EXHIBIT C – CONSTRUCTION HISTORY AND PROPOSED CONSTRUCTION

Klamath Hydroelectric Project
(FERC Project No. 2082)

PacifiCorp
Portland, Oregon

Version: February 2004

CONTENTS

Tables

C1.0 PURPOSE

Exhibit C describes the construction and operation history of the Klamath Hydroelectric Project, as stipulated in Title 18 Section 4.51 (d) of the U.S. Code of Federal Regulations:

> Exhibit C is a construction history and proposed construction schedule for the project. The construction history and schedules must contain:
>
> (1) If the application is for an initial license, a tabulated chronology of construction for the existing projects structures and facilities described under paragraph (b) of this section (Exhibit A), specifying for each structure or facility, to the extent possible, the actual or approximate dates (approximate dates must be identified as such) of:
>
> (i) Commencement and completion of construction or installation;
>
> (ii) Commencement of commercial operation; and
>
> (iii) Any additions or modifications other than routine maintenance;
>
> and
>
> (2) If any new development is proposed, a proposed schedule describing the necessary work and specifying the intervals following issuance of a license when the work would be commenced and completed.

C2.0 EAST SIDE AND WEST SIDE DEVELOPMENTS

C2.1 INTRODUCTION

The East Side and West Side developments are a part of the existing Project; however, they are not part of the proposed Project for this license application. PacifiCorp plans to decommission these developments.

C2.2 CONSTRUCTION HISTORY

The U.S. Bureau of Reclamation's (USBR) Link River dam and PacifiCorp's associated 3.2-megawatt (MW) East Side and 0.6-MW West Side hydroelectric developments are the most upstream of the existing Project developments. The developments are located near river mile (RM) 254 within the city limits of Klamath Falls, Oregon. Link River dam controls the outlet of Upper Klamath Lake, and was built in 1920-1921 to provide water control for both the hydroelectric and irrigation projects. As completed, the concrete Link River dam is 435 feet long with an average height of 16 feet.

East Side powerhouse, originally known as the H.V. Gates' Klamath Falls Light and Water Company's powerhouse (the first electrical provider in the Klamath Falls region) was built on the east side of the Link River and went into operation in 1895. "This plant was located in an old wooden building on the east bank of the Link River at springs near the North end of Conger Avenue" and was expanded in 1906 by a 12-foot by 20-foot concrete and galvanized metal-roofed structure to house additional equipment (Boyle, 1976). Purchased by the Moore brothers, the East Side Power Plant No. 1 (as the Gate's building is called) operated until 1908. East Side Powerhouse No. 2, a 20-foot by 40-foot L-shaped wooden building, was constructed in 1905-6 and operated until June 1917 "…when it had deteriorated sufficiently to need rebuilding" (Boyle, 1976).

The present East Side powerhouse was built in 1924 and went into operation in August of that year. The East Side powerhouse is the first automatic remote controlled plant of the existing Project; it is fed via a ½-mile-long 12-foot-diameter flowline that begins at the Link River dam.

The West Side powerhouse was built by Rufus and Charles Moore's Klamath Light & Power Company as the initial effort in their competition with the Gates-owned Klamath Falls Light and Water Company. The powerhouse was completed and put into operation in 1908. Originally designed with what has been referred to as "…a unique wood flume spillway which discharged surplus water over the top of the powerhouse…," this feature was removed in 1921 as the result of changes to the Link River dam that allowed the construction of a new saw-tooth spillway with a concrete-lined chute to the river (Boyle, 1976).

A summary of the construction and operation history for both the East Side and West Side Developments is presented in Table C2.2-1.

Table C2.2-1. Construction and operations history of the East Side and West Side developments.

Year	Development Facilities	Description
1908	West Side powerhouse	This plant was constructed by R.S. and C.S. Moore. Construction was completed in 1908. No other information is available as to the chronology of construction at this plant.
1921	West Side powerhouse	Wood flume removed as a result of changes to the Link River dam. Constructed of saw-tooth spillway with a concrete-lined chute.
Dec 1923	East Side complex	Camp construction was started for current powerhouse.
Feb 1924	East Side powerhouse	Erection of powerhouse started.
Feb 1924	East Side waterway	Construction of canal began.
Mar 1924	East Side waterway and powerhouse	First concrete was placed.
Apr 1924	East Side waterway	Intake construction was started.
Jun 1924	East Side waterway	Penstock and pipeline work began.
Aug 1924	East Side access	Erection of bridge started.
Aug 1924	East Side powerhouse	Powerhouse began commercial operation.

C2.3 OPERATIONS HISTORY

The East Side Development began commercial operation in August 1924. The start of commercial operation for the West Side Development is unknown. Since 1921 operational changes have occurred at both the Link River dam and the East Side and West Side powerhouses.

In the mid-1990s, entrainment of Endangered Species Act (ESA)-listed fish species including the Lost River sucker (*Deltistes luxatus*) and the shortnose sucker (*Chasmistes brevirostris*) into the East Side and West Side power canals was determined to occur frequently. Most of the entrainment was identified to be occurring in August and September and primarily at night due to the behavioral characteristics of these species. The USFWS requirements set forth in the 2001 Biological Opinion included a complete shut down at the West Side powerhouse for the months of August and September and a reduction in diversion to 200 cfs at night during the same period at the East Side facility (USFWS, 2001). In an effort to assure protection of the latest species, PacifiCorp has expanded the protective period (PacifiCorp letter July 23, 2001, to USBR). Such operations now occur every year from approximately July 27 through October 17.

The 2001 U.S. Fish and Wildlife Service (USFWS) Biological Opinion also included a new instream flow requirement that mandates the release of 250 cubic feet per second (cfs) at Link River dam during summer months when adverse water quality conditions typically occur. A 90 cfs minimum is in place for the remainder of the year.

