Reprinted from
Concrete Openings
Magazine of the Concrete Sawing & Drilling Association
December 2000

DOE Looks for A Better Way

Battelle Saves $270,000 Using Wire Saw for Radiological Decontamination & Decommissioning

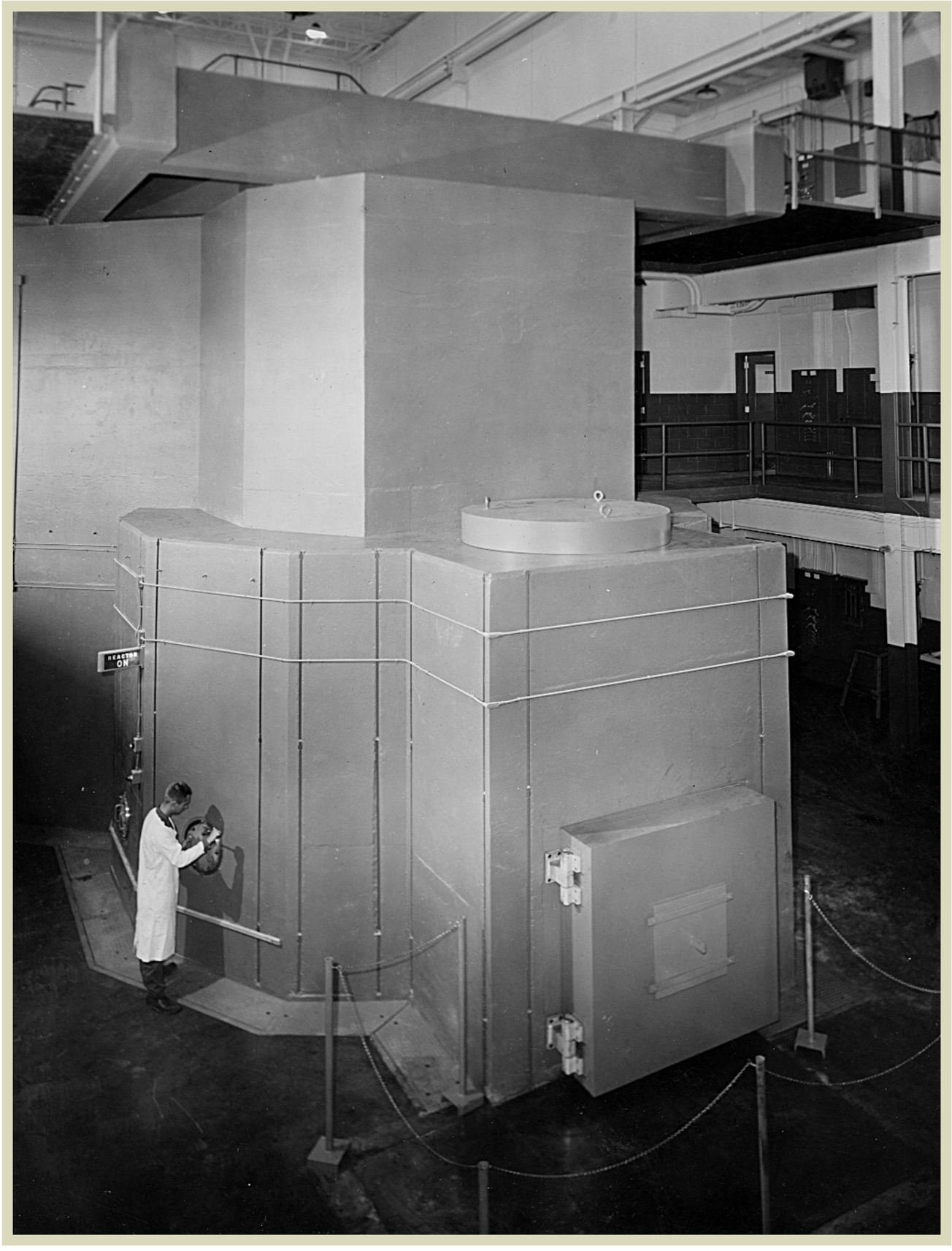
by Patrick O'Brien

Wire saws are ideal for removing large sections of heavily reinforced concrete in pulp and paper mills, steel mills, bridges, dams, power plants and for cutting concrete in any area where space is restricted. Battelle and the U.S. Department of Energy are using the wire saw for decontamination and decommissioning of radioactive concrete. This project will advance the use of wire sawing due to its capability to perform cutting with low noise levels, no vibration and no dust, while working to dispose radioactive materials.

The first privately-owned research reactor built for radioactive material and reactor core studies at Battelle is now part of a Department of Energy (DOE) program involving radiological decontamination, decommissioning and restoration. The United States Department of Energy contracted with Battelle Memorial Institute to perform environmental restoration on Battelle's JN-3 facility at a Battelle Research Park near West Jefferson, Ohio. Battelle performed atomic energy research including the fabrication of uranium and fuel elements, reactor development, submarine propulsion, fuel reprocessing and safety studies of reactor vessels for DOE and its predecessor agencies from 1943 through the mid-1980s.

The JN-3 reactor was built in 1955 and operations were shut down in 1974. In 1975 the reactor was decommissioned to a restricted level using the regulatory limits required at the time. The original decommissioning project included the removal of the fuel and water used in the reactor operation. This decommissioning brought the building to near-free release levels. Twenty-five years later, the instrumentation to detect residual radiation has improved dramatically, allowing lower regulations than the release levels required. At the present time, DOE and Battelle are working under a shared cost program to return this facility to a condition suitable for use and/or release without any radiological restrictions.

This phase of the Battelle Columbus Laboratories Decommissioning Project is intended to reduce the minimal contamination in the building to the present release



End view of swimming pool reactor showing thermal column and beam tube outlets on June 15, 1956.

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levels for use without radiological restrictions. Most of the remaining low radiation levels monitored in the building are from the irradiation of metals in the reactor walls, bio-shield and other structures. These do not present a health hazard for Battelle, the workers or the public. However, the As Low As Reasonably Achievable (ALARA) principles Battelle is working under for this DOE project demand the building reach free-releasable radiation levels. In order to reach this level, Battelle must remove the massive concrete structures, such as the reactor's bio-shield, and miscellaneous contamination from this radioactively "cold" building before it can be demolished.

