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Wire Sawing at the Core of Historic Decommissioning Project

More Than 2,600 Tons of Steel, Concrete Cut at Colorado Nuclear Facility

This article takes a look back at the first decommissioning of a nuclear power plant which involved concrete cutting and removal on a massive scale. Re-commissioning this plant as a natural gas-fired power plant that is environmentally friendly has saved the owners millions of dollars in new construction costs while the plant supplies the energy needs of Coloradans in ways that could not have been dreamed when it was originally built.

The Fort St. Vrain Power Station made history twice. It was the first and only nuclear power plant in America to use high-temperature, gas-cooled reactor technology. It was also the first nuclear plant in the U.S. to be successfully decommissioned.

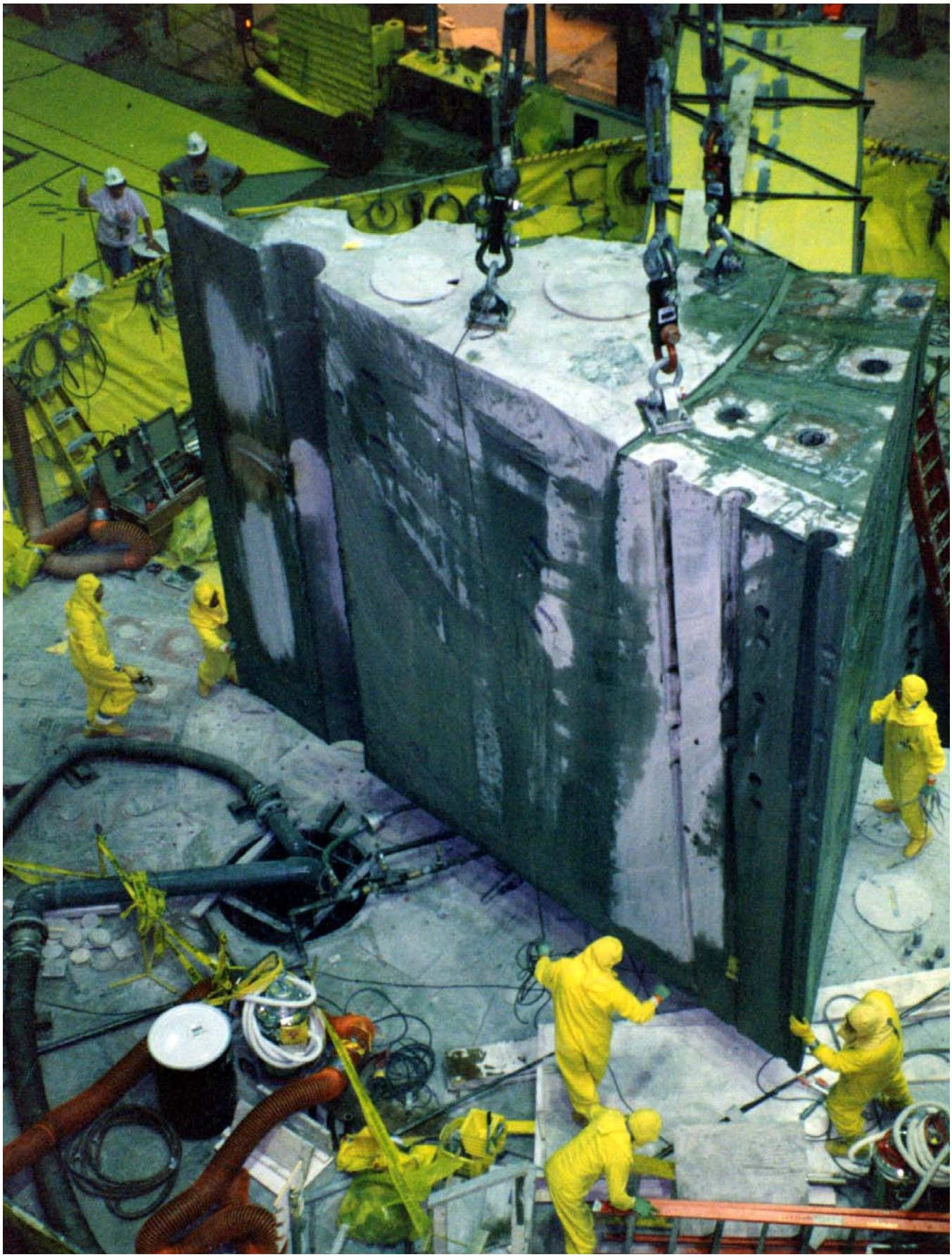
Built in the shadows of the majestic Rocky Mountains, the Fort St. Vrain Power Station (FSV) was Colorado's only nuclear power plant and America's only commercial gas-cooled reactor design. It was named after the historic frontier fort of the same name, once located about a mile north of the power plant site. The first commercial electric power using the reactor was generated from the plant in December 1976. The facility produced power until 1989 when all operations ceased. Continuing operational difficulties, concerns over nuclear fuel availability and financial losses forced the shutdown.

