The Big Creek Project

American ingenuity and engineering created this hydroelectric plant when commercial use of electricity was in its infancy.

By Barbara Wolcott

The discovery of gold may have brought people to California, but engineering contributed more to the settlement of the West than did the discovery of gold.

In 1922, during an expansion of the hydroelectric project, a dog team represented contact with the outside world for workers 7,000 feet above sea level.

The advent of high-voltage alternating current made long-distance transmission of electricity practical, and brought the Sierra Nevada's water resources into the economic lifeblood of southern California.

The population of Los Angeles exceeded 105,000 by 1905, and Henry Huntington's interurban Pacific Electric and Los Angeles Railway used 80 percent of the power produced in the area. Huntington looked to the Sierras for hydroelectric power and bought into reality the dream of John Eastwood.

Eastwood, an engineer, for years had surveyed the Big Creek area of the Sierra Nevada between Yosemite and Sequoia Parks, looking for the ideal place for a hydroelectric system. By October 1902, he had devised a plan of immense proportion, and Huntington elected to finance it as the Edison Co.

The Miller Lux Co., established in 1857 by two other regional visionaries, Henry Miller and Charles Lux, had accumulated water rights to one million acres of watershed for a vast network of cattle ranches. Miller Lux Co. sold some of those water rights to Huntington's company, and the Big Creek project was born.

Hardest Working Water

The Edison Co.'s Big Creek system of dams, lakes, tunnels, forebays, and powerhouses sounds like imagination run amok, built as it is into steep mountain terrain and cut through solid granite, but it has proven to be one of the most practical in the world. That it was done with picks and shovels, horses, oxen, and a small railroad makes it even grander. In a total fall of 6,200 feet, a relatively small amount of water is used nine times, earning it the title of the Hardest Working Water in the World.

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The first order of business for Big Creek was a small railroad from Fresno. Completed in 157 days, it was necessary because the terrain was too rough for teams of mules or oxen.

The SJ&E was constructed with 1,100 curves and two cabled, 80 percent inclines, each a mile long. The geared engines, pulling cars that were no longer than 36 feet, traveled five to six very noisy miles an hour. As the story goes, conductors often would entertain passengers by hopping off the front of the train at one of the sharpest curves and reboarding after crossing the neck between. The railroad, which carried passengers and millions of tons of equipment and supplies to Big Creek, was necessary because the terrain was too rough for teams of mules or oxen.

At the site of what would become Huntington Lake, clearing began in the summer of 1912 and work was pressed to complete the dams to capture the runoff of the following spring. Dams 1 and 2 were completed by the first of the new year, but the smaller Dam 3 took longer because of unexpected difficulty in excavation. Bedrock there was much deeper and harder to reach. Work continued on the small dam even as the larger two dam sluices were closed to begin filling the lake. The lake filled so quickly, trees to be cleared were lumbered out by boat.

Under Water-Powered Lights

Work on Big Creek began at all sites at the same time and continued day and night under water-powered electric lights. By December 1913, the three dams had created Huntington Lake and Powerhouse 1 was on line. The 4,000-foot tunnel delivering water from Huntington Lake to the powerhouse was drilled through solid granite and measured 12 feet in diameter. A second tunnel, 21,600 feet long, was dug to Powerhouse 2. At the same time, 243 miles of transmission lines to Los Angeles were in place, carrying 60,000 kW of power.

Big Creek was by far the largest hydroelectric project in the world at the time and had the greatest vertical distance fall. Construction in the wild terrain was a constant challenge. Measurements required spring balances on the measuring tapes to ensure equal tension in determining distances. Corrections had to be made for temperature variations above and below 62°F. Once a day, surveyors used a steel tape calibrated in Washington by the Bureau of Standards to verify tapes used in the field.

The extremes between winter and summer temperatures brought inventive practices. During the winter of 1912-13, work with concrete continued by using steam pipes under canvas to keep the ambient temperature within workable ranges. Sections of penstock pipe, laid from the powerhouse up the steep incline to Huntington Lake, were filled with water as work progressed to stabilize pipes within the trench and to keep temperatures constant for welding. Without the expansion joints commonly used in construction today, the summer heat made pipelines crawl like snakes until they were buried.

In February 1917, a pipeline between Huntington Lake and Powerhouse No. 1 broke. The 42-inch gate valve controlling the water flow was at the top of the incline.

With four feet of snow on the ground and a blizzard in full sway, three engineers set off on horses hitched to a long narrow sled called a snowboat. When the horses were unable to go further, the men loaded heavy-duty jacks and other tools onto a toboggan and set off on snowshoes for the final mile. By kerosene lantern, they finally got to the valve at 2 a.m. and jacked it shut. The log for the trek merely noted, "Gate was jacked down."

Expanding the Project

Power from the Sierras fueled a surge of settlement in Los Angeles, and it was soon clear that the project had to be enlarged. Huntington Lake was expanded by adding height to the three dams and building a fourth. Each of the original dams was covered with concrete in the process.

Efficiency in the construction was always a challenge. While a turbine was being installed, the generator to be placed above it was assembled on a platform in place. When the turbine was completed, the generator was gently lowered a few inches into permanent position. Some installations were constructed so additional turbines and generators could be added at a later time.