In the late 1980s, ramp rates for the Link River dam were determined in cooperation with Oregon Department of Fish and Wildlife (ODFW). Ramp rates are based on a decrease in cfs and not a direct change in river stage. Ramp rates for termination of spill at the dam are as follows:

- 100 cfs/30 minutes (between 500 and 1,500 cfs)

- 50 cfs/30 minutes (between 300 and 500 cfs)
- 20 cfs/5 minutes (between 0 and 300 cfs)

C2.4 ADDITIONS AND MODIFICATIONS HISTORY

Additions and modifications to the East Side and West Side developments are documented in Table C2.4-1.

Table C2.4-1. Additions and modifications history of the East Side and West Side developments.

Year	Development Facilities	Description
1963	East Side	Coffer dam modified.
1970-1980	East Side	Steel pipe installed.
1972	East Side waterway	Constructed dike to protect flowline and substation.
1975	East Side complex	Chain link fence installed.
1986	East Side access feature	Constructed flowline access bridge.
1986	East Side complex	Temporary irrigation system installed.
1986	East Side waterway	Wood stave pipe upgraded.
1991	East Side powerhouse	Powerhouse ventilation modified.
1995	East Side waterway	Flowline liner installed.
1995	East Side powerhouse	Installed a rotor restraint.
1997	East Side waterway	Constructed trash rake system at the flowline intake structure.
2002	East Side waterway	Repaired wood stave supports.
2002	East Side waterway	Installed liner in wood stave flowline.
2003	East Side waterway	Flowline cradle repaired.
1963	West Side access feature	Bridge overpass constructed.
1973	West Side waterway	Canal overflow spillway rebuilt.
1975	West Side Access Feature	Log bridge constructed.
1991	West Side powerhouse	Powerhouse ventilation modified to improve air conditioning to enhance generator cooling.
1991	West Side Waterway	Rockslide debris removed from spillway section.
1993	West Side powerhouse	New control/communication cable installed from the control building.
1994	West Side powerhouse	Installed steel curb at governor oil tank.
1994	West Side Powerhouse	Oil spill containment and sump control modifications performed.
1994	West Side powerhouse	Powerhouse short-term foundation repaired.
1995	West Side powerhouse	Installed oil sensor well and probe.
1995	West Side Powerhouse	Installed a rotor restraint.
1996	West Side powerhouse	Replaced catch basin under south turbine.
1996	West Side waterway	Flume repaired on canal spillway.

C2.5 PROPOSED CHANGES

Proposed changes to the East Side and West Side developments are documented in Table C2.5-1.

Table C2.5-1. Proposed changes to the East Side and West Side developments.

Year*	Development Facilities	Description
2	East Side Development	Decommission the East Side Development.
2	West Side Development	Decommission the West Side Development.

* In the above, year does not reflect a specific calendar year, but the time after a new FERC license is granted when the activity will take place.

C3.0 KENO DEVELOPMENT

C3.1 INTRODUCTION

For the existing Project, PacifiCorp operates Keno dam to the benefit of USBR's Klamath Irrigation Project and other local irrigators, and to the benefit of dependent wildlife refuges (ODFW Miller Island Refuge and USFWS Lower Klamath Wildlife Refuge). For the future license, PacifiCorp is excluding the Keno Development from the relicensed Project because the development is no longer subject to FERC jurisdiction. In the original license, the FERC exercised jurisdiction over the Keno Development because it was anticipated that the development would include generation. See Pacific Power & Light Co., 34 FPC 1387 (1965). However, PacifiCorp has not installed generation at the development and does not intend to do so. Moreover, PacifiCorp's operation of the Keno Development does not substantially benefit generation at PacifiCorp's downstream Project facilities. As a result, there is no longer any basis upon which to conclude that the Keno development is subject to FERC jurisdiction.

C3.2 CONSTRUCTION HISTORY

In 1920, when “unnamed” San Francisco investors purchased the Keno Power Company, this general area was the site of not only a dam but also a small powerhouse that had provided the town of Keno with electricity. In 1921, California-Oregon Power Company (COPCO) (PacifiCorp’s predecessor) either replaced or augmented that plant with the installation of a 450-kilowatt (kW) generation unit that had previously been in use at the Gold Ray powerhouse in Jackson County (Taylor, 1964).

In 1931, the Keno regulating dam was constructed to regulate the flow of water between Klamath Falls and the site. The initial dam was known as Needle dam and was made of timbers. “The Bureau [of Reclamation] and COPCO, in a contract of July 3, 1930, provided that COPCO would build a regulating dam at Keno reef…”(Boyle, 1976). This dam was replaced with the present structure in 1966, At the same time generation activities ended and the powerhouse structure was removed.

The Keno Development consists of the Keno dam, which is a concrete gravity structure with a height of 25 feet and a crest length of 680 feet. The dam, which has no associated powerhouse, is located approximately 24 miles downstream of Link River dam. Currently, the Keno dam operates as a regulating project to control reservoir levels. A summary of the construction and operation history for the Keno Development is presented in Table C3.2-1.

Table C3.2-1. Construction and operations history of the Keno Development.

Year	Development Facility	Description
Sept 1931	Needle dam	Earth embankment completed.
Dec 1931	Needle dam	Construction of dam completed.
1966	Keno dam	Removed old dam.
1966	Keno dam	Constructed present dam.