In 1990, the Public Service Company of Colorado, owner of Fort St. Vrain, announced plans to decommission the plant at an estimated cost of $125 million. It was expected that the decommissioning would take 3-1/2 years to complete. Returning the plant to a safe and non-radioactive site would begin immediately after the fuel was removed from the reactor. A major part of the decommissioning effort would involve dismantling the post-tensioned concrete reactor vessel, a unique cylindrical vessel containing more than 2,600 tons of concrete and large amounts of steel bars up to 2-1/4 inches in diameter. Additional steel components embedded in the concrete included 20 37-inch-diameter refueling tubes, two 24-inch-diameter purification penetrations or pipes, and several instrument penetrations.

The general contractor, MK-Ferguson Company (now Washington Group International), selected Trentec, a Division of Curtiss-Wright Flow Control Corp. of Cincinnati, Ohio to perform the precision cutting needed to dismantle the reactor vessel. Trentec would have the task of cutting the top section, core support floor and side walls of the reactor vessel in a complicated, three-phase project. Phase I would involve cutting and removing the vessel's top head, the upper portion of the vessel, that weighed more than 1,300 tons. In Phase II, the 270-ton core support floor would be cut and removed. Phase III would involve cutting the concrete side walls adjacent to the reactor core.

Limited access, high radiation and contamination hazards imposed strict constraints on the cutting and removal operation. It was decided that wire sawing would be the best method to use as wire sawing would provide access to hard-to-reach areas while allowing operators to control the cuts from a remote location, thus avoiding much of the irradiated materials. In addition, wire sawing would allow for efficient sizing of the cut pieces for packaging and disposal. Wire sawing would also be fast and efficient, a critical component because of the strict time schedule of this project. Trentec could be assessed with penalties if job deadlines were not met.

Throughout this project, there was an increased awareness of safety precautions that had to be taken to protect the operators from irradiated materials. Rad protection, a term used in the nuclear power industry for clothing and work gear that shields workers from radiation, was required during all phases of this job. Operators wore protective suits, rubber gloves and rubber covers over their shoes. Clean rad protection had to be worn each day.



A 110-ton wedge of concrete is lifted from the reactor vessel top head.

PHASE I - Top Head Removal

Trentec's first objective was to cut the reactor vessel's circular top head which measured 37-1/2 feet in diameter by 15 feet thick. Operators began by core drilling vertical and horizontal intersecting holes for the diamond wire. The initial cut was a horizontal one at the bottom of the reactor head, 2 inches above the internal steel liner. The wire was pulled successfully through the concrete, which included 37 20-inch-diameter vertical steel penetrations, two 24-inch-diameter vertical steel helium penetrations and a 48-inch-diameter steel man-way. In addition, many steel rods of up to 2-1/4-inch-diameter were also cut.

Next, the top head was cut vertically into 12 pie-shaped pieces weighing 110 tons each. Up to three wire saws were used simultaneously. The volume of concrete cut in this portion of the job amounted to 17,500 feet^3. The cut pieces were then rigged and moved to a secondary cutting station where they were cut into three smaller pie-shaped pieces weighing approximately 37 tons each. The general contractor then packaged the pieces to contain any traces of radiation and disposed of them. Phase I cutting was completed in 1993 after approximately seven months of work.

