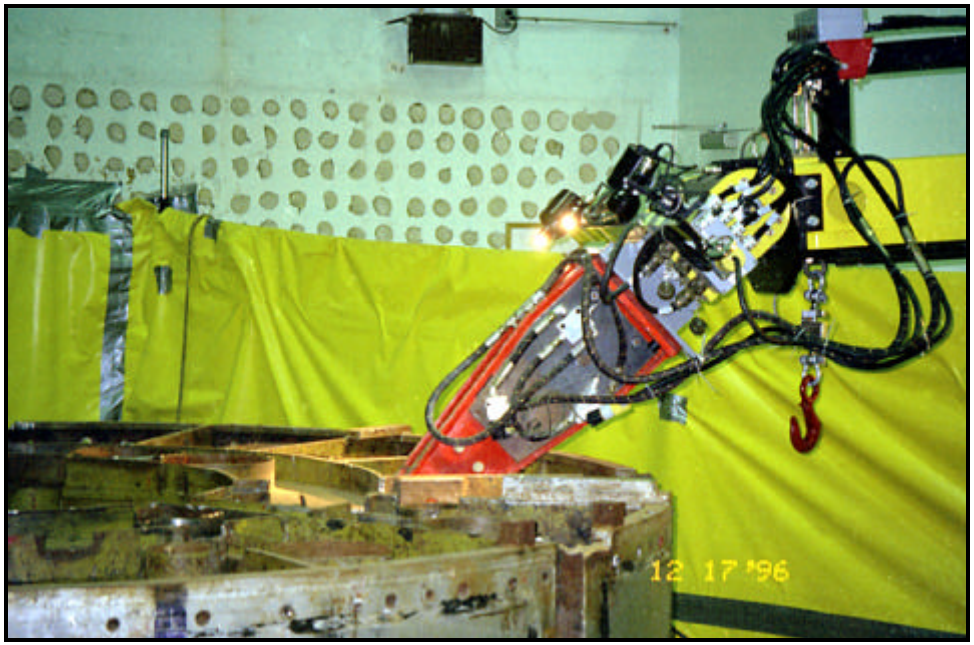
CP-5 Research Reactor D&D Project

CP-5 Research Reactor D&D - December 1996

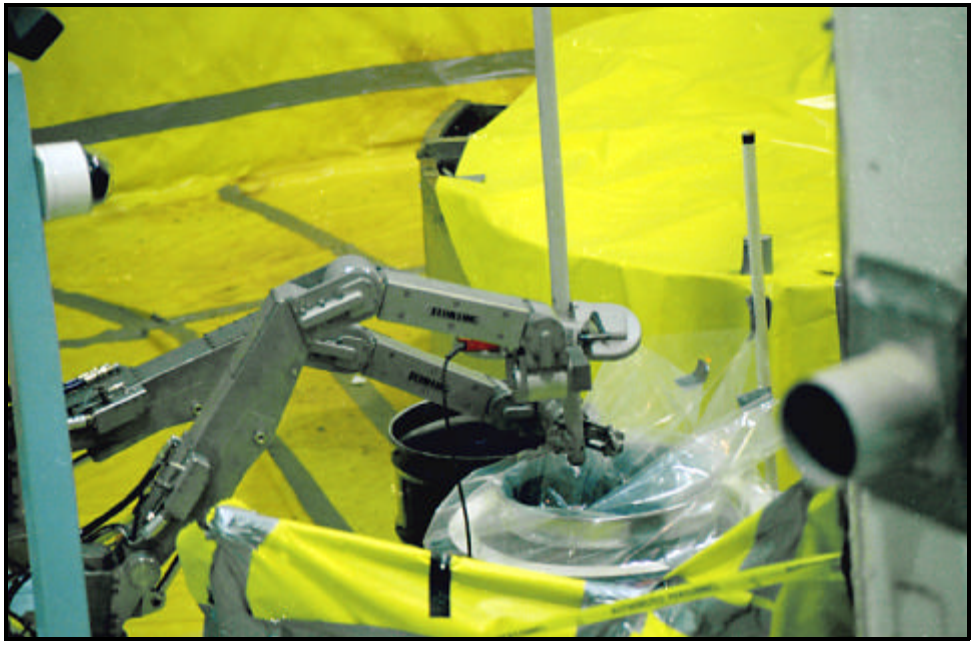
Sitting on the bottom of the CP-5 spent fuel pool were two “anti-criticality” racks that had been used to support the spent fuel after it was removed from the reactor core. The racks and tubes were made of aluminum, and each tube had a cadmium strip inside. The cadmium acted as a neutron absorber, preventing an accidental criticality of the fuel assemblies while they were in the pool. Using the facility’s overhead crane, the racks were removed and transferred to a High Efficiency Particulate Air (HEPA) filtered containment tent. The cadmium strips were segregated from the aluminum tubes, and each material was packaged in separate waste containers by personnel from ANL-E Waste Management Operations and Health Physics.