C3.3 OPERATIONS HISTORY

On January 3, 1968, Pacific Power & Light Company (formerly COPCO, now PacifiCorp) and USBR entered into a contract to operate Keno dam. This contract was in response to the FERC license No. 2082, article No. 55, "The licensee shall enter into formal agreement with the United States Bureau of Reclamation for the purpose of regulating the level of Lake Ewauna and the Klamath River between Keno Dam and Lake Ewauna, and in the event that the Licensee and the Bureau fail to reach an agreement, the Commission will prescribe the terms of such regulation after notice and opportunity for hearing" (FPC, 1956). The 1968 contract requires PacifiCorp to maintain Keno reservoir at elevations between 4085.0 and 4086.5 feet whenever USBR is diverting water to the Klamath Irrigation Project. From the upper bounds to the lower bounds of these elevations is the equivalent of 18,500 acre-feet. The 1968 contract also requires PacifiCorp to take certain steps to facilitate the return flow of used irrigation water into the river at the Klamath Straits Drain (up to 300 cfs) and the Lost River Diversion Channel (up to 3,000 cfs). To operate in this manner requires close coordination between USBR and PacifiCorp on any issues where one party's operation of its project facilities might impact the other party. This coordination is particularly difficult and important in the spring when runoff can be naturally high and irrigators are pumping a large volume of water from their fields into Keno reservoir in preparation for the growing season. The 1968 Keno contract expires in 2006 coincidentally with PacifiCorp's current FERC license. Aside from the contract with USBR and at the request of irrigators with pumps on Keno reservoir, PacifiCorp maintains Keno reservoir at elevation 4085.4 ± 0.1 feet from October 1 to May 15 and 4085.5 ± 0.1 feet from May 16 to September 30 so that lake elevations are suited to irrigation pump depths. These elevations also allow for gravity flow from Keno reservoir onto ODFW's Miller Island Wildlife Refuge.

C3.4 ADDITIONS AND MODIFICATIONS HISTORY

Additions and modifications to the Keno Development are documented in Table C3.4-1.

Table C3.4-1. Additions and modifications history of the Keno Development.

Year	Development Facility	Description
1965	Needle dam	Needle dam repaired: repaired 12 damaged bents and 104 feet of walkway and handrails.
1965	Needle dam	Removed cofferdam in order to control high river flows in future winters.
1966	Keno reservoir	Channel improvements and appurtenant works performed.
1985	Access feature	Constructed temporary dock.
1991	Keno dam	Controls/instruments replaced.
1993	Keno park	Comfort station remodeled.
1993	Keno dam	Installed spillway warning system and debris boom.
2002	Keno dam	Dredging work of approximately 10,000 cubic yards of sediment done above dam to enhance flow to fish ladder intake.

C3.5 PROPOSED CHANGES

PacifiCorp considers the Keno development to no longer be under the jurisdiction of FERC. The dam will be operated per current operations under the jurisdiction of the State of Oregon.

C4.0 J.C. BOYLE DEVELOPMENT

C4.1 CONSTRUCTION HISTORY

The J.C. Boyle Development consists of the J.C. Boyle dam, powerhouse, and appurtenant facilities. Originally named the Big Bend dam, the J.C. Boyle dam was constructed in 1958. It is an earth embankment structure with a concrete gravity spilling section that is 68 feet tall and 693 feet wide. The resulting reservoir is a narrow impoundment of 420 surface acres (J.C. Boyle reservoir). The reservoir supplies water in a waterway to two 40-MW turbines located in a single powerhouse. The powerhouse is about 5 river miles downstream of the dam. It was intended for, and is currently operated as a "peaking" plant.

Placed in service on October 1, 1958, the J. C. Boyle powerhouse is the single largest generating facility of the Project. The plant has two outdoor-type generation units with a steel gantry crane system for repair and maintenance. A substation and small metal maintenance building are also located at the site. A summary of the construction and operation history for J.C. Boyle Development is presented in Table C4.1-1.

Table C4.1-1. Construction and operations history of the J.C. Boyle Development.

Year	Development Facilities	Description
July 1956	Dam	Excavation for dam was started.
Aug 1956	Dam	First concrete poured at dam site.
Nov 1956	Access feature	Permanent bridge below dam site was completed.
Jan 1957	Associated buildings	The two warehouse buildings were erected.
Apr 1957	Dam	Tunnel was holed through.
July 1957	Dam	Construction of cofferdam was started.
Nov 1957	Complex	Construction operations closed down for the winter.
Dec 1957	Associated buildings	Erected Armco warehouse at powerhouse site.
Feb 1958	Powerhouse	Powerhouse excavation completed.
June 1958	Dam	Tunnel lining completed.
Sept 1958	Dam	Fish ladder construction completed.
Oct 1958	Powerhouse	Powerhouse placed in commercial operation.

C4.2 OPERATIONS HISTORY

The J.C. Boyle Development began commercial operation in October 1958. The J.C. Boyle powerhouse is typically operated as a power peaking facility, especially when river flows are less than the rated turbine hydraulic capacity of 2,850 cfs. Due to turbine efficiencies, the preferred flow is 2,500 cfs and is typically the maximum flow at the plant. Power generation (and hence flow through the powerhouse) is shaped to coincide with PacifiCorp's peak customer electricity demand. During the summer months, peak demand typically occurs on weekdays in the late afternoons and early evenings. In general, on a daily basis, water storage occurs in the J.C. Boyle reservoir at night when generation is not occurring. Given the existing required ramp rate for the J.C. Boyle powerhouse (9 inches per hour), generation must begin well in advance of peak load

requirements so that the units are at full generation capacity for the peak demand period. The reservoir usually begins to fill sometime after dark, is full by early morning, and begins to be drawn down again during the daylight hours. The specific period of releases may vary widely depending on the anticipated time of peak demand.

C4.3 ADDITIONS AND MODIFICATIONS HISTORY

Additions and modifications to the J.C. Boyle Development are documented in Table C4.3-1.

Table C4.3-1. Additions and modifications history of the J.C. Boyle Development.

