control**	1	LS		377,796				Note: Use Silt Fence around Job Perimeter															
13.1	Silt Fence	1,800	LF	2.32	4,176	0.010	18	96	1,735	0.75	1,350	30	540	544	2	4,169	100	18	1	2.25	2.3	1Flatbed Trk w/2 Lab & Sm Tools; Fence Mat'l		
13.2	Hay Bale Check Dams	1	LS	4,000	4,000										4,000	4,000						LS Allowance		
13.3	Silt Curtain In L Baker River	1	LS	20,000	20,000										20,000	20,000						LS Allowance		
13.4	Remove Silt Fence & Hay Bales	20	HRS	261	5,220	1.000	20	155	3,108	0.00	0	45.00	900	1,202	261	5,210	1.0	20	1	2	2.0	Case 580L w/Opr & 2 Laborers; Flat Bed Trk; Misc Supplies		
13.5	Clean-up & Erosion Control (2 hr/day)	1,200	HRS	287	344,400	1.000	1,200	155	186,480	20.00	24,000	45.00	54,000	79,344	287	343,824	1.0	1,200	1	120	120.0	Case 580L w/Opr & 2 Laborers; Flat Bed Trk; Misc Supplies		

Appendix C: Reviewer Comments

On May 6, 2010, PSE sent a review draft of this flow continuation study report to the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Washington Department of Fish and Wildlife, as directed by article 407 of the Baker River Hydroelectric Project license. This appendix presents the comments made by the report's reviewers and PSE's response to these comments.

Reviewer Comments and PSE Responses

Comment	Puget Sound Energy Response
Keith Kirkendall, National Marine Fisheries Service, dated June 18, 2010.	
NMFS agrees that the economic reasons are important, but we arrive at the same conclusion supporting installation of the SBV on environmental reasons alone. The Skagit River, to which the Baker River is tributary, support [sic] Endangered Species Act threatened populations of Puget Sound Chinook salmon, steelhead trout, and bull trout. Skagit River Chinook and steelhead have been shown to be susceptible to mortality by dewatering caused by sudden flow reductions. The flow reductions can occur either from normal project operation downramping (when downramping is not operationally restricted) or from when project generators switch off line under infrequent emergency conditions. A flow continuation valve is even more necessary because flow continuation is instant and is not delayed by the lag time for spill to reach the dewatered stream reach. Also, such conditions often occur in the spring months when newly emerged salmon fry are present and especially vulnerable to stranding. Spring reservoir levels in lake Shannon are typically lower than the spill gate elevation, so a flow continuation valve is the only reliable sourced of discharge under emergency outage conditions. Emergency outage conditions, even though infrequent, result in dewatering that causes significant fish mortality. NMFS believes that losses of public environmental resources of this nature are PSE's liability. Therefore, we believe that the cost of the SBV is a reasonable environmental protection measure.	Comment noted. Thank you for your reply.

Comment	Puget Sound Energy Response
Brock Applegate, Washington Department of Fish and Wildlife, dated June 11, 2010	
The Washington Department of Fish and Wildlife (WDFW) has reviewed the License Article 407 flow continuation Study. We have one comment below concerning the plan. The WDFW appreciates Puget Sound Energy's (PSE) willingness to collaborate with WDFW on their many license implementation activities on the Baker River Hydroelectric Project. WDFW requests that PSE test the new facility and flow continuation valve to confirm PSE can achieve the downramping rate and flow criteria in the license. We recommend that PSE add a "Flow and Downramping Rate Test Protocol" of the new facility and flow continuation valve into the Flow Continuation Study. As a contingency measure, PSE should replace the flow continuation valve if it cannot operate it for at least 24 hours continuously or supply the flows and downramping rates required in the license articles. If PSE can satisfy the preceding recommendation, WDFW gives its approval of the License Article 407 Flow Continuation Study. The flow continuation valve should perform its function of supplying downramping rates and flows prescribed in the license for at least 24 hours. WDFW appreciates PSE's inclusion of the flow continuation valve in their project to help improve fish habitat downstream.	PSE will incorporate 24-hour continuous operation tests under various flow conditions into our acceptance testing plan for the bypass valve. Should the bypass valve fail to meet PSE's expectations during day-to-day operations, PSE will modify the valve as needed.
Lou Ellyn Jones, U.S. Fish and Wildlife Service, received May 14, 2010	
I have reviewed the flow continuation study and have no comments.	Thank you for your reply.

Additional Comment

Kim Lane of PSE distributed this flow continuation study to meeting attendees for discussion at the Aquatic Resource Group meeting on May 11, 2010 and the Baker River Coordinating Committee meeting on June 8, 2010. At the June 8 meeting, Stan Walsh of the Upper Skagit Indian Tribe requested that PSE meet instream flow requirements during pressure tunnel outages (such as during tunnel inspection) by spilling. In response to this request, PSE will exert its best efforts to maintain required instream flow under all outage conditions.