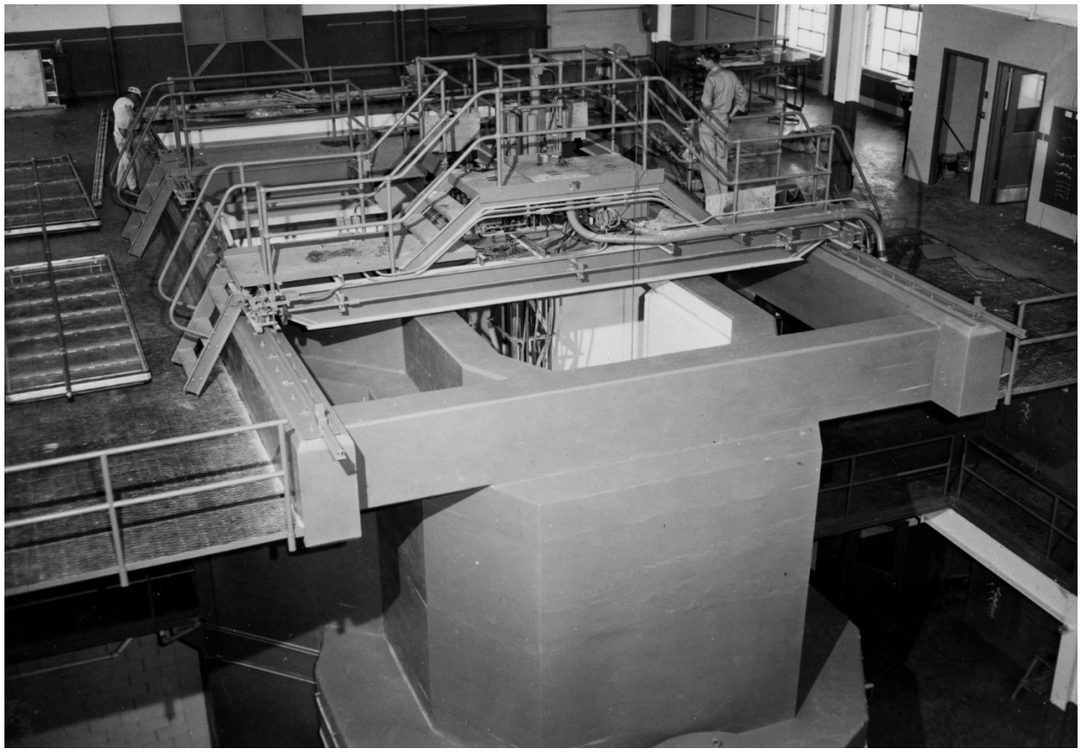
The JN-3 building on Battelle's West Jefferson North site is to be remediated through removal and disposal of the radioactively irradiated bio-shield. The bio-shield was built of high-density six-foot-thick concrete with carbon steel reinforcement to protect personnel from high levels of radiation produced during the reactor's operation. The manual removal of such a large structure would have required expending considerable time, effort and possible worker exposure. Battelle needed a better alternative. "We constantly search for more advanced technologies to aid in the remediation process and then back that up with continuous improvement," stated Carl Brenner, Battelle's JN-3 Project Manager. "DOE is recommending a concept called Accelerated Schedule Technology Deployment (ASTD) to help advance the technology," he added. As a result, Battelle proposed the use of diamond wire sawing to reduce the cost of the bio-shield removal while also facilitating the necessary radiological control during removal and disposal.

Battelle accepted bids from contractors with expertise in wire sawing and selected CSDA member Cutting Edge Services Corporation, of Cincinnati, Ohio. "This is a critical job that requires cutting expertise, innovation and problem- solving capability," said Battelle's Support Engineer Cidney Voth. "I have worked with Cutting Edge President Tim Beckman for a number of years at other sites and found him qualified for this task in the selection process."

In September 2000, Cutting Edge employees completed 40 hours of training in order to work in this radioactive environment. Training included radiation worker training, security and orientation training, bioassay and dosimetry operations, and procedure/work instruction orientation. The contract assumed that each worker would spend 2 hours per day involved in dress-in/dress-out activities as well as daily operational meetings. All the work was performed in compliance with OSHA (Occupational Safety and Health Act) and Battelle Safety and Health requirements.

The scope of work also included the removal of a non-radioactive 29 x 24 x 2 foot-thick wall and 4 x 9 x 4 foot-high pedestal inside the bio-shield. A Brokk hydraulic hammer or "rubble maker" was used for this demolition because the wall was non-radioactive and the operation could be carried out in less time. However, it became apparent that quicker was not better! The hammering created large amounts of dust that had to be controlled with mist spray to reduce the airborne dust exposure. The water then had to be collected and disposed in a radioactively controlled area causing additional challenges to the Battelle/ Cutting Edge team.

The next challenge was to remove the remaining 12,000 cubic feet of concrete that made up the bio-shield structure. The Cutting Edge operators were ready with their wire saws and core drilling assistance from CSDA member Express Saw Cutters of Bridgeville, Pennsylvania. Holes were core



General view of top of reactor showing bridges. June 15, 1956.