Year	Development Facilities	Description
1971	Access feature	Timber Bridge rebuilt.
1971	Dam	Headgate repaired due to corrosion.
1973	Dam	Constructed spillway stop log monorail.
1973	Access feature	Equipment bridge redecked.
1974	Waterway	Canal wall repaired.
1974	Dam	Spillway stop log monorail modified.
1975	Access feature	Rebuilt Boyle Bridge that was destroyed by fire.
1976	Operations house	Dam operator's house repairs/construction of masonry walls and vent performed.
1984	Waterway	Painted penstocks and surge tank.
1988	Fish screens	Installed fish screen wind curtains.
1988	Waterway	Flume shotcrete repaired.
1988	Fish screens	Constructed fish screen building.
1988	Dam	Spillway modified: extension of channel and reinforcement of the plunge pool to stop erosion.
1991	Maintenance bldg.	Rewired Red Barn Shop.
1991	Maintenance bldg.	Constructed equipment/storage building.
1992	Intake	Installed forced air heating and cooling system in fish screen building.
1992	Fish screen	Fish screen removed/replaced.
1993	Maintenance bldg.	Constructed fuel canopy.
1993	Dam	Steel decking on dam installed.
1993	Maintenance area	Fuel system modified.
1994	Powerhouse	Major overhaul and Unit 1 runner replaced.
1994	Access feature	Constructed forebay access road guardrail.
1994	Powerhouse	New scroll case coating applied.
1994	Powerhouse	Unit No. 1 high lift oil system installed.
1994	J.C. Boyle complex (Maintenance Area)	Fire water system modified.
1994	Dam	Modified dam intake and power plant stop log hoist.
1994	Dam	Improvements to trash rack and spillgate log hoist performed.
1995	Powerhouse	Spill Prevention, Control, and Countermeasure (SPCC) Plan modifications performed for oil spill control and containment.

Table C4.3-1. Additions and modifications history of the J.C. Boyle Development.

Year	Development Facilities	Description
1995	Intake	Four new fishscreens and stop log installed.
1997	J.C. Boyle complex	Septic system upgraded.
1998	Dam	Headgate upgraded.
1998	Powerhouse	Modified controls to restore automatic remote operation.
2002-2003	Intake	Installed new intake flume headgate.
2003	Dam	Painted spillgates and deck.

C4.4 PROPOSED CHANGES

Proposed changes to the J.C. Boyle Development are described in Exhibit A. The implementation schedule for these improvements is documented in Table C4.4-1.

Table C4.4-1. Proposed changes to the J.C. Boyle Development.

Year	Development Facilities	Description
2	Surface Collector	Install guide net and gulper-type surface collector system in forebay.
1	Fish Ladder Modifications	Increase exit pool trashrack spacing and add entrance pool weir.
1	Bypass Reach Gauge and Release Gate	Install river gauge to ensure 100 cfs release from dam. Add release gate if required.
3	Synchronous Bypass Valve	Install penstock bypass lines and discharge structures with bypass valves.

C5.0 COPCO NO. 1 DEVELOPMENT

C5.1 CONSTRUCTION HISTORY

The first Klamath River project of the California-Oregon Power Company (COPCO), the dam and powerhouse spanning Ward's Canyon in Siskiyou County was, for its day, a massive multi-million dollar enterprise. Initiated in 1911, when the Siskiyou Electric Light & Power Company began surveying the area "…just above the head of Ward's Canyon" (Rippon/Journal, 3 May 1911). Construction required "a branch feeder railroad," the old Klamath Lake logging railroad, that connected with the main line of the Southern Pacific Railroad south of Hornbrook. "Practically all the work done in the two years from June 1913 to June 1915 was in the foundation of the dam" and by January 1915 a total expenditure of just over $1 million still left the project a long way from a completion that was estimated to require an addition $2 million in funding (Boyle, 1976). With the reorganization of the company and the involvement of the McKee interests from San Francisco, work was renewed in 1916 after a hiatus.

By 1917, "…handicapped by a shortage of power for present demand…," COPCO announced it would put a force of 300 men to work on "its big dam and power plant about 2 miles below the Oregon State Line…as soon as the weather conditions permit." (Rippon,1985). On February 3 of the following year, the "…great Copco Dam and Power Plant were dedicated and placed into service."

In December 1921, work began to raise the height of Copco No. 1 dam and to install a second generation unit that would raise the plant's capacity to 30,000 horsepower. Both elements had been eliminated from the initial design as cost-savings measures and in recognition of the fact that the service in 1915 did not warrant that much additional capacity. In November 1921, the expansion project was completed.

The present Copco No. 1 dam is a 126-foot-high concrete arch dam with a dam crest length of 410 feet. The impoundment formed upstream of the dam is approximately 1,000 surface acres containing about 46,687 acre-feet of total storage. The Copco No. 1 powerhouse is located at the base of the dam and contains two 10-MW turbines that are typically operated in a "peaking" fashion. Water diverted through the Copco No. 1 powerhouse is directed to the Copco No. 2 diversion through 0.2 mile of river channel. A summary of the construction and operation history for the Copco No. 1 Development is presented in Table C5.1-1.

Table C5.1-1. Construction and operations history of the Copco No. 1 Development.

Year	Development Facilities	Description
May 1910	Complex	Survey work started.
Sept 1910	Dam	Foundation investigation started.
Apr 1911	Dam	Foundation investigation completed.
1911-1912	Dam	Abutment cuts at dam performed.
1911-1912	Dam	Tunnel.
1911-1912	Dam	Cleared reservoir site.
1911-1912	Complex	Operation of cinder cone.

Table C5.1-1. Construction and operations history of the Copco No. 1 Development.

Year	Development Facilities	Description
1911-1912	Dam	Installed compressor, head gates, operating platform, mixing plants, cable ways, wing dam, camp, temp power lines, temp water lines, mixing plants, and hoists.
1912-1917	Complex	Constructed rock quarry.
1912-1917	Dam	Erected dam.
1912-1918	Complex	Forebay completed.
1912-1918	Complex	Powerhouse completed.
1912-1918	Complex	Operation of RR completed.
February 1918	Complex	Plant in commercial operation (first generating unit).
1921-1922	Complex	Expansion of complex: dam height increased and second generating unit added.
November 1922	Complex	Second generating unit was in commercial operation.

C5.2 OPERATIONS HISTORY

The Copco No. 1 Development began commercial operation in February 1918. The second generating unit started operation in November 1922. Copco No. 1 dam is operated for power generation, some very minor flood control, and control of water surface elevations of Copco and Iron Gate reservoirs. Copco No. 1 powerhouse usually operates as a load-factoring (peaking) facility. As a load-factoring facility, it is operated to generate during the day when demands are highest, and to store water during the non-peak times (weeknights and weekend). When river flows are near or in excess of turbine hydraulic capacity, the powerhouse generates continuously and excess water is spilled. Copco reservoir can seasonally fluctuate 5.0 feet between normal minimum and full pool elevations, but the average daily fluctuation is about 0.5 feet.

