Thompson Falls Hydroelectric Project
FERC Project No. 1869
Volume I of IV (Public)
Final License Application
Exhibit A: Project Description

Prepared by:

NorthWestern Energy
Butte, MT 59701

With Support From:
GEI Consultants, Inc.
Portland, OR 97239

American Public Land Exchange
Missoula, MT 59802

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List of Abbreviations and Acronyms

CFR	Code of Federal Regulations
cfs	cubic feet per second
El.	elevation
FERC	Federal Energy Regulatory Commission
flow	Project discharge
hp	horsepower
kV	kilovolts
kVA	kilovolt amps
kW	kilowatts
MVA	megavolt-amperes
MW	megawatt
rpm	revolutions per minute
USFS	United States Forest Service
V	volts

1. Exhibit A – Project Description

1.1 Thompson Falls Project

The Thompson Falls Project is located on the Clark Fork River in Sanders County, Montana and has an installed capacity of 92,370 kilowatts (kW). Preliminary development of the Thompson Falls Project began in June 1912, by the Thompson Falls Power Company. Construction commenced in May 1913, and the first generating unit was placed in service on July 1, 1915. The sixth generating unit was placed in service in May 1917. An additional powerhouse containing a seventh unit was completed in 1995. NorthWestern acquired the Thompson Falls Project in 2014 and has been operating it continuously since that time as a part of its integrated electric system.

The original license for the Thompson Falls Project was issued effective January 1, 1938, and expired on December 31, 1975. The current license was issued December 28, 1979, amended on April 30, 1990, and expires December 31, 2025.

The Project consists of: (1) a Main Channel Dam, a concrete gravity structure 1,016 feet long and 54 feet high with an overflow section 913 feet long having 8-foot-high fixed wheel panels atop 8--foot-high flashboards with four radial gates; (2) a smaller dam of the same type 449 feet long and 45 feet high with an overflow section 289 feet long having 8-foot-high fixed wheel panels atop 4 -foot flashboards, and located west of the Main Channel Dam in a dry channel of the river; (3) a rock cut canal 450 feet long and 80 feet wide; (4) six main penstocks 14 feet in diameter; (5) the original steel frame and masonry powerhouse containing six generation units, three rated at 7,000 kW, one rated at 6,000 kW and two rated at 6,375 kW; (6) two generator step-up transformers; (7) two 6.6-kilovolt (kV) generator leads; and (8) appurtenant facilities.

The newer development includes: (1) a 78-foot wide, 300-foot long intake channel; (2) a 78-foot wide, 200-foot long powerhouse containing one 52,613 kW generating unit; (3) a 100-foot wide, 1,000-foot long tailrace channel; (4) a 1,000-foot long access road with a 360-foot long bridge over the reservoir and a 135-foot long bridge over dry creek; (5) a short 115 kV generator lead line running from the generator, through a generator step-up transformer, connecting to the transmission grid on the third floor of the Units' 1-6 powerhouse; and (6) appurtenant facilities.

The proposed Project boundary extends approximately 0.3 mile downstream and 10 miles upstream of the Project's dams. The proposed Project boundary encompasses a total of 1,526 acres, consisting of 1,094 acres of reservoir and 432 acres of non-reservoir. The reservoir is 400 to 1,800 feet wide. The active storage capacity of the reservoir is approximately 15,000 acre-feet, with a total storage capacity of approximately 20,400 acre-feet. The Thompson

River, a major tributary to the Clark Fork River, enters the reservoir about 6.2 miles upstream of the dam. Its lower 0.2 miles is included within the proposed Project boundary. The proposed Project boundary is a combination of a contour elevation of 2,397 feet elevation at the dam (elevation of contour increase proceeding upstream) for most of the reservoir, and a metes and bounds description that incorporates areas above the contour elevation to encompass Project facilities, recreation sites, and all elements of the Thompson Falls Hydroelectric Dam Historic District.

2. Structures

The primary structures consist of two curved concrete gravity dams with overflow spillways and two powerhouses.

