

**EXH. RJR-31
DOCKETS UE-170033/UG-170034
2017 PSE GENERAL RATE CASE
WITNESS: RONALD J. ROBERTS**

**BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION**

**WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION,**

Complainant,

v.

PUGET SOUND ENERGY,

Respondent.

**Docket UE-170033
Docket UG-170034**

**FIRST EXHIBIT (NONCONFIDENTIAL) TO THE
PREFILED REBUTTAL TESTIMONY OF**

RONALD J. ROBERTS

ON BEHALF OF PUGET SOUND ENERGY

AUGUST 9, 2017

The MONTANA POWER COMPANY

RECEIVED

GENERAL OFFICES
ELECTRIC BUILDING
BUTTE, MONTANA 59701

AUG 14 1972

ENVIRONMENTAL SCIENCES
DIVISION

August 11, 1972

Mr. Benjamin F. Wake
Director
State Department of Health and
Environmental Sciences
Helena, MT 59601

Dear Mr. Wake:

Enclosed are completed pages 1, 2 and 3 of our application for a Construction Permit for our Colstrip Project. Please replace pages 1 and 2 of the two copies of our application you already have with the two sets of three pages enclosed with this letter.

Should you require any additional information for this application, we assume you will let us know as soon as possible.

Very truly yours,



R. J. Labrie
Asst. Chief Engineer

DTB/mje
Enclosures

**CONSTRUCTION PERMIT
APPLICATION
FOR SOURCES OF AIR POLLUTION**

Montana State Department of Health and
Environmental Sciences
Air Quality Bureau
Helena, MT

Phone - 449-3454

A P P L I C A T I O N

FOR

Authority to Construct

- A. This application must be filled out completely and must be filed in duplicate.
- B. Applications are incomplete unless accompanied by copies of all plans, specifications and drawings required. Details required for specific equipment are available upon request.
- C. This application must be signed by a responsible member of the organization that is to operate the equipment for which application is made. INCOMPLETE APPLICATIONS ARE NOT ACCEPTABLE.

APPLICATION INFORMATION

1. PERMIT TO BE ISSUED TO (Business license name of corporation, company, individual owner or governmental agency that is to operate the equipment):
THE MONTANA POWER COMPANY and PUGET SOUND POWER & LIGHT COMPANY
2. MAILING ADDRESS: 40 East Broadway Butte, MT 59701 (Montana Power)
10608 N. E. Fourth Bellevue, WA 98009 (Puget)
Number Street City or Community Zone
3. ADDRESS AT WHICH THE EQUIPMENT IS TO BE OPERATED:
1/2 mile east Colstrip, MT 59323
Number Street City or Community Zone
4. TYPE OF ORGANIZATION: Corporation Partnership Individual Owner
Governmental Agency
5. GENERAL NATURE OF BUSINESS:
Electric and Gas Public Utility (Montana); Electric Utility (Puget)
6. EQUIPMENT DESCRIPTION:
Electric Power Generating Plant
7. ESTIMATED COST OF EQUIPMENT OR OF ALTERATION: Air Pollution Control Equipment \$25,000,000
Basic Equipment \$158,000,000
8. PRESENT STATUS OF EQUIPMENT (Check and complete applicable items):
- | | Estimated Starting Date | Estimated Completion Date |
|---|-------------------------|---------------------------|
| <input type="checkbox"/> Construction or installation not started | | |
| <input checked="" type="checkbox"/> Construction or installation partly completed | September 1969* | July 1976 |
| <input type="checkbox"/> Construction completed | | |
| <input type="checkbox"/> Equipment is to be altered | | |
| <input type="checkbox"/> Equipment is partly altered | | |
| <input type="checkbox"/> Equipment has been altered. | | |
| <input type="checkbox"/> Transfer of operator, owner or lessee | | |
| <input type="checkbox"/> Transfer of location | | |

*Date when the first turbine-generator set was ordered.

