ANL/D&D/00-1

# FISCAL YEAR 1999 DECONTAMINATION AND DECOMMISSIONING ACTIVITIES PHOTOBRIEFING BOOK

## FOR THE

# ARGONNE NATIONAL LABORATORY-EAST TECHNOLOGY DEVELOPMENT DIVISION DECONTAMINATION AND DECOMMISSIONING PROGRAM

Work supported by the Office of Environmental Management, U.S. Department of Energy, under Contract W-31-109-Eng-38.

## *Argonne National Laboratory*

Argonne National Laboratory, with facilities in the states of Illinois and Idaho, is owned by the United States Government, and operated by the University of Chicago under the provisions of a contract with the Department of Energy.

This photobriefing book is a product of Argonne's Technology Development Division, Decontamination and Decommissioning (D&D) Program. For further information on the activities of the D&D Program, contact:

Thomas J. Yule
Associate Director, Technology Development Division
Argonne National Laboratory
Argonne, Illinois 60439-4814
Telephone (630) 252-6740

## *Disclaimer*



## *Report Availability*

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge TN 37831; prices available from (423) 576-8401. Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield VA 22161.

## *Cover*

In 1997, the Brokk BM 150 remote controlled demolition system, manufactured by Holmhed Systems AB of Sweden, was demonstrated at the Janus Reactor D&D Project as part of the DOE EM-50 Large Scale Demonstration Project. A larger version of this machine, a BM 250, is being used at the Chicago Pile 5 (CP-5) Reactor D&D Project to remove concrete surrounding the reactor tank (ANL Neg. 25311K, Frame 3A).

## FOREWORD

The Decontamination and Decommissioning (D&D) Program in the Technology Development Division at Argonne National Laboratory-East (ANL-E) is a comprehensive, integrated program based on our nuclear operations experiences and technology development expertise. It is composed of three major elements.

***Operations*** is dedicated to the safe and cost-effective D&D of surplus, contaminated facilities on the ANL-E site. The D&D of these facilities involves

- project identification, design, planning, and budgeting;
- project execution, including disassembling, size reduction, and packaging of all radioactive materials associated with the operation of a facility; demolition of all obsolete support structures; and decontamination of remaining structures and surrounding areas for unrestricted reuse or demolition; and
- project closeout and facility release.

Knowledge gained through successful project completions is shared with others in the DOE complex through topical presentations and lessons learned.

***Technology Development, Demonstration, and Deployment*** draws on our operational experience, and technology development and evaluation capabilities. The development program involves

- novel chemical decontamination to remove corrosion on metal surfaces to remove radioactive deposits;
- robotics to develop and demonstrate a trusted software development methodology that produces reliable software for dual-arm robotic operation; and
- waste volume reduction using surface characterization and decontamination by laser ablation.

***Training*** provides general D&D training courses or niche training courses for attendees with special interests. The courses are organized and planned by Technology Development Division personnel. The lecturers include Argonne personnel, as well as from other Department of Energy laboratories, DOE offices, the Nuclear Regulatory Commission, and commercial firms.

This photobriefing book is dedicated to Operations. To learn more about Technology Development, Demonstration, and Deployment, and Training, visit our web site at www.td.anl.gov/Programs/dd/dd.html.

Thomas J. Yule
Associate Director
Technology Development Division

# Introduction

# INTRODUCTION

The Chicago Pile 5 (CP-5) Reactor, the first reactor built on the Argonne National Laboratory-East site, followed a rich history that had begun in 1942 with Enrico Fermi's original pile built under the west stands at the Stagg Field Stadium of The University of Chicago.

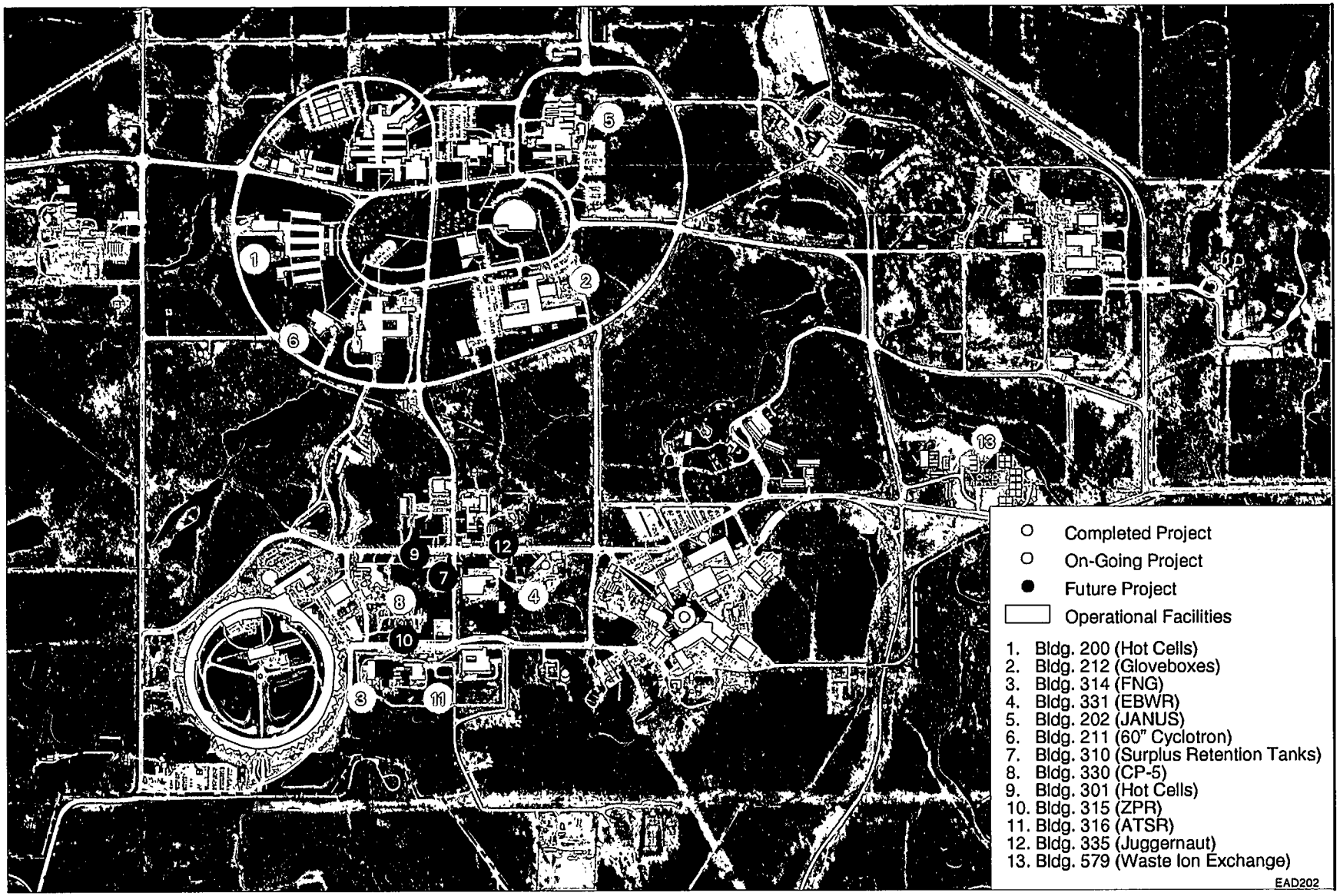
CP-5 was a 5-megawatt, heavy water-moderated, enriched uranium-fueled reactor used to produce neutrons for scientific research from 1954-79. The reactor was shut down and defueled in 1979, and placed into a lay-up condition pending funding for decontamination and decommissioning (D&D). In 1990, work was initiated on the D&D of the facility in order to alleviate safety and environmental concerns associated with the site due to the deterioration of the building and its associated support systems.

A decision was made in early Fiscal Year (FY) 1999 to direct focus and resources to the completion of the CP-5 Reactor D&D Project. An award of contract was made in December 1998 to Duke Engineering and Services (Marlborough MA), and a D&D crew was on site in March 1999 to begin work. The project is scheduled to be completed in July 2000. The Laboratory has determined that the building housing the CP-5 facility is surplus to the Laboratory's needs and will be a candidate for demolition.

In addition to a photographic chronology of FY 1999 activities at the CP-5 Reactor D&D Project, brief descriptions of other FY 1999 activities and of projects planned for the future are provided in this photobriefing book.