C5.3 ADDITIONS AND MODIFICATIONS HISTORY

Additions and modifications to the Copco No. 1 Development are documented in Table C5.3-1.

Table C5.3-1. Construction and operations history of the Copco No. 1 Development.

Year	Development Facilities	Description
1981	Dam	Gate hoist repaired; new engine and pulley hoist installed.
1986	Access feature	Bridge replaced over the Klamath River.
1988	Powerhouse	Installed new water pipe from cistern to chlorinator.
1989	Dam	New hydro system level monitoring equipment installed.
1991	Powerhouse	Units 1 and 2 electronic governor installed.
1991	Powerhouse	Units 1 and 2 new static exciter installed.
1991	Powerhouse	Excitation/control panel work performed.
1991	Powerhouse	Emergency generator installed.
1992	Powerhouse	Installed brakes on the turbine/generator.
1992	Dam	Stop log system installed.

Table C5.3-1. Construction and operations history of the Copco No. 1 Development.

Year	Development Facilities	Description
1993	Powerhouse	New battery installed.
1993	Powerhouse	Modifications to syncrocloser M-0193B performed.
1993	Reservoir	Log boom replaced.
1993	Powerhouse	Installed noise lock panels in powerhouse.
1994	Powerhouse	Exterior metal siding installed on powerhouse.
1994	Dam	Modified stop log hoist.
1994	Powerhouse	Installed 15-ton crane.
1995	Powerhouse	Installed sump drains and tank vent system.
1995	Communications	Installed fiber optic cable between Copco No. 1 and No. 2.
1995	Powerhouse	SPCC modifications for oil spill control and containment performed.
1996	Unit No. 1	Overhauled unit and new runner.
1996	Powerhouse	Replaced broken regulator at solenoid with regulator from Copco No. 2 plant.
1996	Powerhouse	Motor control center upgraded.
1996	Flow line	Replaced Unit 1 and 2 penstock air vent pipes.
1996	Flow line	Installed penstock flow meters Unit 1 and 2.
1996	Unit No. 2	Major overhaul and runner replacement performed.
1997	Transmission	Upgraded 69 kV plant transmission line.
1997	Powerhouse	Re-roofed the powerhouse.
2001	Powerhouse Units 1 and 2	Overhauled the wicket gates.

C5.4 PROPOSED CHANGES

No minor modifications are proposed for Copco No. 1 at this time. Generation upgrades are described in Exhibit A, but no definite schedule exists at this time.

C6.0 COPCO NO. 2 DEVELOPMENT

C6.1 CONSTRUCTION HISTORY

Construction of the Copco No. 2 Development began less than 2 years after the expansion of Copco No. 1 in 1922.

The Copco No. 2 dam was completed in 1925, and at 33 feet high is small compared to Copco No. 1 dam. The dam has a crest length of 278 feet. The reservoir behind the dam is small, with only 73 acre-feet of capacity and no active storage; thus, the close operational relation to Copco No. 1 powerhouse. During typical operations, the No. 2 powerhouse flows match the Copco No. 1 powerhouse releases. The No. 2 powerhouse contains two 13.5-MW units with a combined hydraulic capacity of 3,200 cfs. A summary of the construction and operation history for the Copco No. 2 Development is presented in Table C6.1-1.

Table C6.1-1. Construction and operations history of the Copco No. 2 Development.

Year	Development Facilities	Description
May 1924	Complex	Camp construction started.
May 1924	Complex	Construction of railroad started.
May 1924	Dam	Test hole drilling started.
June 1924	Dam	Derricks installed.
June 1924	Complex	Railroad locomotive purchased.
June 1924	Dam	Cofferdam started.
June 1924	Dam	Bypass flume started.
July 1924	Dam	Compressors installed.
July 1924	Complex	Temporary road to dam site started.
July 1924	Waterway	Drilling at tunnel No. 1 started.
Sept 1924	Complex	Installed crusher and mixing plants.
Sept 1924	Waterway	Drilling at tunnel No. 2 started.
Sept 1924	Powerhouse	Powerhouse excavation started.
Sept 1924	Powerhouse	Tailrace excavation started.
Sept 1924	Substation	Substation excavation started.
Sept 1924	Dam	Work started at dam.
Oct 1924	Waterway	Work started on water conduit.
Oct 1924	Waterway	Work started on penstock.
Nov 1924	Powerhouse	First concrete poured at powerhouse.
Dec 1924	Powerhouse	Powerhouse excavation completed.
Jan 1925	Dam	First concrete poured at dam.
Jan 1925	Waterway	Started lining at tunnel No. 1.
Feb 1925	Waterway	Started lining at tunnel No. 2.
Feb 1925	Waterway	Excavation for surge chamber started.
Feb 1925	Powerhouse	Superstructure of powerhouse started.
Mar 1925	Waterway	Grouting on tunnel No. 1 started.

Table C6.1-1. Construction and operations history of the Copco No. 2 Development.

Year	Development Facilities	Description
May 1925	Dam	Installed gates at dam.
July 20, 1925	Complex	Plant placed in commercial operation.

C6.2 OPERATIONS HISTORY

The Copco No. 2 Development began commercial operation on July 20, 1925. Copco No. 1 and No. 2 operate together as load factoring facilities. Since flows through the system must be closely coordinated due to lack of significant storage and mandatory downstream flow requirements, flow through the Copco plants typically mimics flow (with a time lag) through J.C. Boyle on a daily average basis. Copco No. 2 has virtually no storage reservoir and is operated as a run-of-river plant based on releases at Copco No. 1. That is, Copco No. 2 hydraulic discharge is the same as the Copco No. 1 hydraulic discharge.

C6.3 ADDITIONS AND MODIFICATIONS HISTORY

Additions and modifications to the Copco No. 2 Development are documented in Table C6.3-1.

Table C6.3-1. Additions and modifications history of the Copco No. 2 Development.