Comment Correspondence

State of Washington
Department of Fish and Wildlife
P.O. Box 1100, 111 Sherman St. (physical address), La Conner, Washington 98257-9612

June 11, 2010

Puget Sound Energy
Kim Lane, Baker License Implementation Manager
10885 N.E. 4th Street, PSE-09N
Bellevue, WA 98004-5591

Subject: Baker River Hydroelectric Project, Federal Energy Regulatory Commission No. 2150—License Article 407 Flow Continuation Study

Dear Mr. Lane:

The Washington Department of Fish and Wildlife (WDFW) has reviewed the License Article 407 Flow Continuation Study. We have one comment below concerning the plan. The WDFW appreciates Puget Sound Energy's (PSE) willingness to collaborate with WDFW on their many license implementation activities on the Baker River Hydroelectric Project.

WDFW requests that PSE test the new facility and flow continuation valve to confirm PSE can achieve the downramping rate and flow criteria in the license. We recommend that PSE add a "Flow and Downramping Rate Test Protocol" of the new facility and flow continuation valve into the Flow Continuation Study. As a contingency measure, PSE should replace the flow continuation valve if it cannot operate it for at least 24 hours continuously or supply the flows and downramping rates required in the license articles.

If PSE can satisfy the preceding recommendation, WDFW gives its approval of the License Article 407 Flow Continuation Study. The flow continuation valve should perform its function of supplying downramping rates and flows prescribed in the license for at least 24 hours. WDFW appreciates PSE's inclusion of the flow continuation valve in their project to help improve fish habitat downstream.

WDFW welcomes the opportunity to work with PSE on future projects. We value our working relationship with PSE and encourage future dialog. If you have any questions or need more

Figure C1. Reply from Brock Applegate, Washington Department of Fish and Wildlife.

Mr. Kim Lane
June 4, 2010
Page 2 of 2

information or clarification to comments from the WDFW, please feel free to call me at (360) 466-4345 x254.

Sincerely,

Brock Applegate
Fish and Wildlife Biologist

Cc: Brett Barkdull, WDFW La Conner
David Brock, WDFW Mill Creek
Wendy Cole, WDFW La Conner
Bob Everitt, WDFW Mill Creek
Annette Hoffmann, WDFW Mill Creek
Mark Hunter, WDFW Olympia

Figure C1, continued.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232-1274

June 18, 2010

Kim Lane, Manager
Baker Project License Implementation
Puget Sound Energy
Post Office Box 97034
Bellevue, Washington 98009-9734

Dear Mr. Lane:

NOAA's National Marine Fisheries Service (NMFS) received and reviewed Puget Sound Energy (PSE)'s License Article 407 Flow Continuation Study dated May 2010. PSE's review concludes that instream flows and downramping rates can generally be met ". . . by normal project operations without special flow continuation facilities." PSE also concludes that environmental benefits alone do not provide a sufficient reason to install a flow continuation valve because the conditions that require one are infrequent and unlikely. PSE supports installation of a flow continuation valve synchronous bypass valve (SBV) for economic reasons of standby generation and spinning reserve.

NMFS agrees that the economic reasons are important, but we arrive at the same conclusion supporting installation of the SBV on environmental reasons alone. The Skagit River, to which the Baker River is tributary, support Endangered Species Act threatened populations of Puget Sound Chinook salmon, steelhead trout, and bull trout. Skagit River Chinook and steelhead have been shown to be susceptible to mortality by dewatering caused by sudden flow reductions. The flow reductions can occur either from normal project operation downramping (when downramping is not operationally restricted) or from when project generators switch off line under infrequent emergency conditions. A flow continuation valve is even more necessary because flow continuation is instant and is not delayed by the lag time for spill to reach the dewatered stream reach. Also, such conditions often occur in the spring months when newly emerged salmon fry are present and especially vulnerable to stranding. Spring reservoir levels in Lake Shannon are typically lower than the spill gate elevation, so a flow continuation valve is the only reliable source of discharge under emergency outage conditions.

Emergency outage conditions, even though infrequent, result in dewatering that causes significant fish mortality. NMFS believes that losses of public environmental resources of this nature are PSE's liability. Therefore, we believe that the cost of the SBV is a reasonable environmental protection measure.

Figure C2. Reply from Keith Kirkendall, National Marine Fisheries Service.

2

Thank you for the opportunity to review and comment on PSE's Flow Continuation Study. If you need more information about this subject, please contact Steve Fransen at 360-753-6038 or steven.m.fransen@noaa.gov.

Sincerely,

Keith Kirkendall

Keith Kirkendall, Chief
FERC and Water Diversion Branch
Hydropower Division

Figure C2, continued.