C. R. Fellhauer
D&D Operations Manager

# D&D Operations



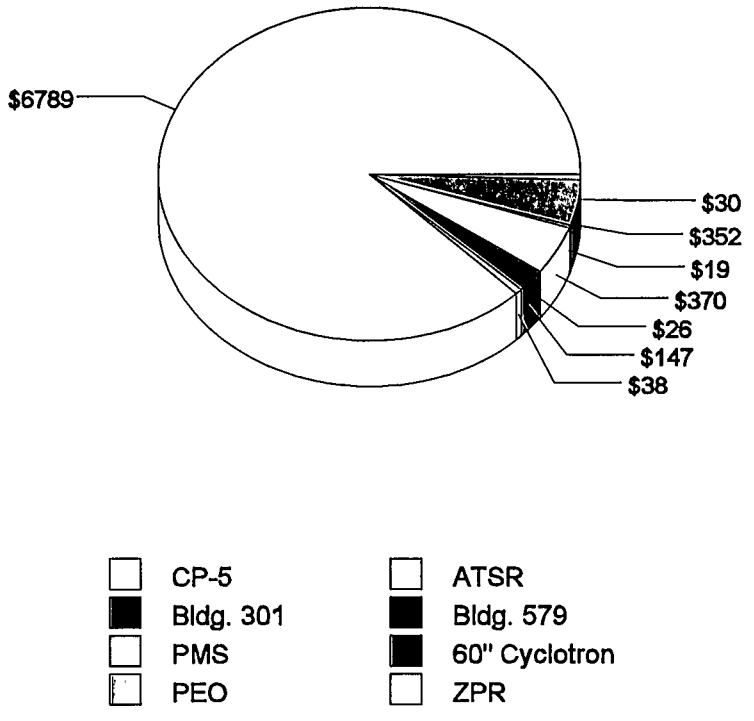

**Status of EM-40 D&D Projects at the Argonne National Laboratory-East Site (as of September 30, 1999)**

# FY 1999 DOE EM-40 Project Highlights

## FY 1999 EM-40 Project Status

- FY 1999 DOE EM-40 project funding totaled $7771K
- Argonne Thermal Source Reactor D&D Project final report was issued
- Building 579 Waste Ion Exchange Facility D&D Project final report was issued
- D&D planning/documentation for the 60" Cyclotron D&D Project and the Building 301 Hot Cells D&D Project were completed
- Award of contract to complete D&D of CP-5 Reactor was made to Duke Engineering and Services
- CP-5 D&D subcontractor on site in March 1999
- Characterization Plan for the Zero Power Reactors 6&9 was completed
- A Request for Bid to complete the 60" Cyclotron D&D Project was issued, and a subcontractor (MOTA Corporation) was selected (award of contract will be made early in FY 2000)
- FY 1999 Program Engineering/Oversight (PEO) and Program Management Support (PMS) activities were conducted

## FY 1999 EM-40 Project Funding (in $K)



# FY 1993 - 1999 DOE EM-40 Project Status and Funding

## EM-40 D&D Projects Completed

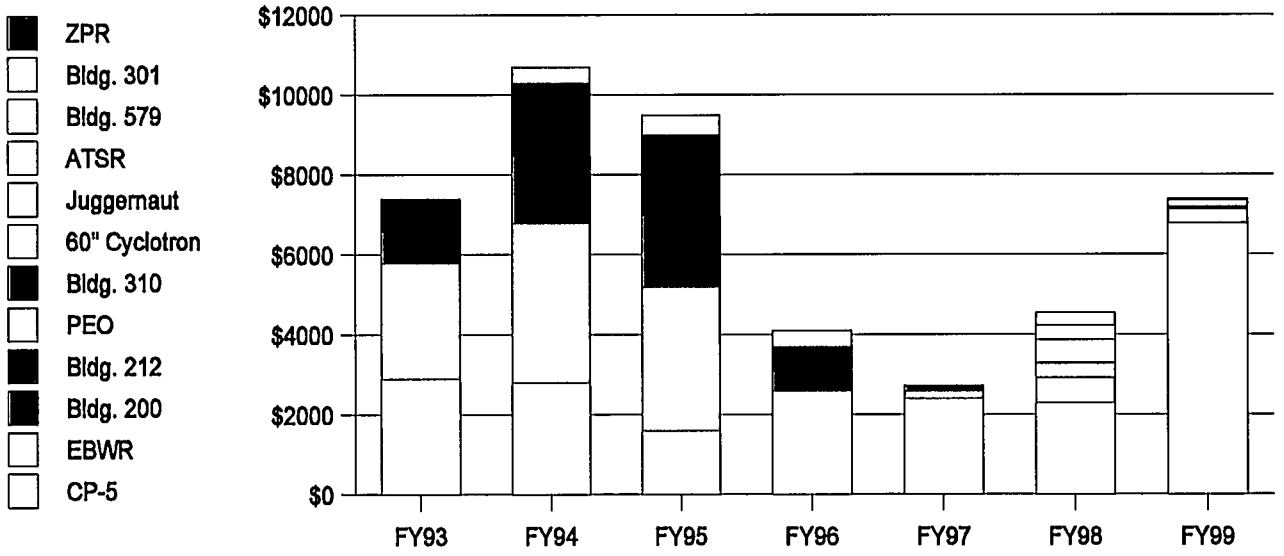
**1996:** Experimental Boiling Water Reactor (Bldg. 331)
M-Wing Hot Cells Facilities (Bldg. 200)
Plutonium Gloveboxes (61 gloveboxes in Bldg. 212)
Fast Neutron Generator (Bldg. 314)

**1997:** JANUS Reactor (Bldg. 202)

**1998:** Argonne Thermal Source Reactor (Bldg. 316)
Waste Ion Exchange Facility (Bldg. 579)

## DOE EM-40 D&D Project Funding by Fiscal Year

(in $K)



# CP-5 Research Reactor D&D Project

## CP-5 Research Reactor D&D

In December 1998, an award of contract was made to Duke Engineering and Services (Marlborough MA) to complete the decontamination and decommissioning (D&D) of the Chicago Pile (CP-5) Research Reactor. The D&D crew was on site in March 1999. This photograph shows representatives of the hands-on work force attending the project orientation held at the project site, Building 330 (ANL Neg. 24991K, Frame 13).

## CP-5 Research Reactor D&D

Two Brokk BM 250 demolition machines were deployed at the CP-5 D&D Project. One was provided by the subcontractor; a second one was on loan from the Princeton Plasma Physics Laboratory, Princeton NJ. In this photograph, workers are using a HILTI® hammer drill to set steel anchors in the concrete floor of the CP-5 reactor shell. The anchors are used to fasten a chain from the Brokk and attach it to the floor. This process helps stabilize the Brokk while it is used to jackhammer concrete (ANL Neg. 25109K, Frame 10).

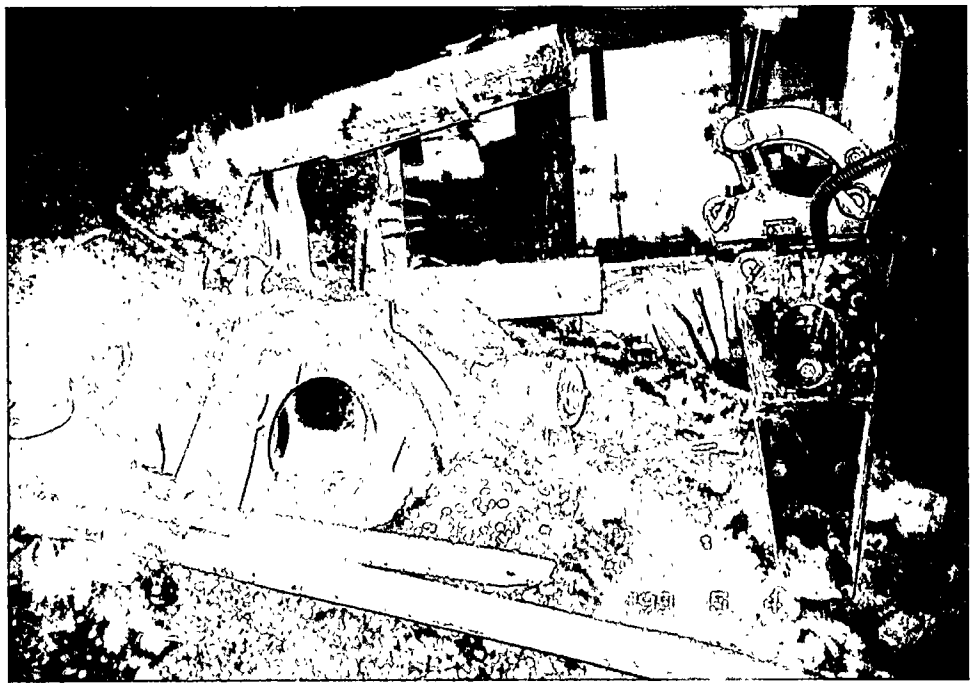
## CP-5 Research Reactor D&D


This photograph of the CP-5 reactor's Face #1 shows the steel tank after the Brokks removed the high-density concrete (ANL Neg. 25109K, Frame 12).