2.1 Dams and Spillways

The Main Channel Dam is a curved gravity structure with an ogee spillway section that is 913 feet long with a net spillway length of 817 feet and an average height of 18 feet above the riverbed. It contains 34 bays divided by concrete piers or permanent steel frames on 24-foot-wide centers, which support the flashboards and removable fixed wheel panels. The remaining part of the Main Channel Dam is a short length of non-overflow gravity wall at the right end of the spillway and two radial gates. The spillway crest is at El. 2,380.0 and the top of the fixed wheel panels establish the normal pond at El. 2,396.5. A concrete apron extends 30 to 50 feet downstream of the entire spillway section. An upstream fish passage facility is located in the right abutment of the non-overflow section.

Four 41-foot-wide by 18-foot-high radial gates are located in spillway bays 16, 17, 26, and 27. An emergency propane-powered generator power supply system is in place at the dam. The fixed wheel panels are installed and removed by a crane, which travels along tracks on a 10-foot-wide bridge over the full length of the spillway. The hydraulic lift is stored permanently in a metal enclosure at the left side of the dam. In a high flow event, the flashboards can be released by torch cutting the bolt that secures the tripping latch and releases the entire assembly free of the flashboard support structure.

Upstream fish passage is provided at the Project via an upstream fish passage facility in the right non-overflow section of the Main Channel Dam. The 48-step pool reinforced concrete fish passage facility includes a fish sampling facility consisting of holding pool and trapping mechanism(s), fish crowder, fish lock, sampling facilities' shelter, several sampling and handling tables, and the sampling facility water supply pipelines.

The Dry Channel Dam, located on a former channel of the river, is separated from the Main Channel Dam by an island. It is a concrete gravity dam curved in plan and consists of two distinct structures. A non-overflow sluiceway section, 122 feet long and 38 feet high is located at the right side of the dam. It contains 10, 5-foot-wide by 6.5-foot-tall sluiceways that were originally controlled by slide gates operated from the crest of the dam. The slide gates were permanently closed circa 1942 and in 1990 bulkheads were constructed within each sluiceway. The second part of the dam is an overflow spillway with an ogee crest. It has an overall length of 289 feet and an average height of 17 feet above the riverbed. The overflow spillway contains 12 bays, each containing six panels, with steel flashboard supports on 24-foot centers. The spillway crest is at

El. 2,384.0, but storage is increased by 4-foot flashboards and 8-foot fixed wheel panels similar to those on the Main Channel Dam, which brings the reservoir level to El. 2,396.5.

A hydraulic lift for removing fixed wheel panels is stored permanently in a metal enclosure at the left side of the dam. As with the Main Channel Dam, the flashboards of the Dry Channel Dam can be released by torch cutting the bolt that secures the tripping latch and releasing the entire assembly from the flashboard support structure.

2.2 Forebay

The forebay for the original powerhouse consists of an excavated channel about 450 feet long and 80 feet wide that broadens out across the face of the powerhouse intake section. A short concrete gravity section borders one end of the forebay adjacent to the powerhouse intake. A 300-foot-long by 78-foot-wide excavated channel leads from the Project reservoir to the new powerhouse containing Unit No. 7 but does not include a forebay.

2.3 Intakes

The intake structure for the original six-unit powerhouse lies at the end of an excavated forebay channel. It is a concrete gravity structure, 258-feet-long and 40-feet-high, with an angled wing wall at each end. The area downstream of the left wingwall was filled with rockfill from the excavation for the powerhouse structure. The intake contains six 14-foot-diameter main turbine penstocks, two 6-foot 8-inch-diameter exciter turbine penstocks, and their associated intake gates and trashracks. The top of the intake is at El. 2,400.0. At the right end of the main wall is a 10--foot by 14-foot gate and sluiceway for diverting trash around the powerhouse.

The reinforced concrete intake and trashrack for the new powerhouse is located at the end of a 140--foot-long by 72-foot-wide and 50-foot-deep rock-cut intake channel and comprises three closed rectangular water passageways each 39 feet high, 18 feet wide, and 75 feet long, sloping directly to the concrete semi-spiral case of the turbine. Each intake passageway is equipped with a service gate operated by a hydraulic hoist. The top of the intake at El. 2,405.0 providing 3.1 feet of freeboard above maximum probable maximum flood water surface elevation and 5.2 feet of freeboard under inflow design flood conditions.