Year	Development Facilities	Description
1981	Access feature	Rebuilt the plant access bridge.
1985	Operator's house	Replaced both operators' cottages.
1989	Copco No. 2 complex	Installed fire protection system.
1991	Powerhouse	Battery rack upgraded.
1991	Complex	Constructed new maintenance/shop building.
1992	Powerhouse	Installed electronic governors Units 1 and 2.
1993	Powerhouse	Static excitation installed Units 1 and 2.
1993	Powerhouse	Design modifications for powerhouse control room acoustics performed.
1994	Complex	Modified fuel system for site vehicles.
1995	Dam	Modified stop log hoist.
1995	Communications	Installed fiber optic cable between Copco No. 1 and No. 2.
1996	Powerhouse	Extended powerhouse retaining wall.
1996	Dam	Rebuilt diversion dam headgate.
1996	Copco No. 2 complex	Domestic water system improvements performed.
1997	Control center bldg.	Roof eve replaced on control center building.
2000	Powerhouse	Overhaul and runner replacement Unit 1 turbine performed.
2001	Dam	Spill gates painted.

C6.4 PROPOSED CHANGES

Proposed minor modifications to the Copco No. 2 development are described in Exhibit A. The implementation schedule for these changes is documented in Table C6.4-1. Generation upgrades are described in Exhibit A, but no definite schedule exists at this time.

Table C6.4-1. Proposed changes to the Copco No. 2 Development.

Year	Development Facilities	Description
1	Instream Flow Bypass	Install automated weir gate to release 10 cfs instream flow.

C7.0 FALL CREEK DEVELOPMENT

C7.1 CONSTRUCTION HISTORY

C7.1.1 Fall Creek Development

The oldest hydroelectric development in the Project is the Fall Creek powerhouse, which was constructed by the Siskiyou Electric Power Company in 1902-1903. Construction began at Fall Creek in 1902 and continued through the winter of 1902-03.

Taking advantage of the existing rail line, the initial work focused on the ditch and other water features. By late January 1903, sixteen railcar loads of 30-inch-diameter steel pipe had been delivered to the site. Construction of the powerhouse itself was underway by early March. In mid-September 1903, all work was completed and the Fall Creek powerhouse was put into operation.

On October 1, 1903, the *Siskiyou Semi-Weekly News*, of Yreka, published a lengthy article describing the new plant, reprinted from the *San Francisco Chronicle*. The first generation unit was a 500-kW General Electric AC unit and the "Fall Creek power plant has been arranged to receive two more generator units…" when needed (Rippon, 1985).

In 1906, Siskiyou Electric Power & Light Company initiated the first series of upgrades and expansions at the Fall Creek plant. In October of that year, with the 3-year-old plant running at full capacity, a new switchyard was finished and the second generation unit added.

The second Fall Creek unit went into operation in June 1907 and by 1909 the addition of a third unit to the facility was underway. This unit, the largest of the three, was apparently in operation by spring 1910 (Rippon, 1985). Currently, these units produce a total of 2.2 MW.

New transformers, upgraded switching yards and the installation of new and improved equipment have allowed the Fall Creek powerhouse to remain a functional and efficient unit for nearly over 100 years. Although virtually all of the once extensive surrounding support structures have been removed, the actual structures of the Fall Creek powerhouse and the adjacent transformer building remain much as they were when completed by the Siskiyou Electric Light & Power Company in 1903. A summary of the construction and operation history for the Fall Creek Development is presented in Table C7.1-1.

Table C7.1-1. Construction and operations history of the Fall Creek Development.

Year	Development Facilities	Description
1903	Powerhouse	Powerhouse was built along with transformer building/Unit No. 1/five operator cottages.
Sept. 1903	Complex	Unit No. 1 began commercial operation.
1907	Powerhouse	Unit No. 2 construction completed.
1910	Powerhouse	Unit No. 3 construction completed.
1954	Powerhouse	Powerhouse became semiautomatic.

C7.1.2 Spring Creek Diversion Dam and Canal

Spring Creek is a tributary to Jenny Creek that in turn feeds into Iron Gate reservoir. Spring Creek water can be diverted out of the Jenny Creek basin into the Fall Creek Basin for use at the Fall Creek powerhouse.

The Spring Creek earthen diversion was originally built near the turn of the last century and was approximately 2.5 feet high. Because this dam and the associated canal had fallen into disrepair, PacifiCorp improved the structure to its current state in 1988. The dam is still a small earthen embankment and is approximately 7 feet high. The dam spans the entire stream width (approximately 66 feet). The water from Spring Creek may be diverted through an earthen canal that empties in the Fall Creek drainage where the flows meander a short distance before reaching Fall Creek diversion dam. The Spring Creek facilities are not part of the existing FERC Project.

For at least a decade, PacifiCorp was denied the opportunity to use Spring Creek water for hydroelectric production because of a water rights dispute with an adjacent landowner. PacifiCorp and the landowner filed their respective claims with the Oregon Water Resources Department and a subsequent ruling was made in favor of PacifiCorp. PacifiCorp's water rights claim is for a diversion of 16.5 cfs from Spring Creek into Fall Creek for hydroelectric production at the Fall Creek facility. PacifiCorp has also recently submitted a water rights claim for 3.865 cfs from five unnamed springs which flow directly into the Spring Creek diversion canal.

C7.2 OPERATIONS HISTORY

The Fall Creek Development began commercial operation in September 1903. The Fall Creek Development has no storage reservoir, and as such, the 3-unit powerhouse operates strictly as a run-of-river project. Generation is dependent on available flow, which is fairly constant given that Fall Creek is mostly spring fed.

C7.3 ADDITIONS AND MODIFICATIONS HISTORY

Additions and modifications to the Fall Creek Development are documented in Table C7.3-1. Additions and modifications to Spring Creek are documented in Table C7.3-2.

Table C7.3-1. Additions and modifications history of the Fall Creek Development.