## CP-5 Research Reactor D&D

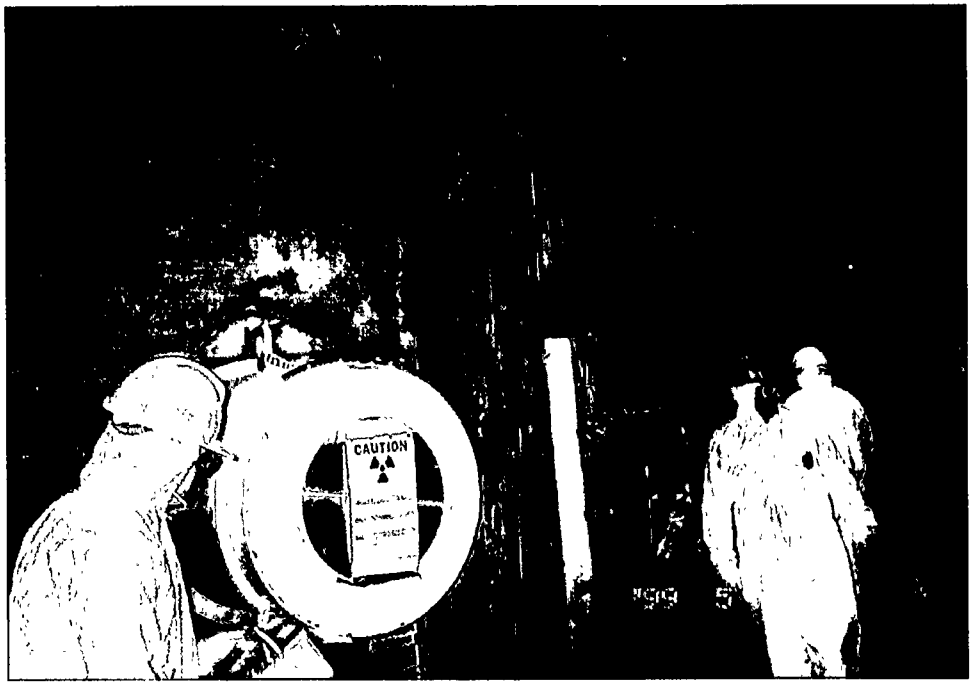
A Brokk was used to remove the high-density concrete bioshield from the south face of the CP-5 reactor. In the foreground, the rubbled remains of the east side of the reactor are shown. The large concrete block on the right is being used as shielding to protect workers from exposure to unnecessary radiation dose (ANL Neg. 25109K, Frame 23).

## CP-5 Research Reactor D&D



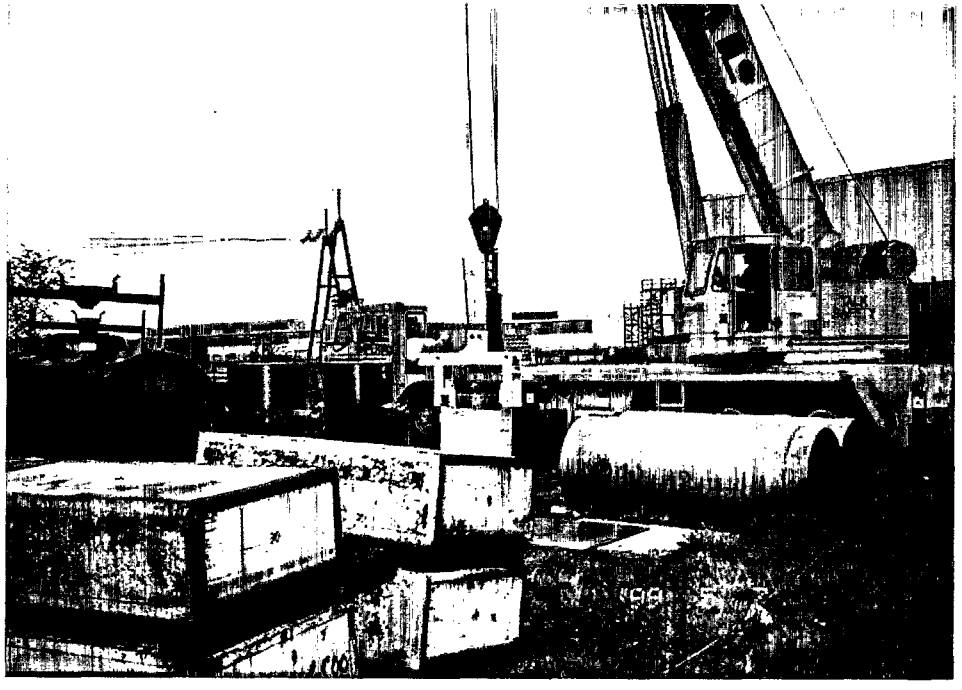
The Brokk is being used to remove concrete from the reactor bioshield to expose a beam gate. Shown in this photograph are horizontal experimental tubes protruding from the reactor face (ANL Neg. 25108K, Frame 4A).

## CP-5 Research Reactor D&D



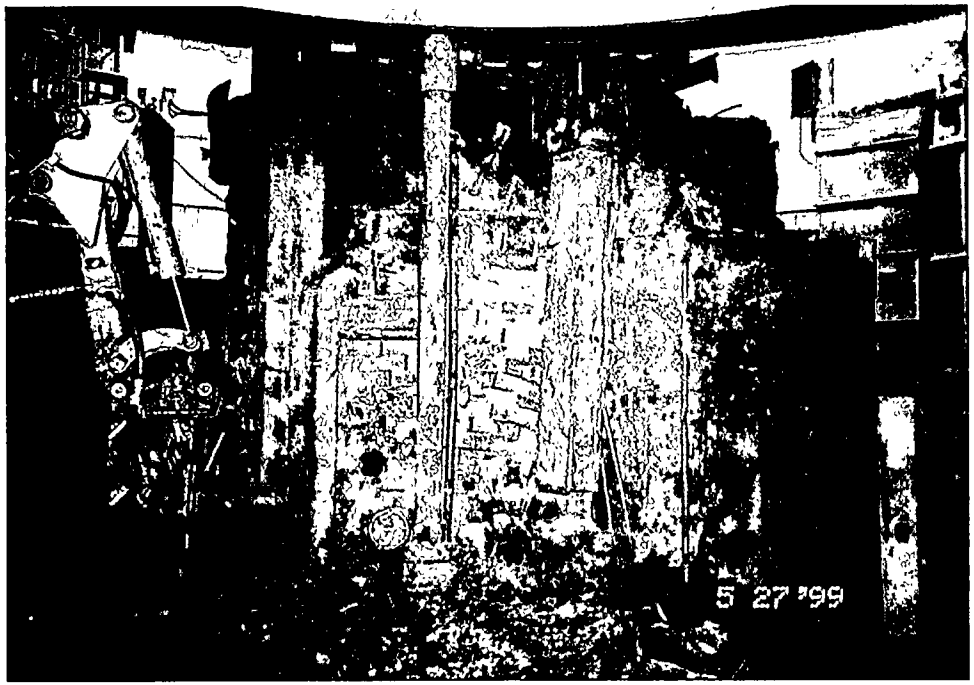

Wearing a red hard hat, Technology Development Division Associate Director Tom Yule is touring the CP-5 reactor shell to witness the progress being made. To the left of Yule, a health physics technician is monitoring the radiation dose in the area (ANL Neg. 25108K, Frame 2A).

## CP-5 Research Reactor D&D



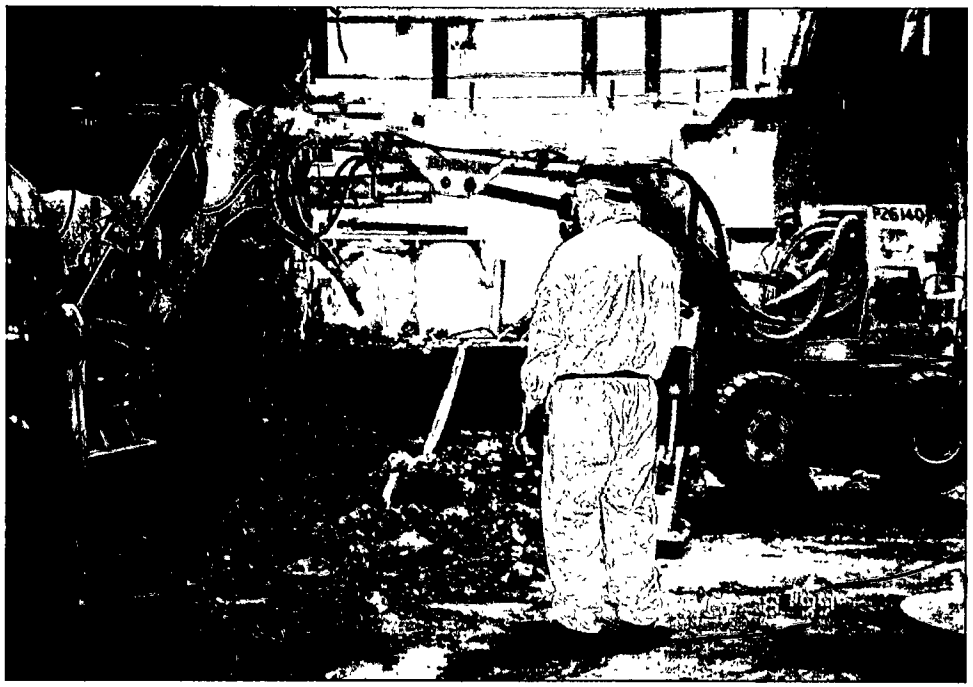
Two 48,000 pound spent fuel casks (sitting in front of the crane) from the Experimental Boiling Water Reactor were being stored in the CP-5 Yard. During miscellaneous cleanup activities, a mobile crane is being used to position these casks for decontamination. These casks will be recycled (ANL Neg. 25162K, Frame 8A).