Construction of the plant air pollution control equipment will begin in June of 1973.

NOTICE OF RECEIPT
OF A

Permit # 513-111472

REQUEST FOR: CONSTRUCTION PERMIT, SUBDIVISION PERMIT, WATER DISCHARGE PERMIT,
VARIANCE, ETC.

AN APPLICATION FOR A(N) Construction Permit HAS BEEN RECEIVED ON
(Type of Permit)

August 14, 1972 FROM THE Montana Power Company and Puget Sound Power & Light FOR
(Date) (Name of Person)

(CONSTRUCTION) (~~WATER DISCHARGE~~) OF Electric Power Generating
Plant (Others) (Description of Facility)

AT Colstrip, Montana
(Location)

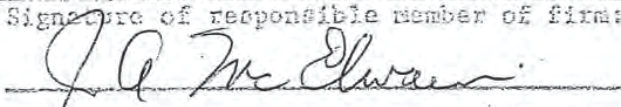
THE LATEST DATE FOR BOARD ACTION IS _____

THE LAST DAY OF THE 90 DAY REVIEW PERIOD IS 11/14/72

Holtz
Bureau Chief

Routing of Notice:

Holtz	()	Lloyd	()	Dr. Anderson	()
Sloulin	()	Carmody	()	Board	()
Willems	(<input checked="" type="checkbox"/>)	Wake	()	News Media	()

9. If this equipment had a previous written permit, give name of corporation, company or individual owner that operated this equipment and state previous permit number, if known.		
NAME	NONE	PERMIT NUMBER*
10. Signature of responsible member of firm: 		Date of Application:
11. Type or print name and official title of person signing this application.	NAME <u>J. A. McElwain</u> TITLE <u>Executive Vice President</u> PHONE NO. <u>(406) 723-5421</u>	The Montana Power Company

*List only most recent Permit Number.

The following are attachments to this application:

ITEM I. EQUIPMENT LOCATION DRAWING

- Sheet 1 Location of property and adjacent ownerships.
- Sheet 2 Location of buildings on the property.
- Sheet 3 Location of equipment on the property.
- Sheet 4 Layout of equipment.

ITEM II. DESCRIPTION OF EQUIPMENT

ITEM III. DESCRIPTION OF PROCESS

ITEM IV. OPERATING SCHEDULE

ITEM V. PROCESS WEIGHT

ITEM VI. FUELS AND BURNERS USED

ITEM VII. FLOW DIAGRAM

ITEM VIII. DRAWINGS OF EQUIPMENT

- Sheet 1 Emission Control System.
- Sheet 2 through 7 Equipment Location.
- Sheet 8 Design Data.

Signature page for Puget Sound Power & Light Company attached.

9. If this equipment had a previous written permit, give name of corporation, company or individual owner that operated this equipment and state previous permit number, if known.		
NAME	NONE	PERMIT NUMBER*
10. Signature of responsible member of firm:		Date of Application:
<u>D. H. Knight</u>		
11. Type or print name and official title of person signing this application:	NAME <u>D. H. Knight</u> TITLE <u>Vice Pres.-Power Supply</u> PHONE NO. <u>454-6363</u>	Puget Sound Power & Light Company

*List only most recent Permit Number.

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ITEM II. DESCRIPTION OF EQUIPMENT

General Plant Descriptions:

Type: Pulverized Coal-fired Steam-Electric Power Plant.

Size: Two units, each approximately 350 MW.