2.4 Powerhouses

The original powerhouse consists of a mass concrete substructure, a masonry rock wall, concrete and structural steel superstructure, and concrete floor and roof slabs supported on steel framing. The structure is 292 feet long, 97 feet wide and 52.5 feet high from the main floor to the eaves and an additional 5.5 feet from the eaves to the ridge. The structure has a concrete foundation with a basement floor approximately 9 feet below the main floor and a concrete substructure 40 feet below the basement floor. A 75-ton traveling crane services the powerhouse. There are five generators rewound to 8.75 megavolt-amperes (MVA) each and one generator rewound to

7.5 MVA. The total installed capacity of the six turbine-generator units is approximately 39.76 megawatts (MW) at a normal net head of 54 feet.

The switchyard and transformers are located inside the powerhouse. Two 3-phase transformers each rated at 30,000 kilovolt amps (kVA)[1] step up the generator voltage of 6.6 kV to a transmission voltage of 115 kV.

The Unit No. 7 powerhouse, completed in 1995, is a cast-in-place reinforced concrete gravity structure founded on rock and includes an integral intake and headworks. A substantial portion of the powerhouse is located below grade. The depth of the powerhouse into rock was established by the amount of submergence below tailwater required by the turbine runner for protection against cavitation damage.

The roof deck of the powerhouse is located at El. 2,370.0. The generator is located immediately below the roof deck, which is provided with a hatch cover to allow installation and removal of the generator and turbine rotating parts. The hatch and all major equipment within the powerhouse are serviced by an external 285-ton traveling gantry crane. The primary laydown area for major equipment is on the roof deck slab. A cantilever on the gantry crane allows the auxiliary hook to handle the draft tube stoplogs.

The configuration of the powerhouse is based primarily on the turbine water passageways and the space needed for auxiliary equipment. The semi-spiral case is designed to direct the water evenly around the turbine distributor ring with minimum hydraulic losses and tapers from 37-feet-high to 12-feet-high. The turbine water passageways are constructed of reinforced concrete. A single pier divides the horizontal leg of the draft tube and two stoplog gates are provided to isolate the turbine water passageways from the tailrace during maintenance.

The turbine is a vertical shaft, double-regulated Kaplan type rated 52.6 MW at 54.5 feet net head and 94.7 revolutions per minute (rpm). Water is directed to the turbine distributor through rectangular concrete intake passageways and a concrete semi-spiral case. The turbine wicket gates and runner blades which control discharge and power are positioned by means of an oil pressure system. The main generator step-up transformer is located on a concrete foundation adjacent to the powerhouse. A concrete curb is provided at the transformer to retain transformer oil in case of a rupture.

2.5 Tailrace

Flow through the original powerhouse is discharged into a tailrace channel that runs perpendicular to the discharge and extends downstream beyond the powerhouse and re-enters the river. Flow

[1] kVA is 1,000-volt amps. A volt is electrical pressure. An amp is electrical current.

from the Unit 7 powerhouse enters a 1,000-foot-long by 100-foot-wide tailrace that flows directly into the river in the direction of the river flow.

3. Impoundment

The Project encompasses about 10 miles of river and reservoir which is 400 to 1,800 feet wide. Active storage capacity of the reservoir is approximately 15,000-acre-feet, total volume is approximately 20,400 acre-feet. At the normal maximum reservoir level El. 2,396.5, the reservoir surface area within the proposed Project boundary is approximately 1,094 acres, not including the islands. The maximum depth of the reservoir is approximately 90 feet.

3.1 Turbines/Generators

The Thompson Falls Project has an authorized installed generating capacity of 92.37[2] MW (**Table 2-1**).

Table 3-1: Authorized Installed Capacity per 18 CFR 11.1

Unit No.	Authorized Turbine Capacity (MW)	Authorized Generator Capacity (MW)	Limiting Factor	Authorized Installed Capacity (MW)	Turbine Flow (cfs)
1	7.65	7.00	Generator	7.00	1,800
2	7.01	7.00	Generator	7.00	1,833
3	7.65	7.00	Generator	7.00	1,800
4	6.38	6.00	Generator	6.00	1,833
5	6.38	7.00	Turbine	6.38	1,833
6	6.38	7.00	Turbine	6.38	1,833
7	52.61	57.06	Turbine	52.61	12,320
Total				**92.37**	**23,252**

Notes: MW = megawatts; cfs = cubic feet per second

3.1.1 Turbines

The original powerhouse Units 1-6 turbines are Vertical Francis units with a rated net head of 54 feet rotating at 100 rpm. Units No. 1 and 3 turbine runners are American Hydro rated at 10,200 horsepower (hp) and 1,800 cubic feet per second (cfs). Unit No. 2 is an Allis Chalmer runner rated at 9,350 hp at 1,833 cfs. Units No. 4, 5 and 6 turbine runners are Allis Chalmer runners with a nameplate rating of 8,500 hp with a rated flow of 1,833 cfs. The Unit 7 turbine is a Kvaener vertical shaft, double-regulated Kaplan type rated 70,150 hp at 54.5 feet net head and 94.7 rpm with a rated flow of 12,320 cfs.