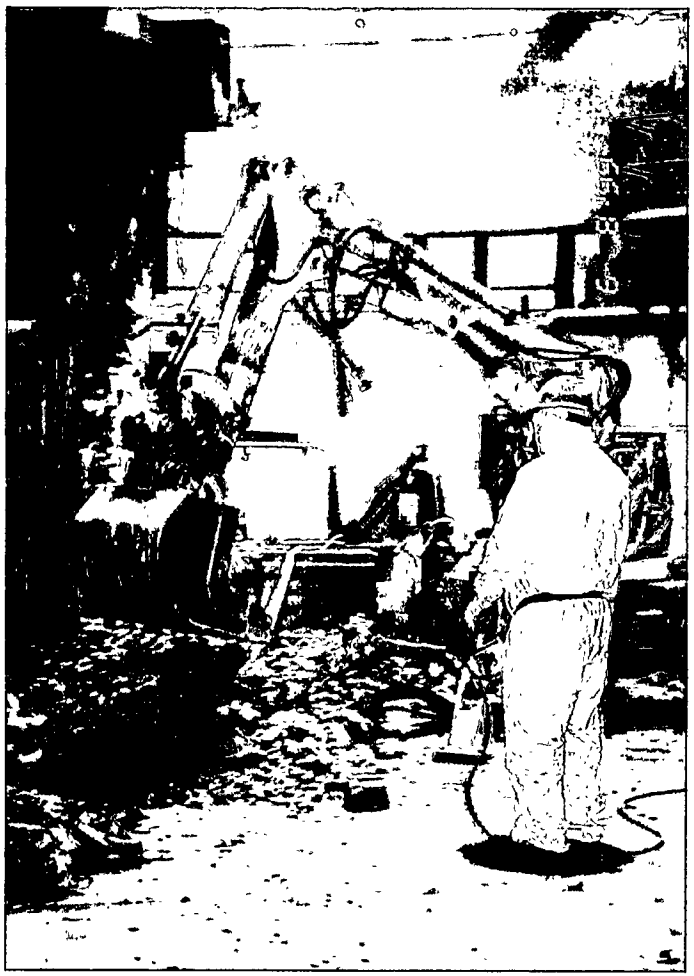
## CP-5 Research Reactor D&D




This picture of the south side of the CP-5 reactor shows the Brokk, fitted with its jackhammer attachment, breaking up one of the isotope trays. Also shown are exposed lead bricks after the bioshield concrete was removed (ANL Neg. 25232K, Frame 7).

## CP-5 Research Reactor D&D





The Brokk, fitted with the jackhammer attachment, is removing the CP-5 bioshield from the face of the reactor (ANL Neg. 25252K, Frame 9). The high-density concrete piles that formed on the shell floor are being removed with the Brokk, now fitted with the bucket attachment. The operator, shown here, is remotely operating the Brokk to scoop up the rubble with the bucket and load it into a bin for shipment (ANL Neg. 25252K, Frame 11).

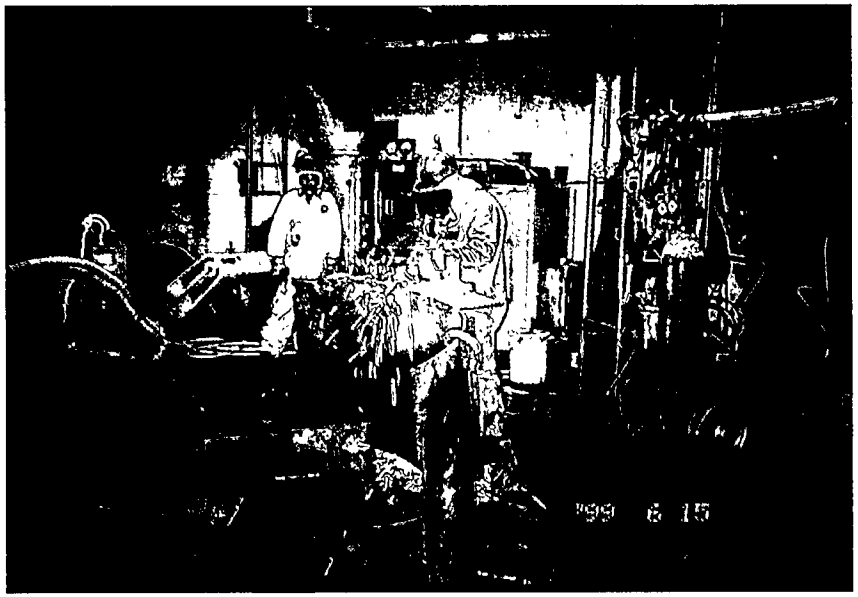
## CP-5 Research Reactor D&D

This is a view of the northeast side of the CP-5 reactor. One Brokk is seen through the thermal column in the center of the reactor. The jackhammer attachment is shown on the left of the picture lying on the floor next to the reactor. Shown on the far right of the picture, the second Brokk is fitted with its bucket attachment ready to load concrete into B-25 bins (ANL Neg. 25252K, Frame 12).

## CP-5 Research Reactor D&D

Looking to the south in the CP-5 reactor shell, a worker is using an oxyacetylene torch to cut free the uppermost section of the reactor steel tank. The upper section of the steel tank is being supported by the polar crane while the worker makes the cut (ANL Neg. 25261K, Frame 2).

## CP-5 Research Reactor D&D



After the top portion of the steel tank is completely cut around the circumference, the section is lowered to an area on the shell floor (ANL Neg. 25261K, Frame 23). The section of steel tank is staged on the floor in the CP-5 shell. Using an oxyacetylene torch, a worker cuts the steel tank into pieces small enough to allow workers to load them into a B-25 bin for disposal (ANL Neg. 25260K, Frame 4A).

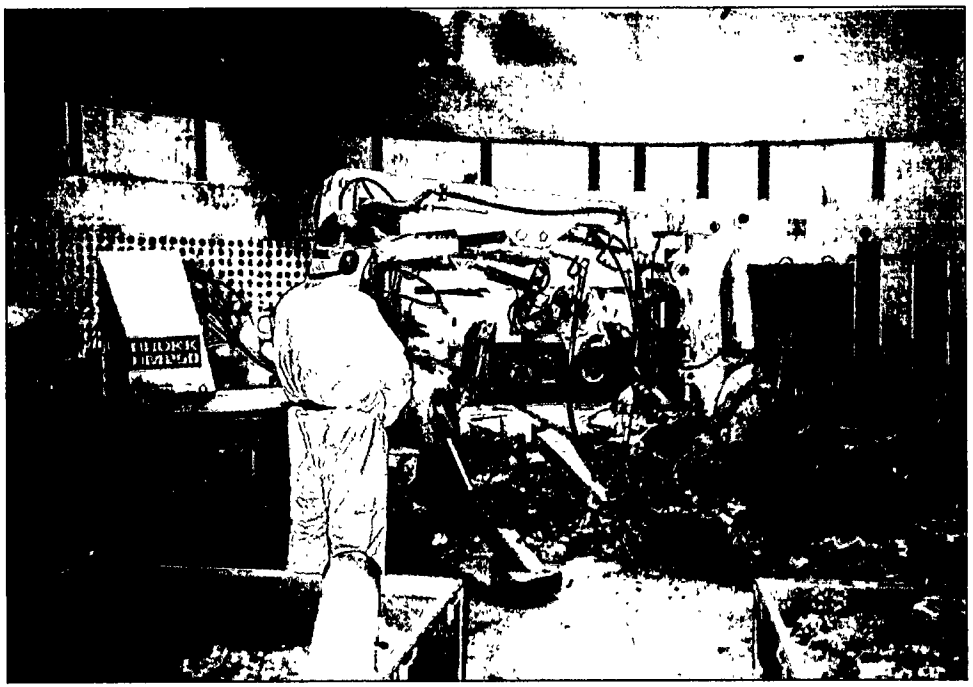
## CP-5 Research Reactor D&D

This picture captures the center section of the CP-5 reactor steel tank being suspended from the polar crane. This section, like the upper section, was cut completely around the circumference by workers using an oxyacetylene torch. It was staged on the CP-5 shell floor, size reduced, and loaded into a B-25 bin for disposal (ANL Neg. 25262K, Frame 22A).

## CP-5 Research Reactor D&D

The lower section of the reactor steel tank was cut completely around the circumference using an oxyacetylene torch. The polar crane was used to secure the load during cutting. In the center of this picture is a lead blanket supported by a chain. The lead blanket is used to shield workers from receiving unnecessary radiation dose from some highly activated components during the size reduction of the steel tank (ANL Neg. 25264K, Frame 9A).

## CP-5 Research Reactor D&D



Taken from the north end of the CP-5 shell floor area, this photograph shows a Brokk fitted with the jackhammer attachment being used to break free the bottom of the reactor tank (ANL Neg. 25311K, Frame 0A).

## CP-5 Research Reactor D&D

Taken from the second floor catwalk inside the CP-5 shell, this photograph shows the Brokk operator removing the concrete surrounding the bottom of the reactor tank before proceeding to pry out the tank (ANL Neg. 25311K, Frame 3A).

