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IA-01-8

Final Radiological Condition of the  
Ames Laboratory Research Reactor Facility  
Ames, Iowa

AGENCY: Office of Operational Safety, Department of Energy

ACTION: Notice of Availability of Archival Information Package

SUMMARY: The Office of Operational Safety of the Department of Energy (DOE) has reviewed documentation relating to the decontamination and decommissioning operations conducted at the Ames Laboratory Research Reactor Facility, Ames, Iowa and has prepared an archival information package to permanently document the results of the action and the site conditions and use restriction placed on the site at the time of release. This review is based on post-decontamination survey data and other pertinent documentation referenced in and included in the archival package. The material and documents included in the package demonstrate that the radiological conditions at the former Ames reactor site are such that the current use of the site poses no radiological hazard to the public; however, conditions require that the site be maintained under monitored unrestricted use. That is, the site use is essentially unrestricted; however, health physics personnel must continue to monitor the radiological conditions at the site and must review any required modification to the site to ensure that conditions remain acceptable for unrestricted use. The monitored use classification is necessary because of residual tritium contamination in certain areas of the former reactor room walls.

The results of the Department's review of activities at the Ames site as recorded in the archival information package are being made available to interested parties at the DOE Public Document Room in Washington, D.C. For further information contact:

Mr. Carl Welty  
Office of Operational Safety  
Environmental Protection Division  
U.S. Department of Energy  
Germantown, Maryland 20545

SUPPLEMENTARY INFORMATION: In order to create a permanent accessible record of the history, decontamination, final radiological condition and post-remedial action restrictions, the Department, through the Office of Operational Safety within the Office of Policy, Safety and Environment, has reviewed the past activities associated with the Ames Laboratory Research Reactor facility and has prepared an archival information package. The package summarizes historical operations and decontamination activities at the site and contains published reports and unpublished documents related to the site's radiological condition and suitability for release.

The Ames Laboratory Research Reactor began operation at full power in June 1966. As a result of a reduction in Federal support of basic research during 1975 and 1976, and the availability of more versatile reactors at other DOE facilities, plans were made to decommission the Ames reactor. Decontamination and decommissioning activities were begun following the 1977 shutdown of the reactor. The decontamination was completed by Ames Laboratory with overview provided by the DOE Chicago Operations Office.

Argonne National Laboratory conducted a series of independent radiological surveys at the Ames Laboratory Research Reactor in order to verify the adequacy of the project for the Department. The surveys were completed during 1980 and 1981 while the reactor building was still being decontaminated and decommissioned. Both Argonne and Ames surveys indicated some areas of the reactor room still contained unacceptable levels of residual radioactivity. The major problem in the building following decontamination was residual tritiated water in the reactor room walls, and other concrete structures. Under normal use this contamination poses no hazard; however, under conditions of poor ventilation, levels of tritium in the air could possibly rise to unacceptable levels. As a result, the Department recommended that the reactor building be released for "monitored use." This essentially allows Ames unrestricted use of the building on the condition that the building is monitored by the facility's health physics staff and that any future modifications to the building be reviewed by the health physics staff to ensure the radiological conditions will not be degraded by the action.

The Archival Information Summary for the Ames Laboratory Research Reactor is to be archived by DOE through the Assistant Secretary for Management and Administration and will be available through either the DOE Records Office or the DOE Historian Office. Copies of the information package will be available for public review between 8:00 a.m. and 4:00 p.m., Monday through Friday (except Federal holidays) in the Department of Energy Public Document Room located at the Forrestal Building in Room 1E-190, 1000 Independence Avenue, S.W., Washington, D.C.