By 1920, expansion moved above Kaiser Pass, and Florence Lake Dam was begun in a unique multiple-arch design. At more than 7,000 feet above sea level, the area was snowbound for six months of the year, and the road alone took two years to complete.

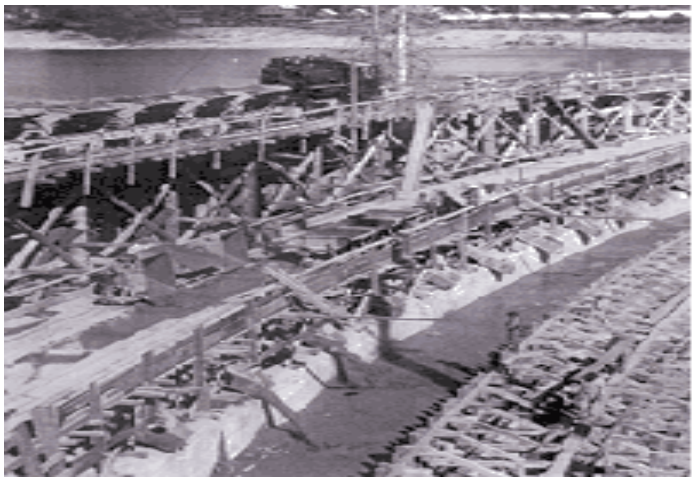
To ensure that the men would have mail, light supplies, and access to medical attention beyond the doctor in residence, an Alaskan sled dog team was hired. Jerry Dwyer and his team ran the road every day, staying overnight at Florence one night and at the halfway camp the next. The dog run was so successful; seven camp dogs were trained to spell the huskies. The graves of three of the Alaskan dogs—Babe, Whisky, and Trim—are marked at the ranger station on Kaiser Peak.

Radio communications between the Florence Lake project and Powerhouse No. 1 were established in lieu of a telephone line. That link between camps provided help when it was least expected. A man in Idaho who had been picking up Big Creek communications wrote to tell the engineers he heard they were looking for a bolt of a special nature. From the radio, he heard they had difficulty finding one and offered to send them one he had.

Bringing in Hot Food

Tunnels ran so deep into the rock that it took too long for workers to return to the surface for a meal in mid-shift; they received lunch by flatcar.

The Ward Tunnel was begun at both ends and because it was so far underground, work was able to proceed year-round. As the tunnel was cut, a railroad followed to bring men, supplies, and ultimately a hot food car when the distance became too great for the men to make the round trip for the mid-shift meal. The flatcar with tables and benches kept food hot, with electricity generated by the same hydroelectric system used to run the railroad and light the tunnel.



Vast amounts of concrete went into the Big Creek system. Between April 1 and August 1, 1927, an average day's pour was 1,431 cubic yards.

The short outside work season at Florence Lake made it especially trying to get buildings up before the snows forced the men inside. Each camp had cold storage for food and meat, a central laundry, recreation hall, and a hospital. In the four and a half years it took to construct the Ward Tunnel to Huntington Lake, two million pounds of fresh meat were consumed along with 1,770,000 pounds of potatoes. Each month the cooks served 55,000 loaves of bread, 5,000 cakes, and 36,000 pies. Big Creek cooks personally inspected Idaho potatoes in the field before purchasing carloads of them.

The Florence Lake Dam's multiple arch design allowed engineers to build a strong structure with a minimum of concrete. Rails from the finished Ward Tunnel were used to reinforce the concrete, and crushed granite aggregate from the tunnel formed the base of each arch. Due to the unusual weather conditions, concrete was tested repeatedly—the material itself, the mixing and batching. A well-equipped laboratory was set up, including a moist-air curing room. Eight hundred field samples and 1,200 cylinder test bores were tested. At 7,327 feet, the new dam attracted the attention of engineers from around the world.

The Big Creek hydroelectric system was cut through solid granite of the Sierras with picks and shovels, horses, oxen, and a small railroad.

Big Creek grew with the demand for electricity and each expansion tapped the same water at a different level. Shaver Lake Dam was created in 50-foot blocks with a construction joint between each. Besides the usual keyway at each joint, a thin copper sheet 30 inches wide extends from top to bottom, spanning the joint to make it watertight. The amount of concrete in the Big Creek system boggles the imagination, considering the kind of equipment available at the time. Between April 1 and August 1 of 1927 an average day's pour of concrete was 1,431 cubic yards. Because of the expansion, the entire Big Creek system was changed to 220,000 volts in May 1923, marking the first commercial use of such high voltage in the world.

Building continued at a record-breaking pace until the demand for electricity leveled off and even dropped during the Great Depression. World War II intervened before more dams and powerhouses could be added to Big Creek, but eventually the project encompassed eight lakes and five forebays, plus nine powerhouses and three tunnels. The last powerhouse at Balsam Meadow, built in 1987, is 1,000 feet underground and was carved from solid granite.

American ingenuity and engineering created Big Creek when commercial use of electricity was in its infancy. Eastwood's plan for Big Creek was formed at the time the Sundance Kid and Butch Cassidy's Hole in the Wall Gang pulled off their last big robbery. Big Creek is a monument to the insight of Eastwood; the daring of Huntington; the genius, precision, and innovation of engineers; and the labor of thousands of American workers. It is the world's greatest project entirely financed by private enterprise for the common good.