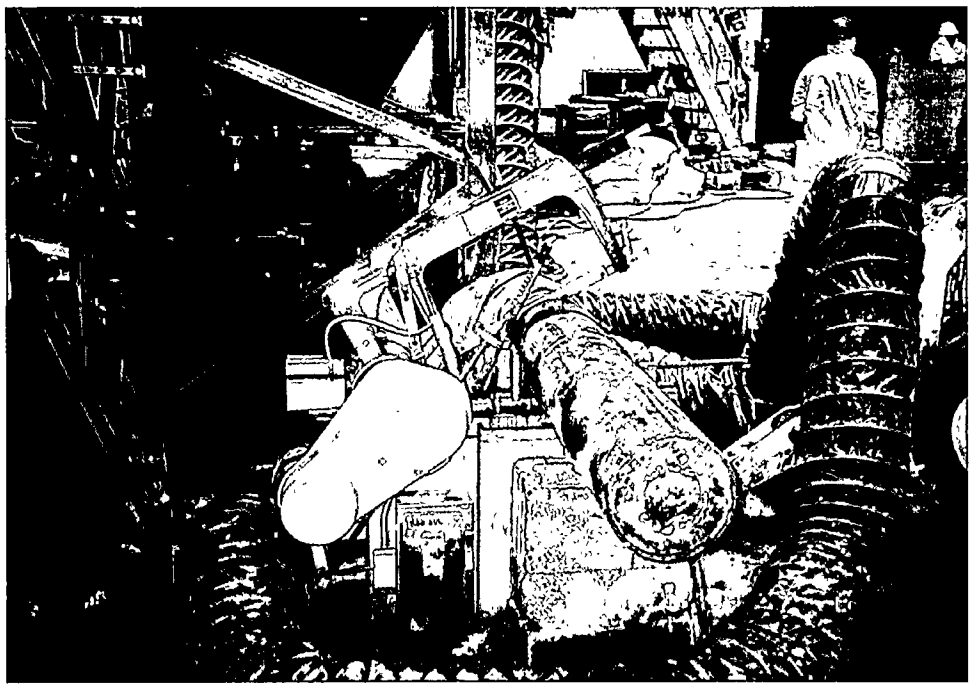
## CP-5 Research Reactor D&D

This picture is from the south side of the CP-5 shell and shows a Brokk operator removing the lower portion of the reactor steel tank. The Brokk, fitted with the jackhammer attachment, is prying loose the sides of the tank (ANL Neg. 25311K, Frame 9A).

## CP-5 Research Reactor D&D

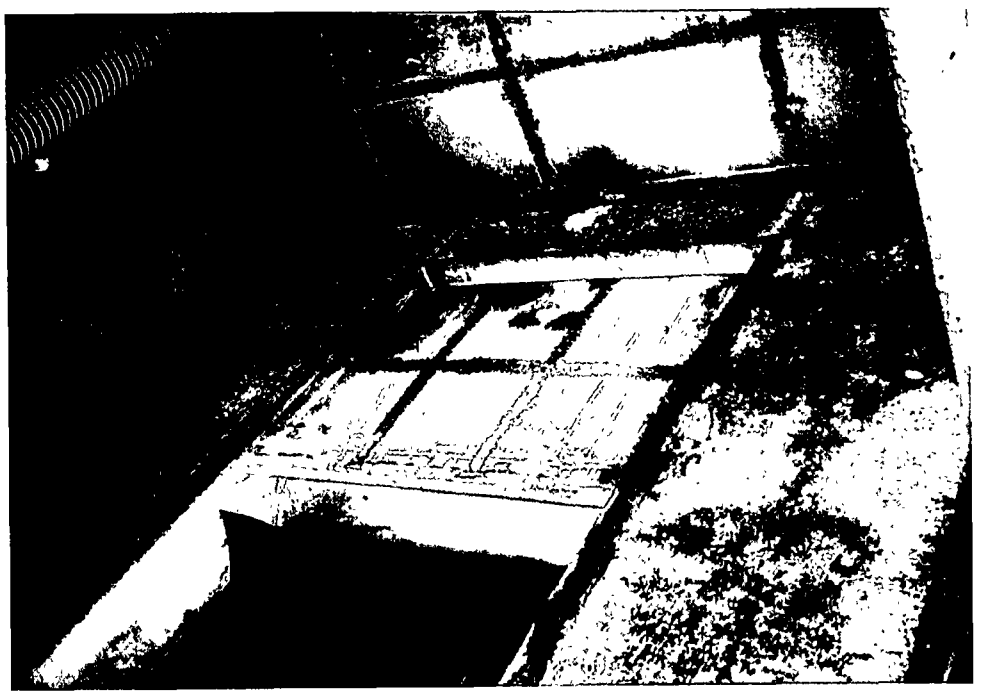
Following the removal of the outer steel reactor tank, the billets that supported the reactor were removed. Before this could be accomplished, the Brokk had to break up the high-density concrete that encased the billets. This photograph shows the billets after the concrete above them was broken loose by the Brokk's jackhammer. The removed billets were loaded into B-12 bins using the Brokk's bucket attachment (ANL Neg. 25310K, Frame 4).

## CP-5 Research Reactor D&D



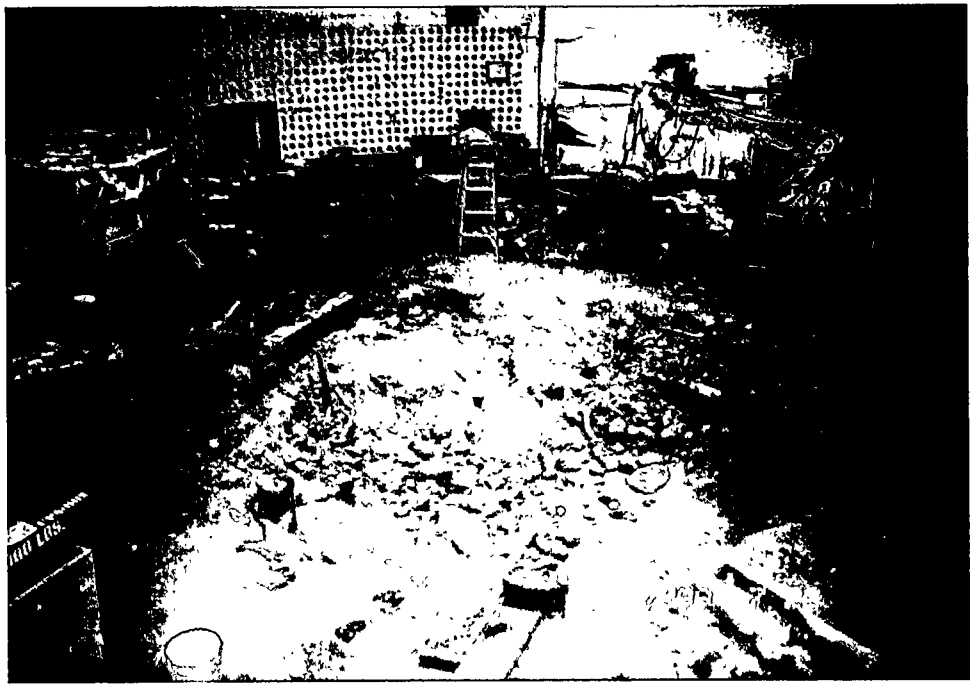
Pictured is one of the horizontal experimental tubes that was removed from the CP-5 reactor. These tubes allowed access to the reactor for various experimentation and became highly radioactive. The tube pictured is being size reduced using a power hack saw that is being operated remotely. This tool allows the material to be size reduced without exposing workers to unnecessary dose and proved to be an effective method of practicing ALARA (ANL Neg. 25310K, Frame 10).

## CP-5 Research Reactor D&D



A hot cell was located in the lower level of E-wing at CP-5. This picture shows the walls after removal and packaging of the stainless steel lining (ANL Neg. 25329K, Frame 7).