CP-5 Research Reactor D&D - December 1996



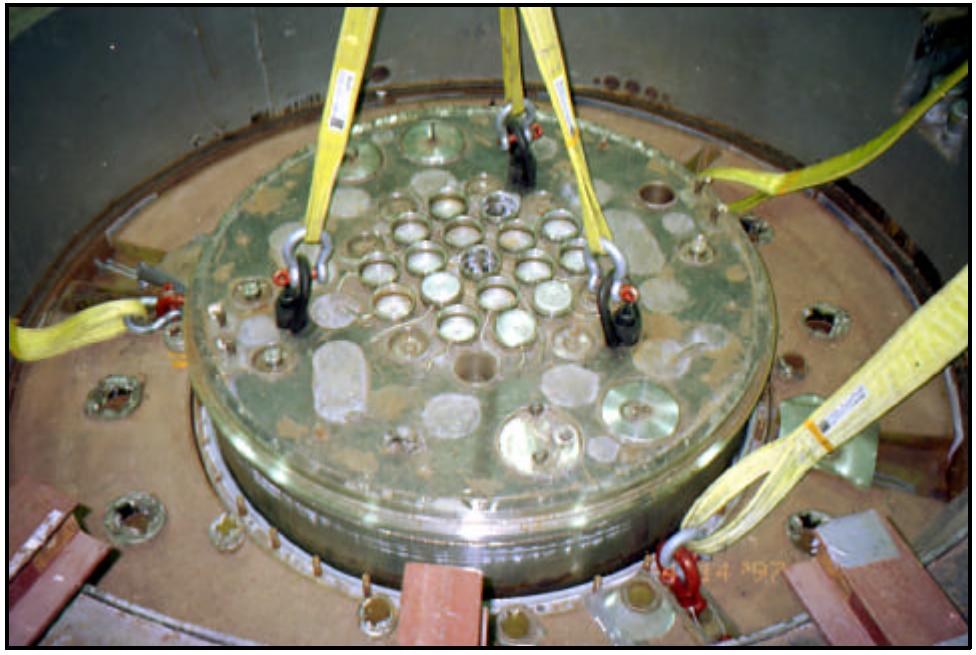
Rosie, from RedZone Robotics, Inc., was brought to CP-5 as part of the DOE EM-50 Large Scale Demonstration Project. Its teleoperated, remotely controlled long reach lifting and positioning capabilities make it useful for many tasks. Rosie has a mounting plate at the end of its boom assembly that allows a variety of components and tools to be attached. Multiple utility ports adjacent to the mounting plate include 120V AC power, 3000 psi hydraulics and audio/video ports. Using a large, modified demolition jackhammer, Rosie removed concrete from a radioactive shield that had been taken from the top of the reactor. The plug, which weighed 43,000 pounds, had to be cut in half before it could be removed from the reactor room and disposed.

CP-5 Research Reactor D&D - March 1997



As part of the CP-5 reactor disassembly, 28 vertical thimbles used to hold samples and experimental packages irradiated in the reactor were removed. One vertical thimble (VT-21) was used to hold a control rod for the reactor and was the most radioactive thimble removed. The Dual Arm Work Platform (DAWP) was used for size reduction of VT-21 and packaging it into a drum. The DAWP is a counter-weighted steel platform equipped with two Schilling manipulator arms operated remotely from a control room. The arms are capable of holding and lifting items weighing up to 240 pounds. In order to size reduce VT-21, one arm was used to stabilize the upper part of the thimble assembly over a shielded drum and the other arm was used to cut the thimble into pieces using a portable bandsaw.

CP-5 Research Reactor D&D - March 1997



The CP-5 reactor had seven large, heavy shielding subassemblies installed as part of its upper structure. One of these subassemblies, the lower center shield plug, was constructed of stainless steel, high-density concrete and lead. The penetrations for the vertical thimbles provided access to the reactor internals. A remotely controlled, 20-ton polar crane was used to raise the 18,000 pound radioactive plug from the reactor and transfer it into a NuPac 7-100 cask for temporary storage. This was one of three “critical” lifts performed in 1997.