During the cutting process, the saws were located in a tent to minimize the operators' contact with irradiated materials. Also, the reactor was flooded with filtered water to shield workers from any remaining radiation. Water for controlling airborne dust and debris was contained and reused to limit the total amount of waste generated.

The only problem encountered during this phase of the job was that some of the cooling tubes that had been welded to the top steel section of the head did not hold together and broke off into the cut line. This hung up the wire and operators had to stop to free the wire. Overall, though, the timetable was not affected.

PHASE II - Core Support Floor Cutting

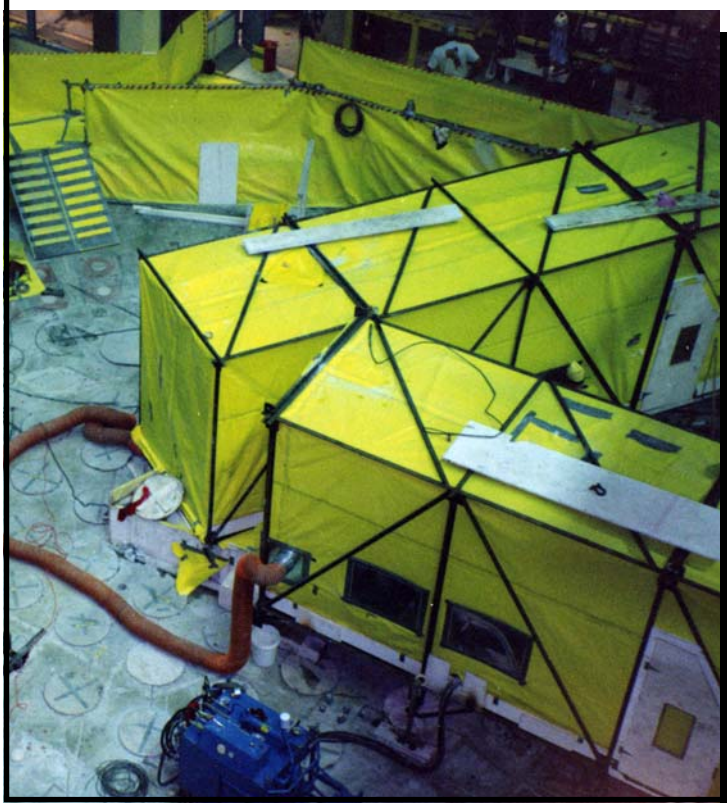
Trentec's next task was to cut the core support floor, a partially submerged layer of concrete that held the reactor core. The floor measured 30 feet in diameter by 5 feet thick and weighed 270 tons. To accomplish the cutting, the floor had to be raised out of the vessel into the top head area. Because the vessel was flooded with water to contain the radiation, divers equipped with torches were hired to swim under the floor to cut the floor loose from its supporting posts. Once loose, the general contractor used an overhead crane to move the floor so that Trentec could proceed with cutting.