## CP-5 Research Reactor D&D

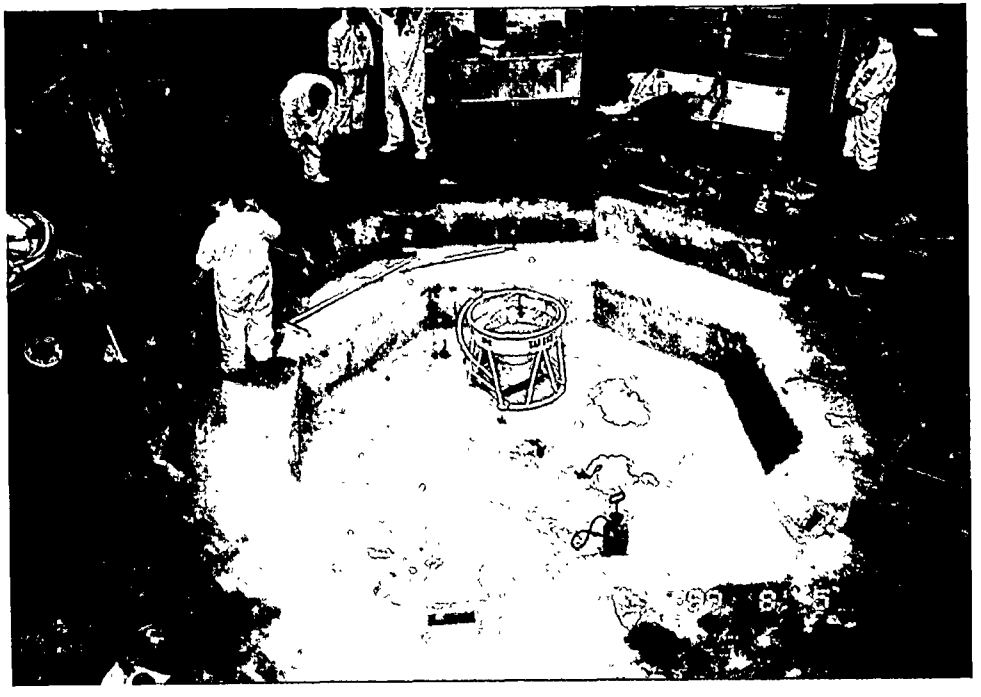


This photograph was taken from the second floor catwalk of the CP-5 shell. After removing the reactor steel tank and billets, a Brokk fitted with a jackhammer breaks loose the remaining concrete. The Brokk is then fitted with the bucket attachment to scoop up the concrete rubble and load it into a B-25 bin for disposal (ANL Neg. 25382K, Frame 2).

## CP-5 Research Reactor D&D

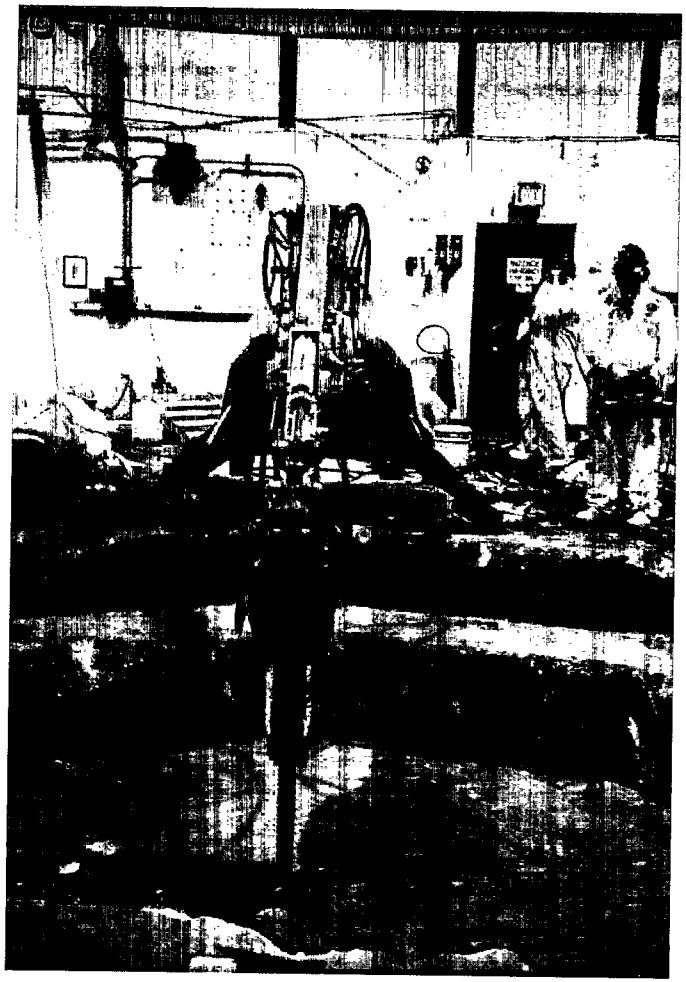
Radioactive lead waste removed from the CP-5 reactor is considered a hazardous material that must be kept segregated from the rest of the waste stream. This waste is loaded into B-12 bins and transferred to Argonne's Plant Facilities and Services Waste Management Operations for final disposition (ANL Neg. 25382K, Frame 11).

## CP-5 Research Reactor D&D



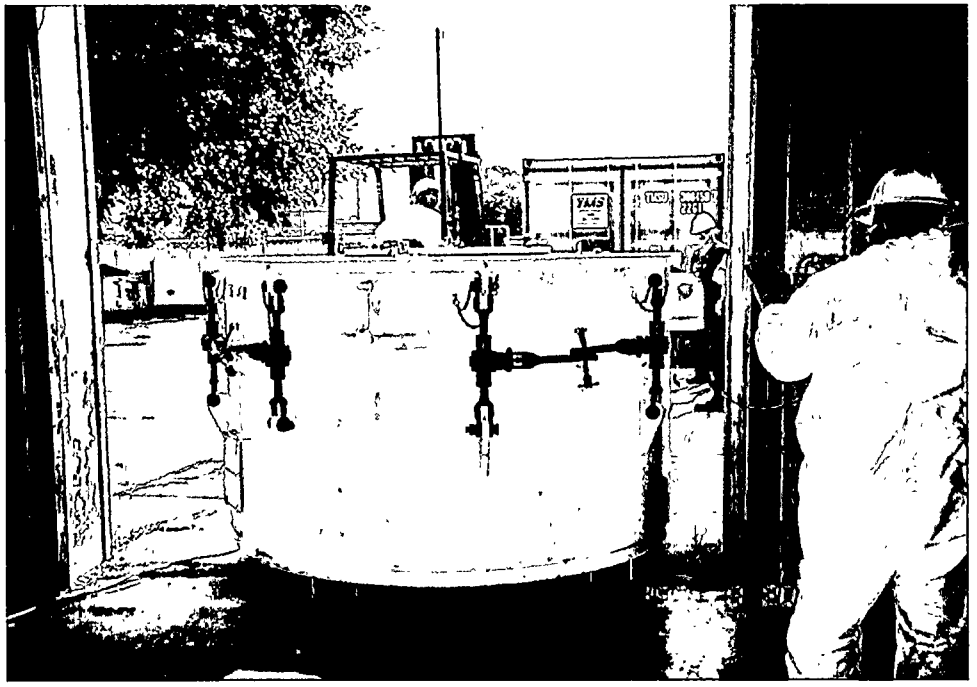
This photograph shows the reactor pedestal after all the loose concrete was scooped up by the Brokk and loaded into B-25 bins. It looks amazingly like the day it was poured. Workers are doing final cleanup before surveying for any remaining hot spots (ANL Neg. 25385K, Frame 18A).

## CP-5 Research Reactor D&D



The Brokk BM-250 proved to be one of the most valuable tools used at the CP-5 D&D Project. In this photograph, the Brokk is removing the hot and cold legs of the reactor cooling system (ANL Neg. 25385K, Frame 22A).

## CP-5 Research Reactor D&D



During the CP-5 D&D Project, many highly radioactive components were encountered. These components are size reduced when possible and loaded into 7-100 casks. There are two 7-100 casks at the CP-5 facility. One cask is used to collect remote-handled low-level radioactive waste. The second cask is used to collect remote-handled low-level mixed waste. This photo shows workers from Argonne's Plant Facilities and Services Rigging Department moving a 7-100 cask containing remote-handled low-level radioactive waste from CP-5. The 45,000 pound cask is being moved to the Building 317 vault for final disposition by Argonne's Plant Facilities and Services Waste Management Operations (ANL Neg. 25469K, Frame 6A).

## CP-5 Research Reactor D&D

The CP-5 shell dome, seen in this photograph along with the polar crane, had been covered with acoustical tiles. These tiles have all been removed by the D&D crew (ANL Neg. 25468K, Frame 2A).

# Future Projects

## Future DOE EM-40 D&D Projects at the ANL-E Site

In FY 1999, the Department of Energy approved a revised ANL-E EM-40 Baseline. This document updated cost, schedule, and technical scope for those projects on-going at the beginning of FY 1999 and for those that have not yet begun. All work included in the revised baseline is scheduled to be completed by the end of FY 2003.

FY 1999 focus was on the CP-5 Research Reactor D&D Project. Its scheduled completion is in FY 2000. Projects remaining on the DOE EM-40 roster are:

- 60" Cyclotron (Bldg. 211) - An accelerator used for basic research, this facility met widely diversified operational requirements, producing beams of deuterons, helium ions, singly charged hydrogen molecules and neutrons of a broad energy spectrum. A subcontractor (MOTA Corporation) was selected in FY 1999, and premobilization activities will begin in October 1999. Field work is scheduled to begin in January 2000, with scheduled completion in December 2000.