Dated: \_\_\_\_\_

REVISED

MAR 29 1985

D. E. Patterson  
Director, Office of Operational Safety

ARCHIVAL INFORMATION SUMMARY

AMES LABORATORY  
RESEARCH REACTOR FACILITY  
IOWA STATE UNIVERSITY  
AMES, IOWA

Department of Energy  
Office of Policy, Safety and Environment  
Office of Operational Safety  
Environmental Protection Division

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ARCHIVAL INFORMATION SUMMARY  
AMES LABORATORY  
RESEARCH REACTOR FACILITY  
IOWA STATE UNIVERSITY  
AMES, IOWA

INTRODUCTION AND PURPOSE

The Ames Laboratory Research Reactor was built between 1961 and 1965 on a 35-acre open site about 1.5 miles from the Iowa State University campus, located in Ames, Iowa. Its function was to support Federal research programs. The reactor was cooled and moderated with heavy water and was operated at a power of 5 megawatts from June 1966 until its December 1977 shutdown. The Argonne National Laboratory (ANL) Radiological Survey Group conducted a series of radiological measurements and tests at the reactor during 1980 and 1981 while the reactor building was being decontaminated and decommissioned for the purpose of returning the building to general use.

Because the decontamination activities at this facility were conducted outside the auspices of the Department of Energy's (DOE) four major remedial action programs (Formerly Utilized Sites, Uranium Mill Tailings, Surplus Facilities, and Grand Junction), no authority was delegated for formally certifying this site as radiologically acceptable for other uses prior to release. Therefore, in order to create a permanent accessible record of the history, decontamination, and final radiological condition of this site, DOE, through the Environmental Protection Division within the Office of Policy, Safety and Environment, has reviewed the past activities associated with the Ames Laboratory Research Reactor facility and has prepared this archival information summary.

This summary reviews site activities and references published reports and unpublished documents containing information on the site's final radiological condition and supporting release of the site for other uses.

This summary, together with the referenced documents, is to be archived by DOE through the Assistant Secretary for Management and Administration and will be available through either the DOE Records Office or the DOE Historian Office. Copies of the information package will be available for public review at the DOE Public Document Room in Washington, D.C.

#### PROPERTY IDENTIFICATION AND SITE DESCRIPTION

The site is known as the Ames Laboratory Research Reactor Facility which is located within the environs of Iowa State University as shown in Figure 1.

As shown in Figure 2, the reactor building has three major regions, the reactor containment room, a laboratory wing, and a staging area. The containment area includes the reactor room and basement. The three-floor laboratory wing has mechanical equipment in the basement and two floors of offices and laboratories, including the reactor control room and an observation/conference room on the second floor. A door in the control room opens to stairs to the reactor room floor and formerly to a catwalk to the reactor top. The staging area is adjacent to the laboratory wing and the reactor room and connected to the latter by a large air lock. Two other air locks connect the reactor with the two upper floors of the laboratory wing. Auxiliary structures include a waste disposal building and a combination warehouse/laboratory building. The functions of these structures did not change as a result of the decontamination and decommissioning activities. A bunker for horizontal and vertical storage of radioactive equipment and material has been constructed near the disposal building.