Year	Development Facilities	Description
1955	Powerhouse	Modified and repaired the turbine actuator for Unit No. 1.
1958	Powerhouse	Electrical maintenance and installation of oil circuit breakers performed.
1958	Powerhouse	Relay and meter installed.
1970	Dam	Reconstructed original diversion dam.
May 1972		Filed with FERC new drawings for approval (Exhibit L Drawing FPC No. 2082-204 – Rehab of Fall Creek diversion dam). Replacement of timber crib overflow dam by an earth and rock embankment approximately 4 feet high and a concrete lined spillway.
1985	Powerhouse	Replaced turbine Unit No. 2 and Unit No. 3 supply valves and repaired flood damage to building.

Table C7.3-1. Additions and modifications history of the Fall Creek Development.

Year	Development Facilities	Description
1987	Complex	Water system filter installed.
1988	Waterway	Canal Upgraded: modified diversion dam and headgate; penstock intake modified; shotcrete lined.
1988	Waterway	Removed penstock bypass loop.
1988	Complex	Installed water supply pipe system.
1988	Waterway	Rehabilitated existing canal intake structure.
1988	Dam	Constructed new culvert crossing on dam.
1989	Forebay	Forebay trash rack modified.
1993	Powerhouse	Rehabilitated/repaired Unit No. 1 after penstock leak.
1994	Powerhouse	Installed steel curb at station service transformers.
1994	Powerhouse	Oil spill containment and sump control modifications (SPCC) performed.

Table C7.3-2. Additions and modifications history of Spring Creek.

Year	Development Facilities	Description
1902		Siskiyou Electric Power Co. (PacifiCorp predecessor) constructed diversion dam and canal to appropriate waters of Spring Creek.
1987	Dam	Repaired rotted logs in dam with rock and cinders.
1988	Dam	Renovated earthen dam including permanent vehicle access to both abutments, gate at the intake to the canal to control diversion flows, and a gate in the reservoir to control downstream releases in Spring Creek and to allow sediments to be sluiced away from the inlet.
1988	Canal	Renovated canal including tree and root removal from uphill canal embankment, tree and root removal from downhill canal embankment, rebuild of downhill earth and rock embankment to provide 6-inch canal freeboard under a total diversion of 16 cfs, widening of the downhill embankment for a vehicle access lane, and the addition of a concrete lined low-level overflow spillway section.
1988		Removed culvert at end of Spring Creek and replaced with open cut section.
September 1989	Canal	Staff gauge installed in canal.
August 1991	Spring Creek Canal	Unauthorized earthen coffer dam in canal by adjacent landowner. Company pursued resolution through Oregon Water Resources Department.

C7.4 PROPOSED CHANGES

PacifiCorp proposes to include the Spring Creek diversion dam and waterway in the new FERC license. It is anticipated that minimum flow requirements will be determined during the re-licensing process.

Proposed minor modifications to the Fall Creek development are described in Exhibit A. The implementation schedule for these modifications are documented in Table C7.4-1. Generation upgrades are described in Exhibit A, but no definite schedule exists at this time.

Table C7.4-1. Proposed changes to the Fall Creek development.

Year	Development Facilities	Description
1	Fall Creek Canal Screen	Construct diagonal-type canal screen and fish bypass.
1	Fall Creek Fish Ladder	Construct rock pool- and weir-type fish ladder.
1	Spring Creek Parshall Flume	Construct Parshall flume on Spring Creek canal.

C8.0 IRON GATE DEVELOPMENT

C8.1 CONSTRUCTION HISTORY

The Iron Gate Development consists of Iron Gate dam and powerhouse. It is the last development of the Project both in date of construction and location on the Klamath River. Work was initiated in 1956 when COPCO filed an application for water use with the State of California. In January 1960, FERC approved COPCO's license application and construction began almost immediately with the facilities completed and put to service in 1962. Iron Gate was originally conceived and surveyed as part of early investigations of the Klamath River prior to World War II.

Iron Gate dam is an earthen embankment dam with a concrete spillway. The dam is 173 feet high and has a crest length of 740 feet that forms a 944-surface-acre reservoir. The powerhouse contains a single 18-MW unit located at the base of the dam. The dam is located at RM 190 of the Klamath River and serves as the downstream-most regulating point on the system. The large reservoir buffers upstream peaking operations at the Copco No. 1 and No. 2 developments, and provides stable flows downstream. There are no fish passage facilities at the dam; instead a fish hatchery was built and has been operated for mitigation. A summary of the construction and operation history for the Iron Gate Development is presented in Table C8.1-1.

Table C8.1-1. Construction and operations history of the Iron Gate Development.

Year	Development Facilities	Description
Jan 1957	Complex	All preliminary work and foundation investigations were completed.
Apr 1960	Reservoir	Reservoir clearing was completed.
July 1960	Dam	Excavation of the tunnel was started.
Aug 1960	Dam	Tunnel was holed-through.
Sept 1960	Dam	Sheet piling cofferdam constructed at downstream portal of tunnel.
Jan 1961	Dam	Tunnel lining completed.
1961	Dam	Grout cap for the right abutment of the dam was completed.
1961	Powerhouse	Excavation for the powerhouse was started.
June 1961	Powerhouse	Initial concrete pour for the powerhouse was made.
July 1961	Waterway	Penstock erection was started.
Nov 1961	Powerhouse	Power transformer and steel tower were installed on powerhouse deck.
Jan 1962	Dam	Excavation and concrete work on the spillway was completed.
Feb 1962	Complex	Plant was put in commercial operation.

C8.2 OPERATIONS HISTORY

The Iron Gate Development began commercial operation in February 1962. Operation conditions for Iron Gate are stipulated in the current FERC license. With respect to the flows, Article 52 notes minimum stream flows by month. They include:

- 1,300 cfs September 1—April 30
- 1,000 cfs May 1—May 31

- 710 cfs June 1—July 31
- 1,000 cfs August 1—August 31

Ramp rates are also identified in the current FERC license under the same Article and stipulate not more than a 250 cfs per hour or a 3-inch change in river stage per hour, whichever produces the least change in stage.