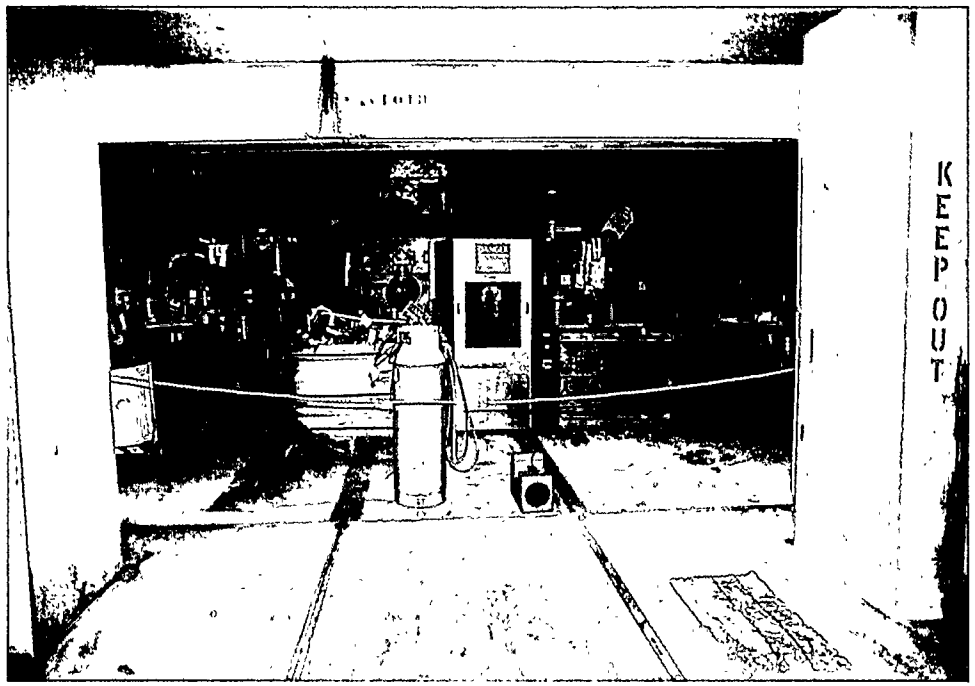
- Hot Cells (Bldg. 301) - The hot cell area, the first permanent cells constructed at ANL-E, contains eight caves that were used to perform a variety of radiological research activities.

- Surplus Retention Tanks (Bldg. 310) - These tanks were placed into service more than 30 years ago and used for interim storage of radioactive liquids when the processing and holding tanks at an adjacent facility were full.

- Zero Power Reactors 6&9 (Bldg. 315) - This facility was used for fast reactor physics research.

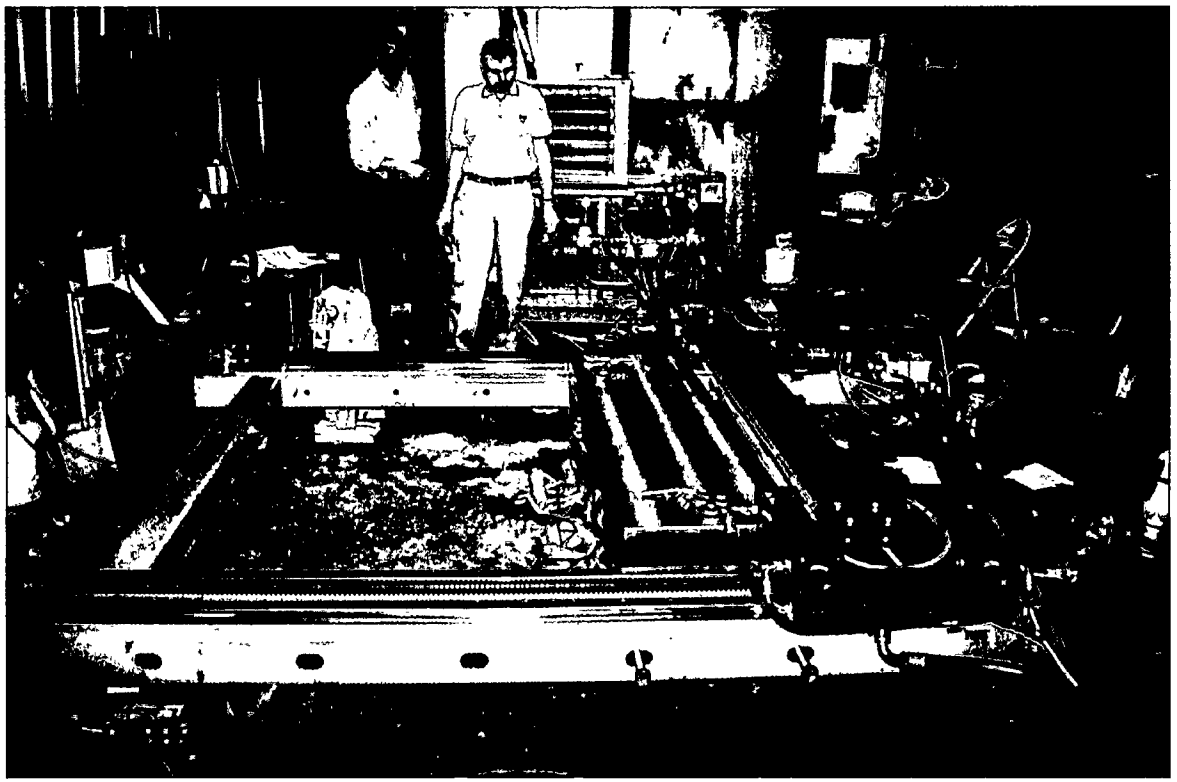
- Juggernaut Reactor (Bldg. 335) - A light-water moderated and cooled, graphite-reflected research reactor designed to conduct basic research.

## 60" Cyclotron D&D Project




Argonne's 60" Cyclotron in Building 211 was a fixed frequency machine built in 1952 to conduct basic research. It has had a rich history, meeting widely diversified operational requirements and producing beams of deuterons, helium ions, singly charged hydrogen molecules, and neutrons of a broad energy spectrum. Early work encompassed fields of heavy element chemistry, nuclear activation studies, nuclear scattering, solid state physics, radiation chemistry, isotope production, and biological studies. Argonne's Nuclear Medicine Group was a significant later user of the facility; other users were the Argonne Physics Division and Oak Ridge National Laboratory. Operations ended in 1992 (ANL Neg. 25695K, Frame 3A).

## 60" Cyclotron D&D Project



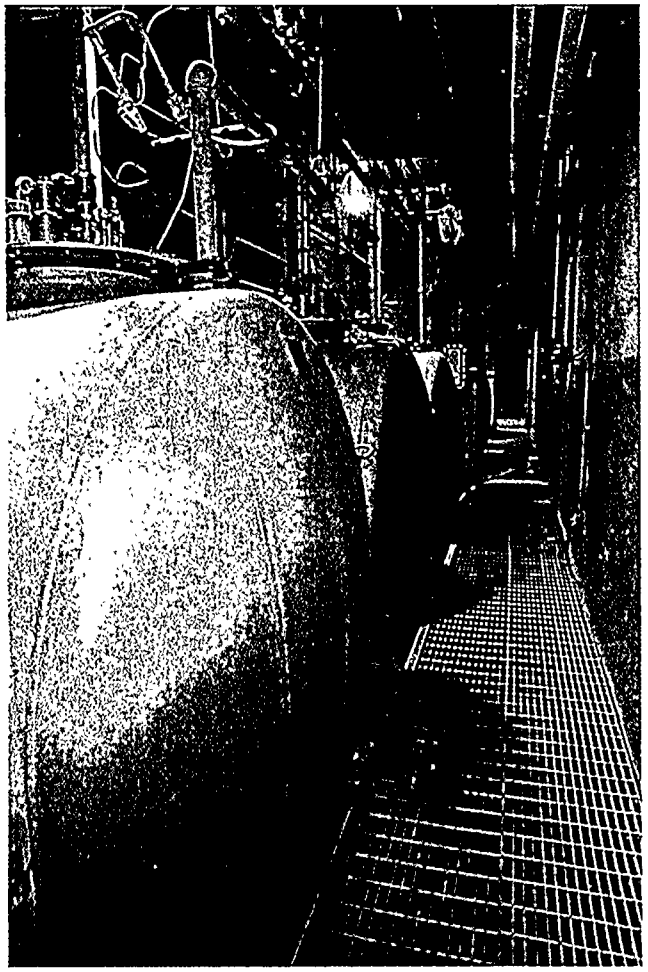
The purpose of the 60" Cyclotron D&D Project is to decommission the cyclotron and permit the release of the facility for unrestricted reuse. To accomplish this, the cyclotron will be disassembled, size-reduced, and segregated. All radioactive materials associated with the facility will be disposed of at an approved facility. Project planning and documentation were completed early in FY 1999.

Late in FY 1999, MOTA Corporation (Columbia SC) was selected as contractor to complete the D&D of this facility. MOTA will use a custom-built 76-inch reciprocating saw manufactured by Reverse Engineering (Columbia SC) to cut the cyclotron's 220-ton steel yolk into blocks that are approximately 17,000 pounds each. Ron Mencarelli of MOTA (right) and Paul Brown of Reverse Engineering were observers when the saw was tested at the manufacturer's site before it was sent to Argonne National Laboratory (MOTA Corporation photograph).