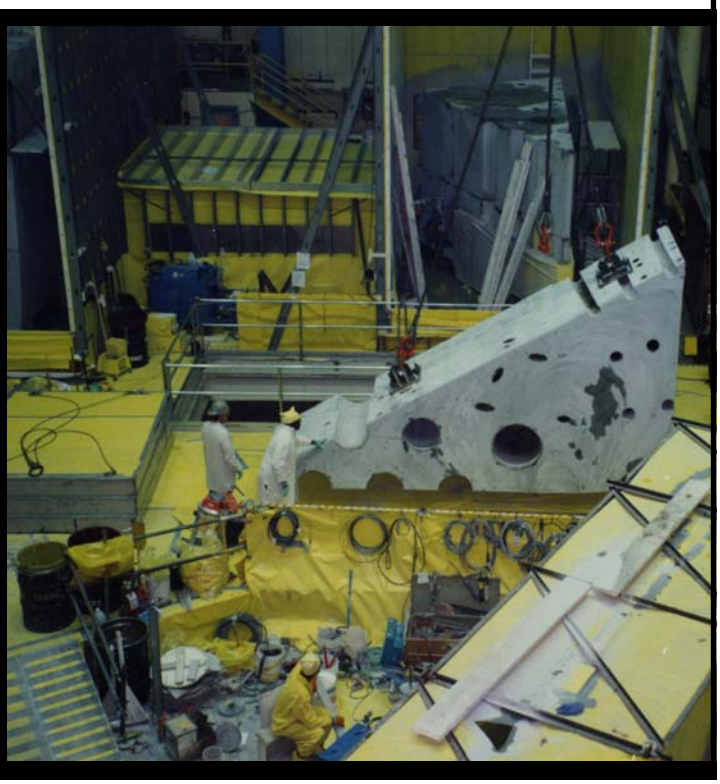
Operators cut the massive concrete piece in half with a large center cut. Each half was then moved to a secondary cutting station and cut into five pieces. For each cut, wire sliced through 5 feet of concrete and a total of 1-1/4-inches of steel plate and steel reinforcement. A total of 10 pieces weighing 27 tons each were then packaged and disposed of by the general contractor. Phase II was completed in 1994 over the course of three months.

PHASE III - Side Wall Cutting

The final phase required Trentec to

Left: Operators worked from inside a containment tent to avoid exposure to irradiated materials.
Right: Large pieces cut from the reactor's top head were cut into smaller pieces weighing approximately 37 tons each.





wire saw the activated concrete wall adjacent to the core region. This wall was 44 feet high and 2-1/2 feet thick. The steel reinforcement contained in this wall had absorbed most of the radioactive particles from the reactor core and still contained traces of radiation. This wall was cut into 14 sections, each 8 feet wide, using vertical radial cuts. For each cut, operators encountered heavily-reinforced concrete and 1-1/4-inches of steel liner plate. The 14 pieces, each weighing 75 tons, were moved to a secondary cutting station where they were cut into three smaller pieces. The general contractor again packaged and disposed of the pieces. In all, 1,050 tons of concrete were cut and removed. Phase III, performed in 1994, was completed in several weeks.

Results

Over the course of two years, Trentec cut 2,640 tons of heavily-reinforced concrete. The company met the demanding time frame of the job, receiving no penalties for delays, and also finished within budget. The nuclear reactor vessel was fully dismantled. With Trentec's contribution to the project, the Public Service Company of Colorado successfully completed the decommissioning of Fort St. Vrain in September 1996.

Robert Carson of Trentec served as the chief engineer of the cutting operation and was very satisified with Trentec's performance, especially given the magnitude and complexity of this project. "There have been a lot of decommissioning jobs since this project, but I think Fort St. Vrain was the most difficult in terms of the volume of concrete and steel to be removed and the type of access we had," he said. Trentec was awarded the job based, in large part, on their previous success working with the general contractor on other nuclear power plant projects.

The Fort St. Vrain Power Station was reborn as a non-nuclear power plant in 1996. Some of the original facilities such as the turbine hall were used in the construction of the new power plant, which uses three combined-cycle turbine generators of approximately 140-megawatts, powered by natural gas. After producing electricity in the newer turbine generators, waste heat is captured for steam production for the plant's original 300-megawatt generator. The new plant generates up to 720 megawatts of electricity and provides approximately 750,000 Colorado consumers with clean, reliable power. ●

COMPANY PROFILE

Established in 1988, Trentec, a Division of Curtiss-Wright Flow Control Corp., performs large diamond wire sawing projects throughout North America and also manufactures and sells diamond wire sawing tools and equipment worldwide. Trentec has been a CSDA member since 1994.

RESOURCES
Owner: Public Service Company of Colorado (now Xcel Energy)
Platteville, CO
General Contractor:
MK-Ferguson Company (now Washington Group International)
Boise, ID
Sawing & Drilling Contractor:
Trentec, a Division of Curtiss-Wright Flow Control Corp.
Cincinnati, OH
Methods Used: Wire Sawing, Core Drilling
Tel: 513-528-7900
Fax: 513-528-9292
Web: http://diamondwire.trentec.com
E-mail: rcarson@trentec.com