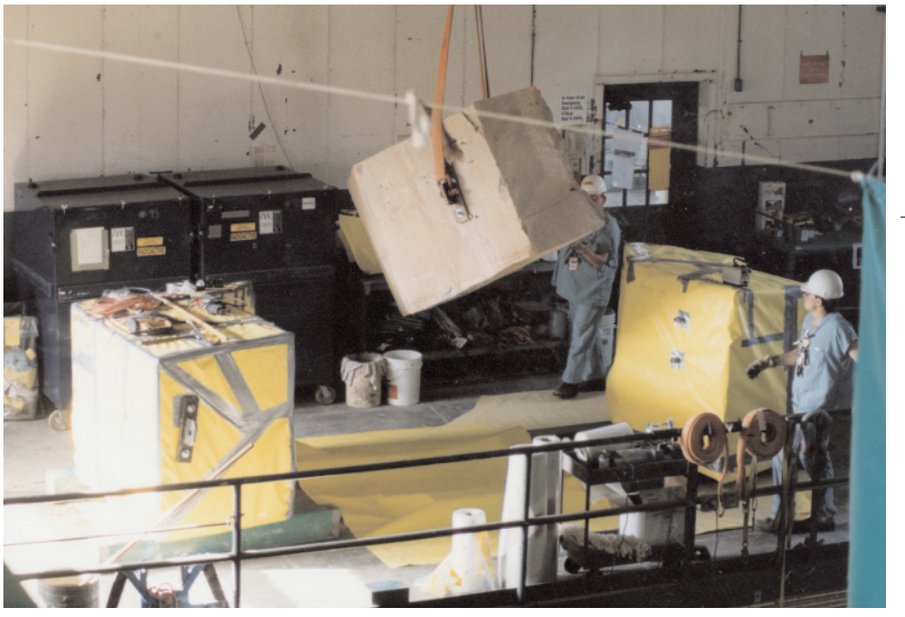
Clockwise from top:

Target weight for massive blocks was 5-10 tons.

The blocks were lowered to an area where they were wrapped with a special yellow cover for transport to the DOE-approved disposal site.

Wire sawing began at the top of the reactor and worked down.

One of the 64 blocks that was lifted out by the overhead crane.



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drilled at strategic locations of the concrete structure so that the diamond wire could be fed through in order to complete the loop of diamond wire before cutting could begin. The diamond wire is a multi-strand cable with diamond segments threaded on it that is looped through a series of pulleys and is continuously pulled through the concrete. Since virtually no concrete structure or cross-section is too large to cut, wire saws are used whenever other cutting methods are impractical.

The Cutting Edge team had to wire saw the concrete wall into 5-10-ton blocks that could be lifted out by the overhead 10-ton crane. The target weight for each block was 17,000 pounds and it is estimated that 64 blocks will be removed before the project is competed. The bio-shield consisted of two types of concrete. The standard concrete was 170 pounds per cubic foot and those blocks averaged 8 tons. The Barytes concrete had a higher density of 220 pounds per cubic foot and those blocks averaged 9 tons. Four diamond wire technicians will use two wire saws and two hundred feet of 11-mm and 15-mm diamond wire to cut a total of 12,000 cubic feet before the project is completed. The area to be cut is detailed in the diagram on page 15. The operators began with the removal of the top T-shaped concrete and then began cutting sections free starting from the top.

The diamond wire has many advantages in addition to the productivity and time efficiency in dismantling large concrete structures. An operating wire saw has low noise levels and because water is used to cool the diamond segments, little, if any, dust is generated during the cutting operation. In addition, wire sawing does not weaken the surrounding structure because there is no vibration and thus the stability of the remaining concrete is not affected. Hammering of the concrete introduces the possibility of making the radioactive material in the concrete unstable, which can be a major risk. Finally, only a small area of the one-inch diameter wire saw comes in contact with the radioactive material minimizing clean-up operations. From a radiological control standpoint, this technology provides a more efficient material disposal, more effective contamination control and better personnel exposure control.