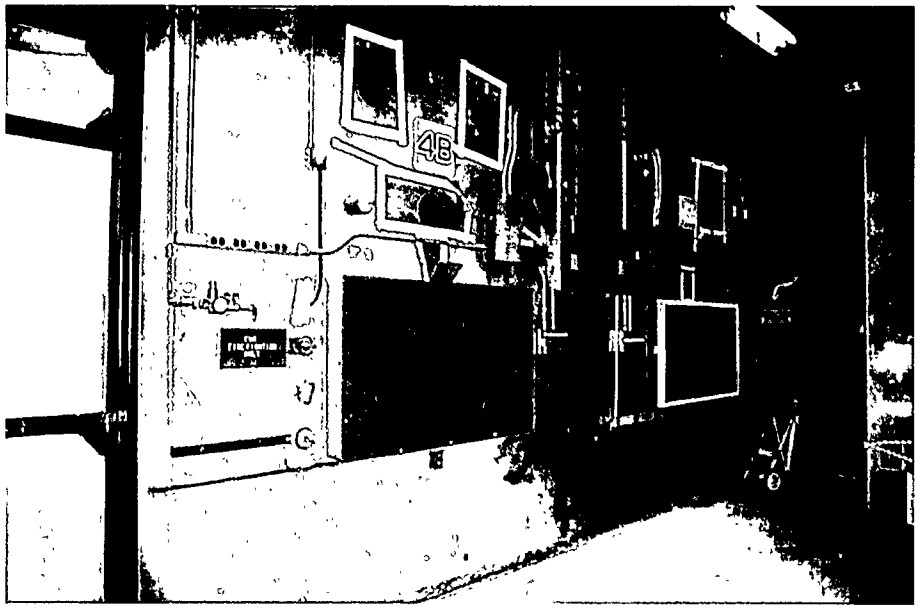
## Building 310 Retention Tanks D&D Project

The ANL-E Building 310 service floor retention tank facility was originally installed more than 30 years ago. Even though the Building 310 tanks were installed for excess storage capacity for the adjacent Building 306 tanks, they were infrequently used for this purpose. The facility consists of three rooms containing three tanks each, and a larger room containing one tank, for a total of ten tanks. The tanks have not been used since 1975, when it was decided that the excess capacity was no longer required.

Project planning was completed in FY 1997, and D&D activities are scheduled to begin in FY 2000. D&D activities will be performed by ANL Waste Management Operations and Health Physics personnel, and will include the removal of the ten retention tanks and the fixtures and piping leading to the tanks, and decontamination of the retention tank area so that it can be released for unrestricted reuse (ANL Neg. No. 12379, Frame 15).



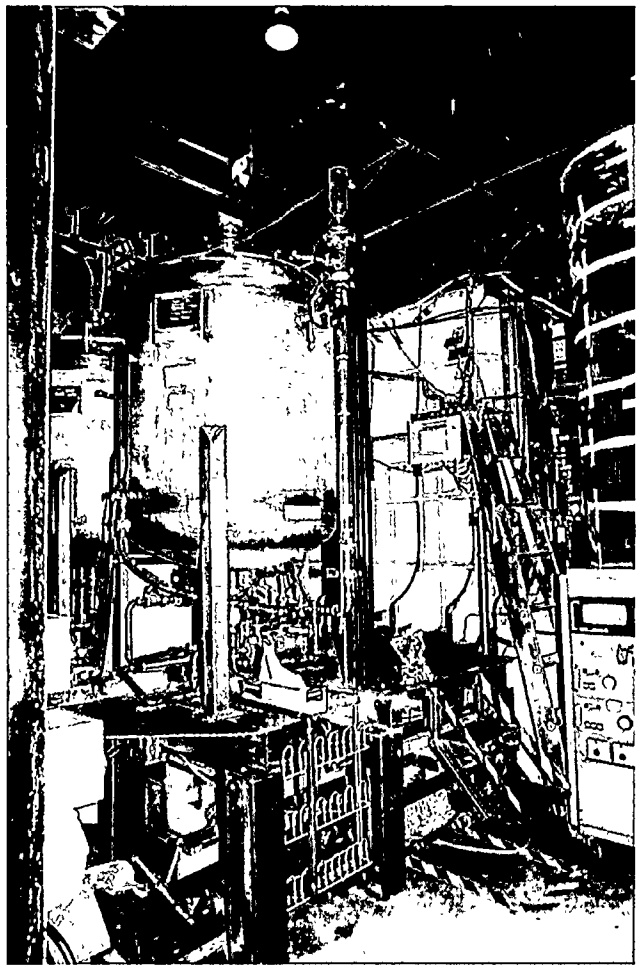
## Building 301 Hot Cells D&D Project



The hot-cell facility in Building 301 was placed into use in the early 1950s to perform a variety of radiological research and development experiments for the U.S. Department of Energy on nuclear reactor fuel components and materials. The eight caves contained within the hot-cell facility were phased out in 1971 because they were obsolete and deteriorating. The interior of the caves received a preliminary cleanup, but significant levels of fixed contamination within the painted floor, walls, cells, and equipment remain throughout the facility. From 1971 until it was taken out of active use in 1992, the hot-cell facility was used for non-radiological experimentation.

The scope of this project includes cleaning or dismantling radioactively contaminated equipment and disposing of it. Project planning and documentation were completed during FY 1999. In the future, the hot-cell area and other contaminated areas will be decontaminated and removed to permit the area to be released for unrestricted reuse, and the cave structures, retention tanks, and ventilation systems will be demolished. The Laboratory has determined that this building is surplus to the Laboratory's needs and will be a candidate for demolition (ANL Neg. No. 24027K, Frame 12).

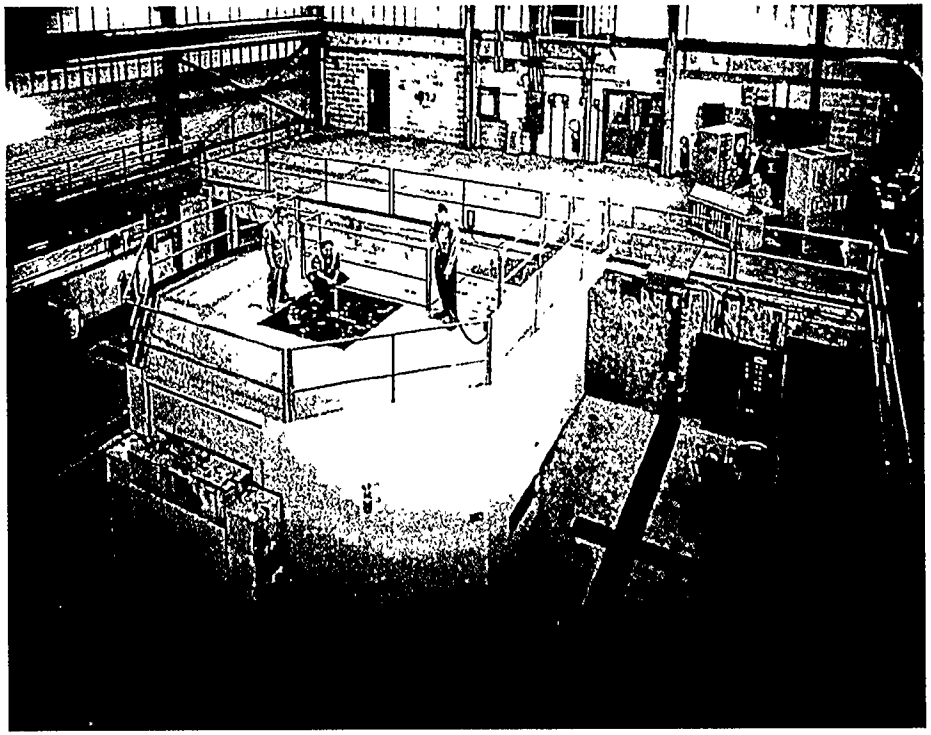
## ZPR 6 & 9 D&D Project



The Zero Power Reactors (ZPR) 6 and 9 in Building 315 were low-power, experimental reactors utilized for fast reactor physics studies from the early 1960s until 1982. Uranium and plutonium fuels were used to study the neutronic properties of reactor assemblies. Each reactor is in an individual, blast-resistant, concrete cell. Shield walls separate the cells from their control rooms; between the cells is a separate work room used to load fuel drawers. The facility is no longer in use; it is contaminated with low-level radioactivity.

The purpose of this project is to decommission ZPR-6 and ZPR-9 and permit the area's release for unrestricted reuse. To accomplish this, the reactors, process systems, and associated equipment will be cleaned or dismantled and disposed of properly. A characterization plan was prepared in FY 1999. Project planning and documentation, and D&D activities remain to be completed (ANL Neg. No. 23663K, Frame 2A).

## Juggernaut Reactor D&D Project



The Juggernaut Reactor in Building 335 was a light-water moderated and cooled, graphite-reflected research reactor with a rated thermal power of 250 kW. It operated from 1962 through 1970. The purpose of the facility was to provide neutron flux levels of medium intensity for research and development experiments for the fast reactor development program. At the time of reactor shutdown, the reactor fuel was removed and all systems were drained.

Only the high bay area of Building 335 housing the Juggernaut Reactor, the pump room, and the pit are covered by this project. The scope of this project includes the disassembly, size-reduction, segregation, packaging, and disposal of all radioactive materials associated with the facility. After the removal of all radioactive materials, the facility will be decontaminated to levels that allow its release for unrestricted reuse.

Project planning and documentation, and D&D activities remain to be completed (ANL Neg. No. 122-510).