In 1997, operational changes occurred in response to the federal listing under the ESA of coho salmon (*Oncorhynchus kisutch*) in the Klamath River downstream of Iron Gate dam. These changes included new minimum instream flows and ramping rates.

Since 1997, river flows downstream of the dam have been regulated to meet targets specified in NOAA Fisheries' Biological Opinions (BO). While the FERC license specified minimum flows, BO flows have been less, equal to, or exceeded the FERC minimums, dependent on water year type. The annual instream flow releases below Iron Gate dam are now dictated by frequent ESA consultations between USBR and NOAA Fisheries using the forecasting of water year types by the Natural Resource Conservation Service (NRCS). The agencies use this information to determine water year "types" and identify releases at Iron Gate dam. As a recent example, in 2002, operations at Iron Gate dam followed a "below average water year," as determined by USBR's review of the NRCS predictions and inflow to Upper Klamath Lake. Midway through the summer, USBR, based on reduced inflow to Upper Klamath Lake, changed the water year type to "dry" and adjusted Iron Gate outflows based on the year type change. Minimum flow releases at Iron Gate dam for 2002 were as shown in Table C8.2-1 (bold type indicates actual instream flow):

Table C8.2-1. 2002 actual minimum flow releases (cfs) at Iron Gate dam.

Time Step	Below Average Water Year	Dry Water Year
January	**1,334**	888
February	**1,806**	747
March 1-15	**2,190**	849
March 16-31	**1,896**	993
April 1-15	**1,742**	969
April 16-30	**1,347**	922
May 1-15	**1,021**	761
May 16-31	**1,043**	979
June 1-15	**959**	741
June 16-30	**746**	612
July 1-15	**736**	547
July 16-31	**724**	542
August	1,000	**647**
September	1,300	**749**
October	1,345	**879**
November	1,324	**873**
December	1,621	**889**

To comply with ESA, at a minimum, PacifiCorp passes minimum flows stated in the current BO rather than those cited as the FERC minimum. Iron Gate Fish Hatchery return water and Bogus Creek contributions are included in this minimum flow.

With respect to ramping, PacifiCorp now operates to meet stricter ramp rates at Iron Gate dam as determined in the 2001 BO and unchanged in the 2002 BO.

The BO ramp rates are as follows:

- 50 cfs per 2-hour period when not spilling (flows less than 1,750 cfs). Also, flows cannot be reduced more than a total of 150 cfs per 24 hours.
- 125 cfs per 4-hour period when spilling (flows greater than 1,750 cfs). Also, flows cannot be reduced more than a total of 300 cfs per 24 hours.

C8.3 ADDITIONS AND MODIFICATIONS HISTORY

Additions and modifications to the Iron Gate Development are documented in Table C8.3-1.

Table C8.3-1. Additions and modifications history of the Iron Gate Development.

Year	Development Facilities	Description
1962	Powerhouse	66-inch Howell-Bunger valve modifications performed.
1964	Fish hatchery	Installed fishwater aerator.
1965	Fish hatchery	Fish hatchery constructed.
1965	Dam	Spillway and dam modified: rebuilt and lined spilling chute.
1965	Fish hatchery	Constructed metal office and storage building; constructed four wood frame dwellings; constructed four rearing ponds; constructed concrete and wood aerator structure.
1970	Access feature	Revetment made to powerhouse access road to reduce erosion.
1973	Dam	Installed debris radial gate in spillway.
1974	Dam	Spillway and apron repaired.
1974	Dam	Dam spillway and chute repaired.
1976	Fish hatchery	Fish hatchery rearing pond modified/constructed.
1976	Powerhouse	Waste discharge facility improvements performed.
1977	Dam	New toe drain installed.
1985	Waterway	Penstock air vent replaced.
1986	Fish hatchery	Fish hatchery modified.
1989	Dam	New hydro system level monitoring equipment installed.
1990	Reservoir	Spillway buoys installed.
1991	Powerhouse	Forced air cooling system installed.
1992	Waterway	New flow monitoring system installed.
1992	Dam	Repairs to dam bridge crane performed.

Table C8.3-1. Additions and modifications history of the Iron Gate Development.

Year	Development Facilities	Description
1993	Communications bldg.	Improvements and modifications to electronics/communications building performed.
1994	Powerhouse	Installation of galvanized steel plate at air intake vent; steel curb installation and transformer deck modifications performed.
1994	Powerhouse	Oil spill containment and sump control modifications performed.
1994	Fish hatchery	Fish hatchery building improvements performed.
1995	Dam	Completed headgate oil control barrier.
1995	Powerhouse	Installed turbine pit conductors.
1995	Powerhouse	Sump tank discharge pipe installed.
1995	Operator's house	Addition to the operator's house completed.
1996	Fish hatchery	Fish hatchery concrete coating performed.
1996	Fish hatchery	Hatchery mechanical improvements performed.
1997	Access bridge	Cross bracing and piler cap beam replacements performed.
2002	Powerhouse	Rebuilt Howell-Bunger bypass valve.
2003	Dam	Modified dam crest to add 5 feet height for PMF protection. Added additional wall height to spillway chute walls at specific locations.

C8.4 PROPOSED CHANGES

No power-related changes are proposed. Flows will continue to be released at Iron Gate dam to meet the conditions of any current NOAA Fisheries Biological Opinion. Ongoing O&M will result in various upgrades dependent on type of O&M activities.

Minor modifications proposed for the Iron Gate Development include the purchase of a mass-marking trailer for use at the hatchery. The mass-marking trailer is a portable building containing automated fish-marking equipment.

Modifications to Iron Gate dam may be required to facilitate the release of low-level reservoir water, pending the outcome of water quality investigations. These modifications may include retrofit of the existing low-level outlet and bulkhead gate.

The implementation schedule for these changes is documented in Table C8.4-1.

Table C8.4-1. Proposed changes to the Iron Gate development.

Year	Development Facilities	Description
1	Hatchery Marking Trailer	Provide state-of-the-art marking trailer and associated annual O&M.

C9.0 INFORMATION SOURCES

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