

## Hydropower

Hydropower is the production of electricity using the energy of falling water. Chief Joseph Dam is the nation's second largest producer of hydropower. To learn how this power is produced go to our Hydroelectricity page. The physical structure of the dam itself is what allows us to produce hydropower. Below are 4 sections that will tell you about the dam:

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### A Run of the River Dam

Chief Joseph Dam is a "run of the river" dam which means the lake behind the dam is not able to store large amounts of water. Water coming to Chief Joseph Dam from Grand Coulee Dam must be passed on to Wells Dam at approximately the same rate. With 27 main generators in the powerhouse, it has the hydraulic capacity of 213,000 cubic feet per second (cfs), or 1,593,000 gallons per second.

In the event more water was passed on to Chief Joseph Dam than could be used for power generation, the spillway gates would be opened to pass the excess water. With an average annual flow rate of 108,000 cfs, the Columbia River seldom exceeds the powerplant's capability to pass water. Spilling of water is infrequent at Chief Joseph Dam.

### Shaped for Power

the dam is 5,962 feet long in an area where the river is only 980 feet wide. the unique "I" shape enabled the corps of engineers to extend the powerhouse, making room for additional generators. this design allows the powerplant to take maximum advantage of the river for power production.





## Leaks

Water leakage in dams is a common occurrence - even for dams made of concrete. Most concrete dams, due to their large size, are made up of many sections called monoliths. There is a certain amount of leakage between monoliths and in other concrete joints due to the slight expansion and contraction of the concrete caused by temperature fluctuations.

Water can also pass under or around dams through soil or cracks in the bedrock.

Chief Joseph Dam contains 84 monoliths. It also contains an elaborate drainage system. The system collects water leaking through concrete joints, as well as water seeping through rock and soil, and passes it safely downstream. The design of the drainage system allows for routine inspection and continuous monitoring to ensure that it is working properly.

## Interesting Facts about Chief Joseph Dam

- About 2.2 million cubic yards of reinforced concrete was used to construct Chief Joseph Dam. That's enough concrete to build a two-lane highway between the dam and Salt Lake City, Utah.
- Chief Joseph Dam has 27 main unit penstocks - one to deliver water to each generator. Each of these penstocks carries enough water to fill an Olympic - size swimming pool in seven seconds.
- Chief Joseph Dam also has two small penstocks that supply water for two station service generators. The station service generators supply the power used to operate the dam.
- There are 4.5 miles of galleries (passageways) in the dam.
- The value of the electricity produced at Chief Joseph Dam is about \$450 million annually.
- Chief Joseph Dam has the nation's longest straight-line powerhouse. At 2039 feet, it's nearly one half mile long.
- Chief Joseph Dam is the nation's second leading producer of hydropower.