CP-5 Research Reactor D&D - March 1997

A radiation survey of the lower center shield plug was performed by an ANL-E Health Physics technician immediately after it was transferred into a NuPac 7-100 cask. This is one of four NuPac 7-100 casks at the CP-5 facility. Two are certified Type A containers and will be used to transport low-level radioactive waste (LLRW) to the Hanford Disposal Site. The other two casks are “strong-tight” containers used for temporary, on-site storage of LLRW removed from the CP-5 reactor and bioshield.

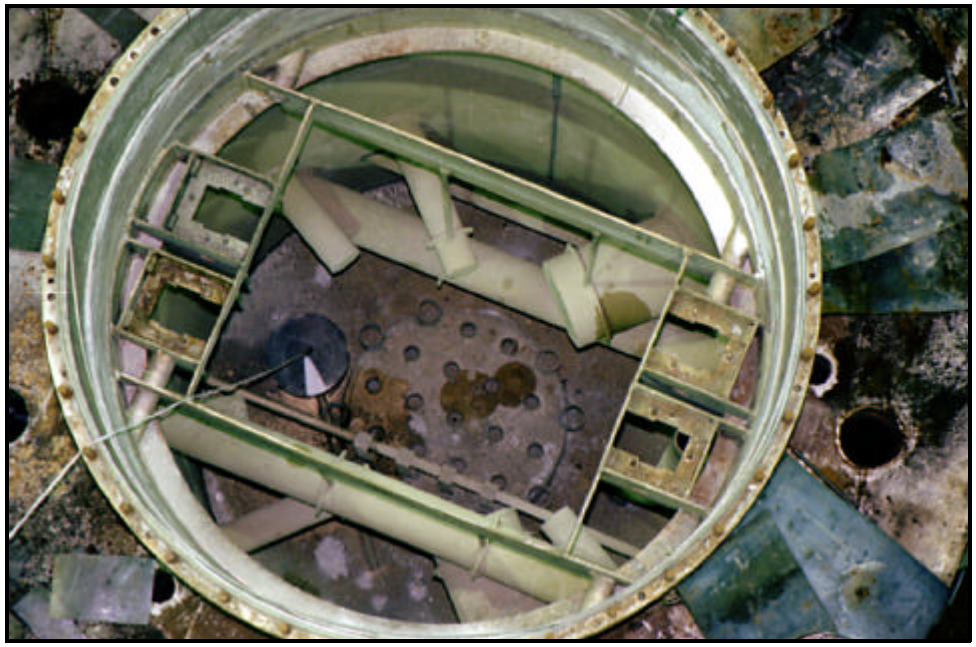
CP-5 Research Reactor D&D - March 1997

The upper center shield plug was the third of seven shield plugs removed from the CP-5 reactor structure. This plug, made of carbon steel, weighed approximately 6000 pounds. Before removing this assembly, obstructions such as other shielding assemblies, tubing and miscellaneous protuberances were manually cut or unbolted from the surrounding components. An ANL-E Waste Management Operations D&D crew member and the CP-5 Field Engineer were on hand as the center shield plug was removed from the inside of the upper outer shield plug assembly.