Major Equipment Description (one of each item per unit):

A. Steam Generator

Make : Combustion Engineering
Type : CCRR
Size : 2,520,000 lbs/hr steam generating unit
Model: Combustion Engineering Contract No. 4270

B. Turbine Generator

Make : General Electric
Type : TC 2F
Size : 333 MW
Model: G.E. S.O. X539 (Unit one)
G.E. S.O. X628 (Unit two)

C. Cooling Towers

Make : Ecodyne Corp. (Fluor Cooling Products Co.)
Type : Wet, crossflow, induced draft cooling tower
Size : 117,200 GPM inlet water flow per unit
Model: Ecodyne Job No. E 70-12968 (Unit one)
Ecodyne Job No. E 70-12969 (Unit two)

D. Gas Scrubbing System

Make : Pending
Type : Venturi with wet alkali chemical system
Size : 1,600,000 CFM
Model: Pending

NOTE: This equipment will be guaranteed to limit particulate emissions to .018 grains per actual cubic foot and to limit sulfur oxide emissions to 1.0 lbs per million Btu input over the entire operating range of the power plant.

Boiler Exit Gases will be directed to the scrubber manifold through two ducts. The total flow per unit and properties of gases are as follows:

		Control Load	
Boiler load	20%	56%	100%
Flow rate, thousands of actual cfm	378	772	1,430
Temperature of gases entering scrubbers °F	199	236	291
Pressure at scrubber inlet, in. H ₂ O	-3"	-6"	-14"

The gases contain 6.1% moisture by weight at 100% load.

SO₂ Removal Requirement. At any boiler load, the SO₂ concentration in the scrubbed gas shall not exceed one pound per million Btu of heat released in the furnace.

Particulate Removal Requirement at any boiler load, the particulate concentration in the scrubbed gas shall not exceed 0.018 grains per actual cubic foot at the scrubber reheater outlet.

Water is available for the process as follows:

	<u>Cooling Tower Blowdown</u>
Quantity available, gpm per unit	400-650
<u>Analysis:</u>	
Total hardness, ppm as CaCO ₃	1761
Calcium, ppm as CaCO ₃	1112
Magnesium, ppm as CaCO ₃	649
Alkalinity, M ppm as CaCO ₃	-
Alkalinity, p ppm as CaCO ₃	-
Chloride, ppm, as Cl	73
Phosphate, ppm	-

Sodium, ppm as Na	460
Silica, ppm as SiO ₂	158
Nitrate, ppm	-
Sulfate, ppm as SO ₄	2520
Bicarbonate, ppm as HCO ₃	38
pH	7.3+0.2

<u>Electric Motor List</u>	<u>Number</u>	<u>hp</u>
I.D. Fan Motor	4	3,800 hp ea
Venturi Recirculation Pump Motor	6 (2 spare)	270 hp ea
Effluent Holding Tank Pump Motor	2 (1 spare)	35, hp ea
Settling Pond Overflow Pump Motor	2 (1 spare)	20 hp ea
Feed Tank Pump Motor	2 (1 spare)	20 hp ea
Agitator for Recirculation Tank Motor	4	20 hp ea
Agitator for Feed Tank Motor	1	20 hp ea
Agitator for Slurry Effluent Tank Motor	1	15 hp ea
Venturi Variable Throat Operator Motor	4	3 hp ea

2. STEAM GENERATOR

Design Operating Conditions:

Maximum continuous evaporation, lbs/hr	2,520,000
Max. press. drop through reheater at 2,130,000 lbs/hr R.H. flow, psig	27
Temperature at superheater outlet, °F	1,005
Temperature at reheater outlet, °F	1,005

Air temperature entering air heater, °F	100
Exit gas temperature uncorrected, °F	300
Exit gas temperature corrected, °F	291
Reheater Design Pressure, psig	710

Performance Data:

	<u>Temperature Control Load</u>	<u>Performance Guarantee Load</u>	<u>Predicted Maximum Continuous Load</u>
Total Evaporation, lbs/hr	1,365,000	2,520,000	2,520,000
Throttle steam, lbs/hr	1,300,000	2,400,000	2,482,000
Superheater outlet press. psia	2,440	2,610	2,597
Superheater outlet temperature, °F	1,005	1,005	995
Auxiliary steam, lbs/hr (not through superheater)	65,000	120,000	38,000
Reheater flow, lbs/hr	1,160,000	2,130,000	2,180,000
Reheater inlet pressure, psia	341	613	637
Reheater inlet temp., °F	566	617	647
Reheater outlet temp., °F	1,005	1,005	1,005
Final Feedwater temp., °F	429	490	492