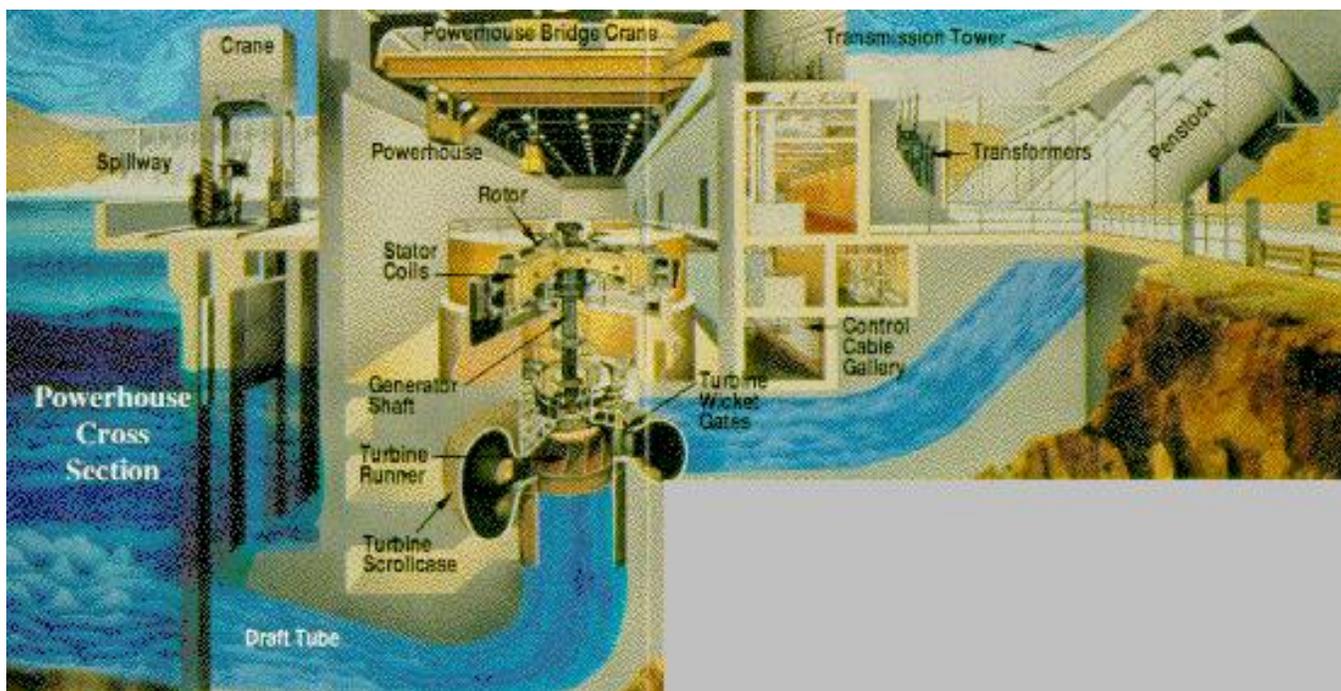
## Hydroelectricity

hydropower converts the energy of flowing water into electricity. the amount of electricity generated is determined by the volume of water and the amount of "head" (the height from the turbines in the powerplant to the water surface) created by the dam. the greater the flow and head, the more electricity is produced.

Chief Joseph Dam holds back the Columbia River, creating a head of 178 feet. Penstocks carry water from Rufus Woods Lake to turbines inside the powerhouse. As the water falls through a penstock it rotates a turbine, causing the rotor to spin. The rotor has magnetic poles, which generate electricity when they spin around the copper windings in the generator's stator.

The electricity created is rated at 13,800 volts. It is then converted to 230,000 volts or 540,000 volts in order to reduce transmission line power losses. Initially it is carried to the Bonneville Power Administration (BPA) switchyard on the hill south of the dam.

BPA distributes and sells electricity produced at federal power plants in the Northwest to public and private utilities. At Chief Joseph Dam, 80 percent of our power is sent to the Everett area north of Seattle. Power produced here is not only used in Washington, but also in Oregon, Montana, Idaho, California, Wyoming, Utah and Nevada.



Water behind the dam flows through huge penstocks (pipes) down to the turbines in the powerhouse. Moving at high velocity, the water strikes the turbine runner blades causing the runner to turn, spinning a steel shaft that turns the generator's rotor. Large electromagnets are located around the outside of the wheel-like rotor frame. As the rotor turns, the electromagnets establish an alternating magnetic field that penetrates the stationary copper conductors in the coils of the generator stator. As the individual copper

conductors in the coils are subjected to the alternating magnetic field, electrical energy is produced.

#### Hydropower Facts

- Hydropower is more efficient than any other form of electrical generation. It is capable of converting 90% of available energy into electricity. The best fossil fuel plant is only about 50% efficient.
- Hydropower is a low cost alternative. On average, hydropower production costs one-third that of nuclear or fossil fuel production.
- Hydropower can easily respond to power needs by its ability to be turned on and off quickly. Other forms of electrical production, such as a coal powerplant, require a great deal of time to start or stop producing electricity.
- Hydropower is a clean, reusable source of electricity. It produces no emissions and its fuel (water) can be used at each downstream dam.
- Hydropower is domestic. Our supply of water is continually replenished through rain and snowmelt. We are not dependent upon foreign fuel supplies and their possible interruption.

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