CP-5 Research Reactor D&D - March 1997

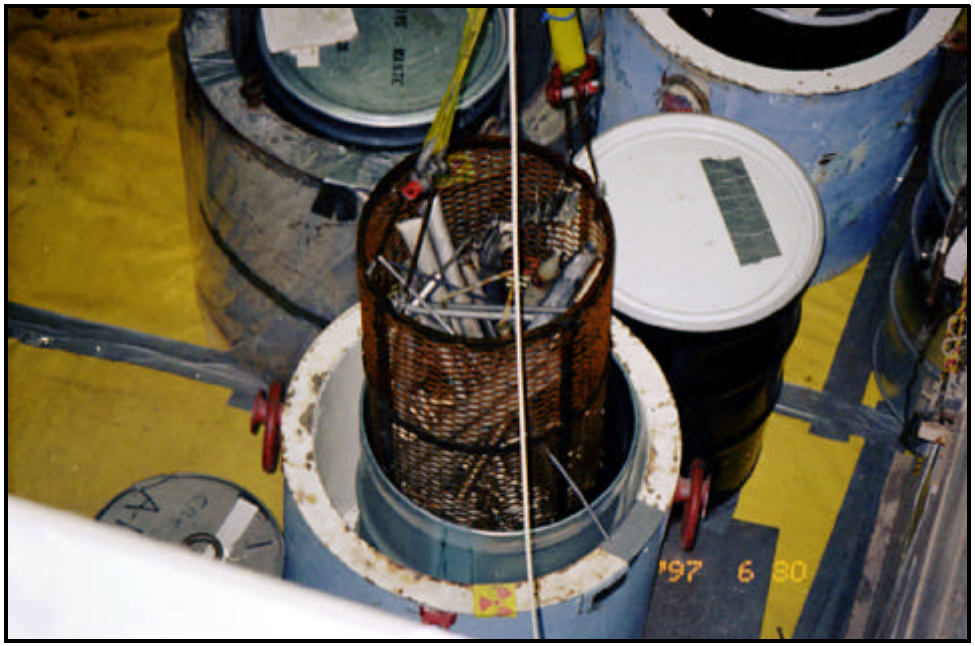
The remotely controlled polar crane and the two robots, Rosie and the DAWP, were set up to allow for operations at a safe distance from the radiation and industrial hazards associated with the dismantlement of the CP-5 reactor assembly. The old reactor control room was partially redesigned to provide a low exposure, remote location for the operators of these sophisticated pieces of equipment. The control room houses the control panels, computers, electronic systems, video displays and power supplies for the robotics systems, and the controller and gauges for the modified shell-ventilation system. Robotics operators received extensive training to become qualified on Rosie and the DAWP. The DAWP operator relies on ten available cameras to provide the views necessary to remotely size reduce radioactive material.

CP-5 Research Reactor D&D - June 1997



After the seven shield plugs were removed from the top of the CP-5 reactor, the inside of the vessel and top of the graphite area could be seen. The vessel - centered inside of the graphite tank - is comprised of several components, including the grid plate assembly that held the control rods, the horizontal beam tubes and the fuel-rod cooling-water plenum at the bottom of the vessel. This photo of the outer part of the graphite tank shows the vertical irradiation openings and seal plate above the graphite.

CP-5 Research Reactor D&D - June 1997



During the removal of the weight plugs from the bottom of the E-wing spent fuel pool, many unexpected items were discovered. Among these were radioactive, experimental packages made of different metals, wire cables, cutoff remnants of old experiments, nuts, bolts, a very fine layer of silt approximately 5 inches thick and other pieces of radioactive debris. The silt was removed using a filtration system. The materials were size reduced and collected in a wire mesh basket using a pneumatically operated cutter and a retrieval tool and long-reach poles. The disposable mesh baskets containing the materials were loaded into shielded 55-gallon drums.

CP-5 Research Reactor D&D - July 1997

D&D activities present unique and sometimes difficult challenges. Original facility and design drawings used to identify assemblies, materials and obstructions that may be encountered during D&D activities do not always portray an accurate picture. What was shown on the drawings to be a cast-iron ring made from eighteen lap-jointed segments bolted with four bolts per segment, was actually a ring constructed of twelve 1/4-inch-thick, overlapping carbon-steel, 120° segments spot welded together to form a single ring assembly. The ring lifted from the reactor assembly was 2 inches thick, 6 feet in diameter and weighed 2000 pounds.

CP-5 Research Reactor D&D - September 1997

Rosie, fitted with a Kraft TeleRobotics, Inc. Predator manipulator arm, was able to remotely lift and position radioactive materials and tooling to perform tasks in highly radioactive environments. Rosie and the Predator arm were used to remove graphite blocks weighing between 20 and 80 pounds from the west thermal column of the CP-5 reactor bioshield assembly. The dose rate to personnel working in the area would have been up to 2 Rem per hour.

CP-5 Research Reactor D&D - September 1997

The Predator arm was used to remove graphite from the CP-5 west thermal column. Approximately eighty 4 inch x 4 inch graphite blocks of varying lengths were removed and packaged into a radioactive waste bin (the yellow bin seen in the background).

CP-5 Research Reactor D&D - September 1997

Two sets of horizontal storage holes are located in the E-wing adjacent to the spent fuel pool. The storage holes were used to store various radioactive materials including control rod blades and experimental packages. The storage holes are internally contaminated. Working within a containment tent, the CP-5 crew removed the remaining materials stored inside the holes, segregated the materials according to their radiation levels and waste type, and packaged the materials in appropriate containers.