[2] Authorized installed capacities calculated per 18CFR §11.1(i)

3.1.2 Generators

Units No. 1 through 6 generators are three phase, 60-cycle, synchronous type, manufactured by General Electric Company. Units 1, 2, 3, 5, and 6 have been rewound to 8,750 kVA with a power factor of 0.80 and operate at 6,600 volts (V). The Unit No. 4 generator has a nameplate rating of 7,500 kVA with a power factor of 0.8. The Unit No. 7 generator has a nameplate rating of 63,400 kVA with a power factor of 0.9 and operates at 13,800 V.

4. Primary Transmission Lines

The project has three generator lead lines that constitute primary transmission lines under FERC's regulations. Generating Units 1-3 and 4-6 are connected to two generator step-up transformers that are connected to circuit switchers by two 6.6 kV generator lead lines that are approximately 50 ft. long. A 300 ft. long 115 kV generator lead line for Unit 7 also passes through the roof of the Units' 1-6 (original) powerhouse then down to its own breaker. All 5 breakers and both circuit switchers are then connected to the 115kv buss.

Project generation is interconnected to NorthWestern's transmission system by the 115 kV buss on the ceiling of the Units' 1-6 (original) powerhouse. Four 115 kV transmission lines on the roof of the Units' 1-6 (original) powerhouse, the Burke A and B and the Kerr A and B lines, pass through the roof and each are connected to a breaker on the third floor. This is where the Project interconnects to the grid.

5. Appurtenant Facilities and Equipment

5.1 Electrical Equipment

The Units' 1 through 6 powerhouse (original powerhouse) contains two three-phase, air-cooled generator step-up transformers rated at 30,000 kVA each and manufactured by ABB. The Unit 7 powerhouse (new powerhouse) is connected to a three-phase, air-cooled generator step-up transformer rated at 63,000 kVA also manufactured by ABB.

5.2 Mechanical Equipment

The mechanical equipment consists of conventional pumps, compressors, and other powerhouse equipment. A 75-ton bridge crane, which travels over the length of the powerhouse, is provided to service and maintain the Units' 1-6 turbine/generating equipment. A 285-ton outdoor bridge crane is in place to serve the Unit 7 powerhouse.

Each turbine is controlled by electro-hydraulic governors. The governors sense speed fluctuations and cause the hydraulic gate operator to adjust the wicket gate openings.

5.3 Access Roads

Three road segments which are gated and exclusively used by NorthWestern, and totaling about 0.75 miles, provide access to the two dams and two powerhouses and other fenced and secured areas of the Project. These three segments include about 0.5 miles of road that provide access to both powerhouses, about 0.2 miles of road that provide access to the two dams and upstream fish passage facility, and about 0.05 miles of road that provides access to the south side of the Main Channel Dam. These three road segments are initially accessed by three public roads before reaching the gates. For reference purposes, these public roads, which are not considered Project roads and are not part of the license, include Gallatin Street, Blue Creek Road, and an unnamed public road.

6. Federal Lands

The proposed Project boundary extends approximately 0.3 mile downstream and approximately 10 miles upstream of the Project's dams. The proposed Project boundary encompasses a total of 1,526 acres, consisting of 1,094 acres of reservoir and 432 acres of non-reservoir. The acreage includes 66.9 acres of federal lands managed by the United States Forest Service (USFS). The federal lands are listed in **Table 6-1**.

Table 6-1: Thompson Falls Project – Federal Lands Within Proposed Project Boundary.

Township	Range	Section	Subdivision	Acres	Agency
21N	28W	15	Government Lot 1	0.3	USFS
21N	28W	17	Government Lots 5-11	49.6	USFS
21N	28W	18	Government Lots 8-10	4.3	USFS
21N	28W	21	Government Lot 1	1.45	USFS
21N	28W	22	Government Lots 3-4	11.25	USFS
Total				**66.9**	