ITEM III. DESCRIPTION OF PROCESS

Coal of approximately 1.5 inch lump size is transported to the plant storage site. It is mechanically conveyed into the plant and fed to coal pulverizers which reduce it in size from 1.5 inches to a size such that 70% of the coal will pass through a 200 mesh sieve. The pulverized coal is then used as combustion fuel for a steam generator. The coal is fed into the steam generator through fuel nozzles, which are located at the four corners of a furnace. The coal is mixed with air in the furnace and ignited. The combustion process gives off energy in the form of heat which is transferred through the furnace walls to water which is converted to steam at 2,400 lbs per sq in. and 1,000°F. The steam is piped to a turbine which extracts energy by reducing the steam to a low pressure and temperature. The energy is used to rotate the shaft of an electric generator whose output is delivered to an electric transmission system exterior to the plant.

The low pressure steam exhausted from the turbine is reconverted to water by cooling in a condenser, and then returned to the steam generator for reuse. The cooling is accomplished by supplying water at a lower temperature than the steam to the tube side of a shell and tube heat exchanger (condenser). The cooling water absorbs the heat of the condensing steam through the tube walls and is pumped to a cooling tower where it is exposed in the form of droplets to a flow of atmospheric air. The air evaporates some of the water causing the balance to be cooled so that it can be returned to the condenser for reuse. Fresh water to replace the amount that is evaporated is supplied to the cooling tower from an outside source.

In the steam generator, the unused portions of the combustion air and the gaseous products of combustion are combined, and along with any suspended fly ash from the burned coal, are conveyed to a flue gas scrubbing system installed for emission control. This is a full stream scrubber system that will simultaneously remove fly ash and sulfur dioxide. The removal is accomplished by scrubbing the flue gas with an alkaline solution of water and calcium carbonate, which is generally available from the fly ash. If the alkalinity of the ash varies to a point where additional alkalinity must be added, it is obtained by the addition of soda ash (Na_2CO_3) or lime (CaO). The gaseous sulfur dioxide will react with the calcium carbonate to form solid calcium or sodium salts. At the same time, the mechanical action of the scrubber traps fly ash particles in the water droplets. Recirculation within the scrubber system makes the alkalinity in the ash available for the process. The used scrubber solution, newly formed salts, and trapped fly

ash are piped to an ash pond where the solids settle out. The pond water is then recirculated back to the scrubber in a closed loop system from which no water is discharged to any natural bodies. This emission control system is guaranteed to limit the sulfur oxide emissions to 1.0 lb SO₂/million Btu and the fly ash emissions to .018 grains per actual cubic ft, at any operational load of the power plant.

The coal charged into the process will have the following average composition:

Moisture	23.87%
Fixed Carbon	38.95
Volatile Matter	28.59
Ash	8.59
	<u>100.00%</u>
Sulfur	0.77% (included above)
Heating Value	8,843 Btu/lb

At full load, 385,500 lbs per hour of this fuel will be burned in each unit corresponding to 3,410 million Btu per hour of heat release per unit. The corresponding sulfur oxide production would be 5,650 lbs per hr SO₂ or 1.658 lbs SO₂ per million Btu input. The fly ash production would be 26,492 lbs per hr, since 20% of the total input of 33,114 lbs per hr will become attached to the furnace walls and removed as boiler slag while the balance leaves the furnace as fly ash. This corresponds to 7.77 lbs of fly ash per million Btu.

The guarantees on the emission control systems are equivalent to 99.5% particulate removal and 39.7% SO₂ removal, which will limit particulate emissions to 0.039 lbs per million Btu input and sulfur oxide emissions to 1.0 lbs per million Btu input.

For additional detail on quantities flowing throughout the process see Item VII.