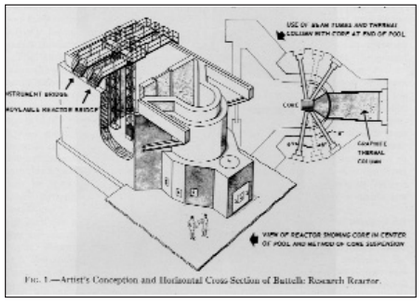
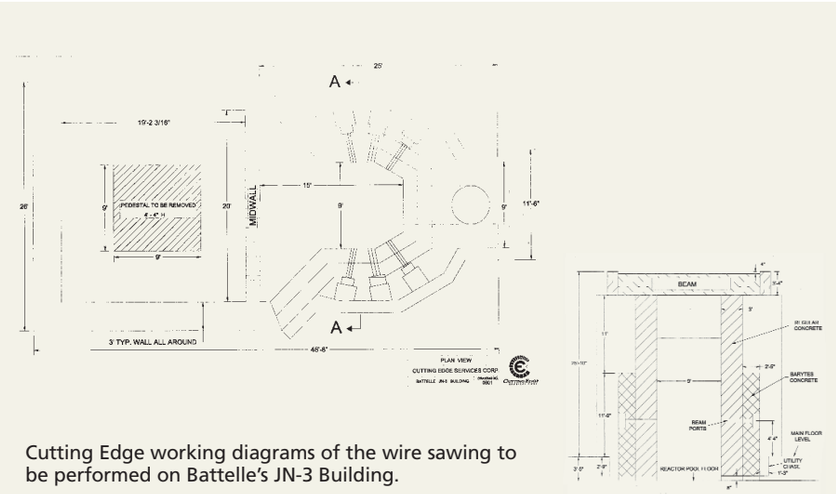


FIG. 1.—Artist's Conception and Horizontal Cross-Section of Battelle Research Reactor.



Cutting Edge working diagrams of the wire sawing to be performed on Battelle's JN-3 Building.

Another key advantage that was the direct result of wire sawing was much lower water usage. Because the water from the cutting operation had to be handled as radioactive material, the disposal of large quantities posed a difficult challenge for Battelle and Cutting Edge. In the first few days of sawing, 1,000 gallons of water per day were required. Though this was not unusual, the disposal of nearly twenty 55-gallon drums of contaminated water per day was unacceptable. Shipping costs for 55-gallon drums were $8 per cubic foot plus $20 per drum.

Cutting Edge devised a water recycle system that removed material from the radioactive water. The recycle system allows the sediment to settle out of the water so that the water can be recycled. Only the resulting sediment needed disposed of as radioactive waste, and the usage of fresh water dropped to 50 gallons per week!

Once the eight-foot-thick concrete sections are lifted out by crane they are lowered and then wrapped in a special protective yellow wrapping by Battelle workers for transport to a DOE-approved disposal site in Utah. Each concrete block is numbered sequentially and the weight is displayed to facilitate transportation and later loading.

Cutting Edge estimates that it will finish the cutting operations on this project by mid-January. This type of work has paved the way for future projects of this caliber. A critical mission of the DOE is the restoration of public and private facilities and sites contaminated during the course of work for the federal government. "The successful use of the wire saw on this project could result in other radiological decontamination, decommissioning and restoration projects under the DOE," said Voth. Professional CSDA contractors like Cutting Edge Services will be ready when DOE calls.

Cutting Edge Services Corporation is a CSDA contractor member located in Cincinnati, Ohio. CEO and President Tim Beckman has 17 years of experience with wire sawing, with a particular emphasis on nuclear facilities, dams and power plants. Cutting Edge was established in 1997 as a diamond cutting and concrete removal specialty firm for large and unusual projects. The focus of diamond cutting is wire sawing since Beckman was instrumental in commercializing construction sire sawing in 1983.

Battelle Memorial Institute is a not-for-profit research facility located in and around Columbus, Ohio. It provides basic and applied research for a variety of governmental agencies and commercial customers. ●