JANUS Reactor D&D Project

JANUS Reactor D&D - January 1997

D&D of the JANUS Biological Irradiation Facility required removal of all surplus equipment. The reactor control panels were among the first items to be removed. This required locating all electrical power sources and isolating them to protect workers. All wire terminals were verified de-energized, the wires cut and the panel sections removed from the control room. Even with these precautions, two energized wires were cut during the process. No injuries occurred. The investigation into the incident revealed that the wires had been improperly routed through the cabinets instead of being routed separately in electrical conduit. Additional electrical test equipment (proximity testers) were utilized during the rest of the work.

JANUS Reactor D&D - February 1997

The walls, floor and ceiling of the High Dose Room were covered with lead bricks or plates to a depth of four inches. Lead sheets also covered the face of the reactor to a depth of seven inches. Health Physics technicians surveyed every piece of lead removed. They were able to free release for recycle over 200,000 pounds of lead.

JANUS Reactor D&D - February 1997

The High Dose Room lead consisted of 4 inch x 4 inch x 24 inch chevron-shaped lead bricks that had been fused together by pouring the joints full of molten lead. Various cutting techniques were tested to determine the best method for segmenting the wall. An electric chain saw provided the best solution. Other methods tested included electric-powered chisels, circular saws and routers.

JANUS Reactor D&D - March 1997

Before the reactor vessel could be removed, it was necessary to disconnect and remove all primary system piping from the top of the vessel shield lid. This piping was internally contaminated with radioactive material. After removal, it was packaged for disposal as low-level radioactive waste.

JANUS Reactor D&D - April 1997

The reactor vessel shield lid was constructed of a stainless steel shell filled with concrete. A special disposal box was constructed to allow packaging of the lid in one piece, saving worker time and exposure.

JANUS Reactor D&D - April 1997

The reactor vessel was removed from the reactor cavity containment tent and transferred to the size-reduction area using the installed 10-ton crane. The vessel and internals, weighing a total of 8000 pounds, were constructed of aluminum. Some of the internal structures were activated to a level of 400 mR per hour on contact.

JANUS Reactor D&D - April 1997

Decontamination technicians removed the lead and graphite blocks from the side of the reactor vessel. Each lead block weighed approximately 30 pounds, while each graphite block weighed approximately 6 pounds. The lead provided shielding for gamma radiation. The graphite reflected neutrons back into the reactor, as well as serving as a thermal column.

JANUS Reactor D&D - April 1997

The reactor vessel was placed on its side for size reduction using electric saws. Workers wore HEPA-filtered respirators to prevent inhalation of any radioactive material. Note the use of heavy leather gloves over the rubber gloves when working near the cut surfaces.

JANUS Reactor D&D - May 1997

The reactor face in the Low Dose Room was shielded with four-inch-thick lead bricks. These were removed by hand, surveyed for free-release for recycle, and sent to the ANL-E Lead Bank. Workers wore respirators to prevent inhalation of lead dust.

JANUS Reactor D&D - May 1997

As the D&D work in each room was completed, the walls and floor were marked with grid lines to allow for identification of areas for the final release survey. A laser was utilized to project a beam of light onto the walls and floor to provide accurate grid placement.

JANUS Reactor D&D - July 1997

In areas where access was limited, activated concrete around the reactor was removed by jack hammers. The concrete was high-density and proved very difficult to remove with hand-held equipment. The workers wore fall-restraint harnesses and safety lanyards to prevent injury from falls through open areas on each side.

JANUS Reactor D&D - July 1997

Throughout the project, waste containers were inspected and transferred to ANL-E Waste Management for ultimate shipment and disposal at the Hanford, Washington DOE Disposal Site. A document package accompanies each container from the time an empty container is placed into use until it is buried.

JANUS Reactor D&D - August 1997

To expedite activated concrete removal, a remotely controlled, electro-hydraulic machine was utilized to break the concrete. Replacing the hammer with a scoop bucket, the machine was used to pick up and load the pieces of concrete into the disposal boxes.

JANUS Reactor D&D - September 1997

When all D&D work activities were completed, the HEPA-filtered ventilation system was no longer required. The 75-foot tall exhaust stack was removed, surveyed and free-released as scrap metal. A large crane and a boom lift with a work platform was used to remove the stack.