ITEM IV. OPERATING SCHEDULE

The equipment will normally be operated twenty-four hours per day, seven days per week, at outputs that will vary from 25% to 100% in accordance with customer demand.

ITEM V. PROCESS WEIGHT

Materials charged into process, per unit.

1. Fuel

Coal - 385,500 lbs per hr

2. Air

Combustion	-	3,035,000	lbs per hr
Leakage	-	282,000	lbs per hr
Scrubber Reheat	-	598,000	lbs per hr
Total	-	3,841,000	lbs per hr

3. Water

Make-up to cooling tower - 3,963 gpm

NOTE: For additional detail on process flows, see Item VII.

ITEM VI. FUELS AND BURNERS USED

1. Fuel

Type : Coal, Subbituminous C
Firing Rate: 385,500 lbs/hr per unit

NOTE: For additional detail on composition, see Item III.

2. Burners

Make : Combustion Engineering
Model : No number assigned
Size : 22 inch diameter
Type : TT (Tilting Tangential)
Number : 20 (4 each for five pulverizers.
One pulverizer is a spare.)
Capacity Range: 6,024 lbs/hr minimum
24,094 lbs/hr maximum

NOTE: Each pulverizer feeds four nozzles. The minimum firing rate is one pulverizer in service at 24,096 lbs per hr. The maximum allowable firing rate is four pulverizers in service at 385,500 lbs per hr.

ITEM VIII. DRAWINGS OF EQUIPMENT
(Sheet 8 Design Data)

1. EMISSION CONTROL SYSTEM

Boiler Fuel is Colstrip mine coal with the following annual average analysis (as received basis).

Proximate Analysis:

Moisture	23.87%
Volatile Matter	28.59%
Fixed Carbon	38.95%
Ash	8.59%
	100.00%

Heating Value 8,843 Btu/lb

Ultimate Analysis:

Hydrogen	3.43%
Carbon	51.88%
Nitrogen	0.76%
Oxygen	10.70%
Sulfur	0.77%
Ash	8.59%
Moisture	23.87%
	100.00%

Ash in the Coal. The ash contained in the coal has the following estimated chemical analysis: (Sulfur trioxide-free)

SiO	41.60%
Al ₂ O ₃	22.42%
TiO ₂	0.79%
Fe ₂ O ₃	5.44%
CaO	21.90%
MgO	4.95%
Na ₂ O	0.31%
K ₂ O	0.13%
P ₂ O ₅	0.41%

(Balance Unidentified)

Summary Statistics

Electric Generation - Two General Electric turbine generator units

Capacity - 350 MW each - 700 MW Total (Nominal)

Steam Generation - Two Combustion Engineering units

Capacity - 2,520,000 #/hr steam each - max.

Size - 206 ft. high, 160 ft. wide, 238 ft. long (Approx.)

Flue Gas Scrubber - Two Venturi type

Capacity - 1,600,000 cfm @ 293°F

Cooling Tower - Two wet crossflow induced draft type

Size - 65 ft. high x 48 ft. wide x 252 ft. long (Approx.)

Water Supply - from Yellowtail Dam, Yellowstone River or Tongue River

Quantity - 8000 gpm max.,
- 4000 acre ft. annually

Discharge - All water will be recycled to the maximum extent possible.

- None will be released from the plant site.

Electric Transmission - Two additional 230 kV lines will be

required to connect this generation to

the M.P. Co. integrated system at Billings.

Coal Supply - from Western Energy Company mine adjacent to the plant site.

Quantity - 3 million tons annually - max.

- would require mining about 60-70 acres of land.

Delivery - by conveyor belt system

Total Est. Cost - \$183 million including \$25 million of air pollution control equipment

Employment - Plant construction - 800 + men (at peak)

Plant operation - Unit 1 - 44 men

- Unit 2 - 19 men add'l

Mining operation - 55 men

Total permanent workers 118 men

Colstrip - Town expansion is being planned by The Ken R. White Company of Denver, land use planners and designers, for Western Energy Company.