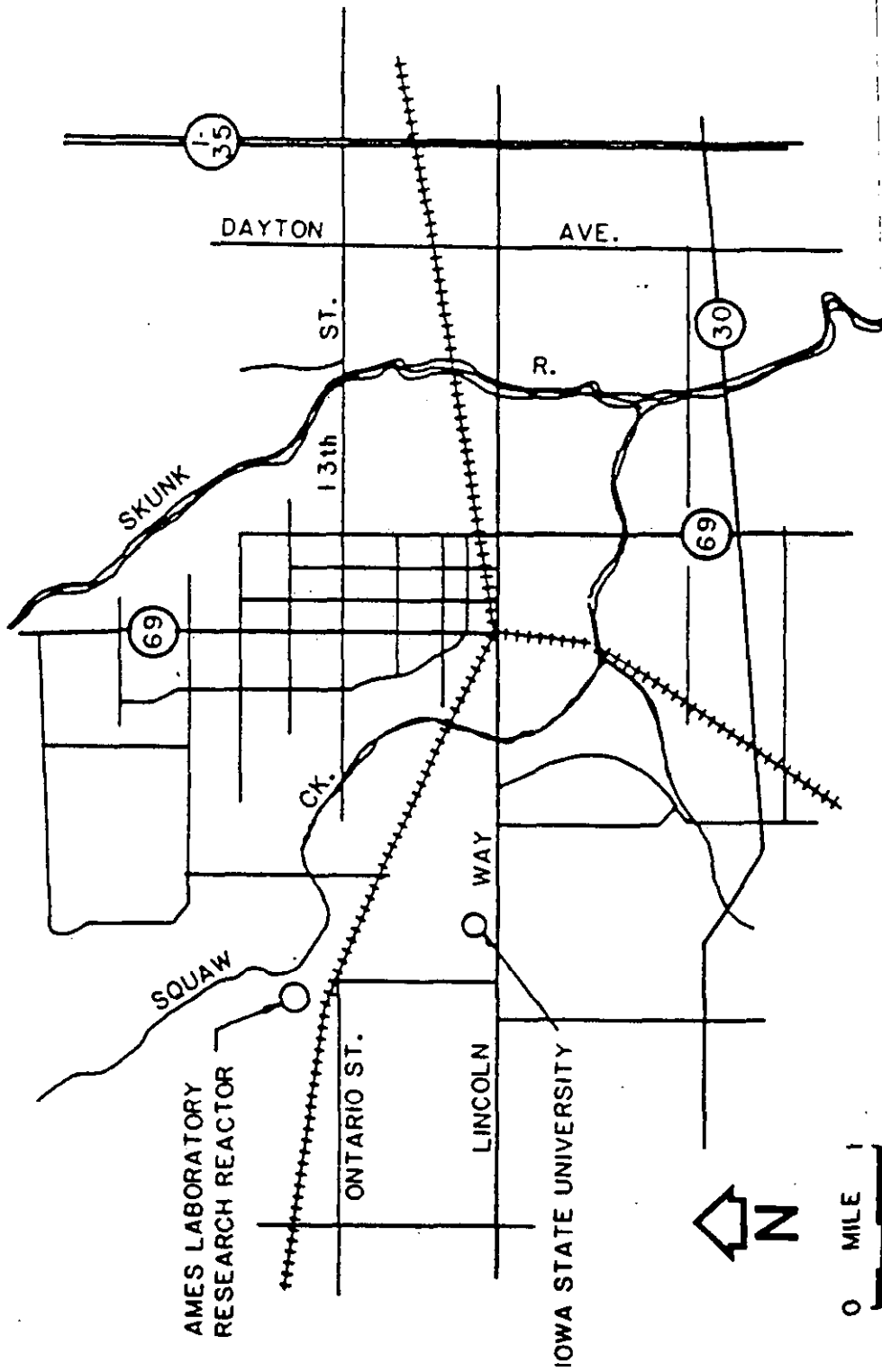


Figure 1. Ames, Iowa Environs Locating the Reactor Site

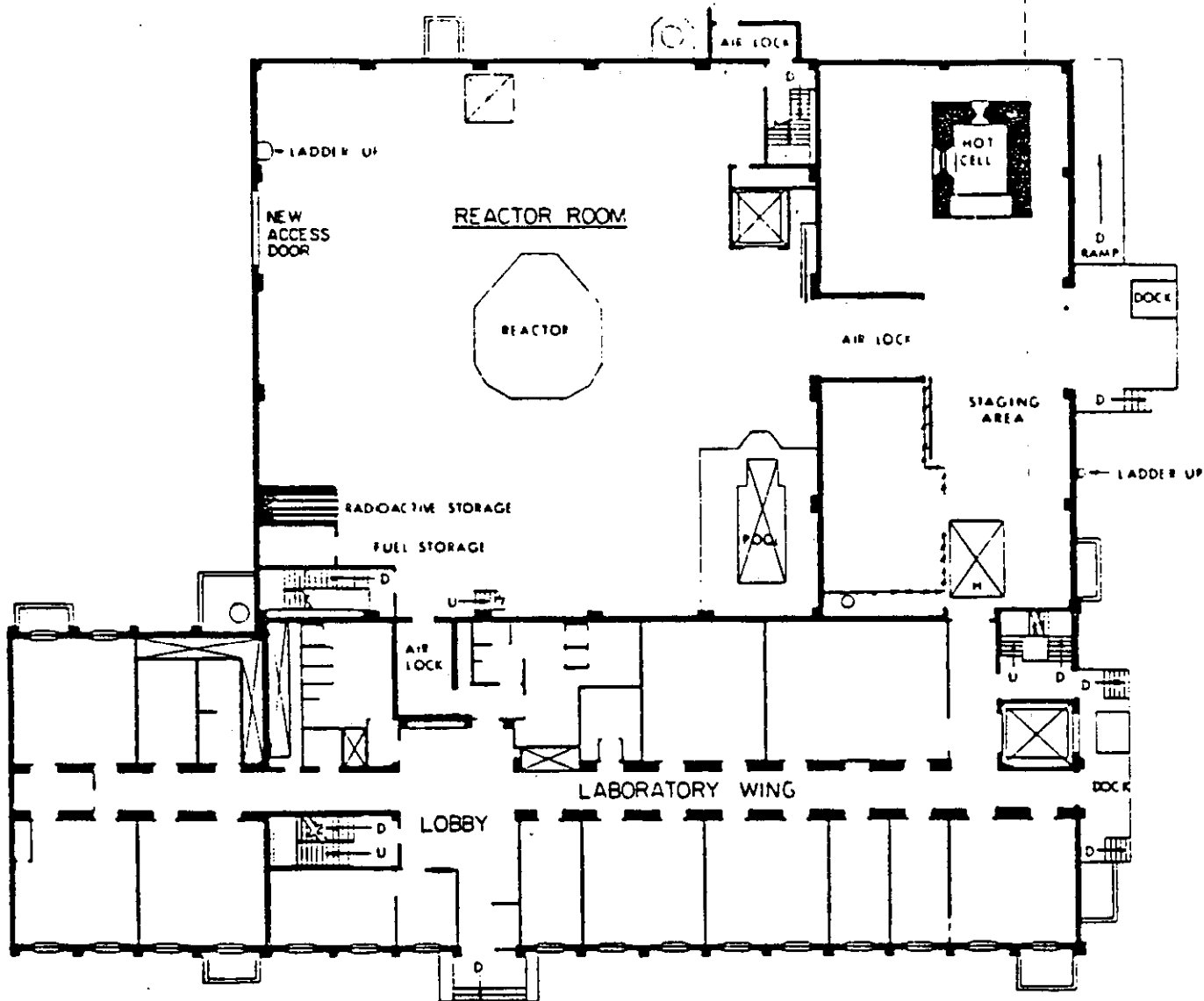


Figure 2. Research Reactor--First Floor Plan



SUMMARY OF ACTIVITIES AT THE AMES LABORATORY  
RESEARCH REACTOR FACILITY  
AMES, IOWA

SITE FUNCTION AND HISTORY

The Ames Laboratory Research Reactor began operation at full power in June 1966. The reactor used 93 percent enriched uranium, operated at a thermal power of 5 megawatts, and was cooled and moderated by heavy water at atmospheric pressure. Experimental facilities included a graphite thermal column, 9 horizontal beam tubes, 2 through-tubes tangential to the core, 4 pneumatic irrigation tubes, and 9 vertical thimbles into the heavy water tank. Except for refueling, maintenance, and a few unscheduled repair periods, it was operated on a 24-hour, 7-day schedule until final shutdown on December 31, 1977.

As a result of a reduction in Federal support of basic research during 1975 and 1976, it became increasingly difficult to fund the operation of the reactor. Various ways of reducing operating costs were considered, but savings produced were seen to be inadequate or inconsistent with the purpose of providing as many neutrons as possible for the research programs. Because the Ames Laboratory Reactor was not as heavily used as those at Oak Ridge, Brookhaven, or Argonne, and space could be made available at Oak Ridge and Brookhaven reactors for the major Ames reactor experiments, the Ames reactor was chosen for decommissioning.

OWNER HISTORY

The site has been and is owned by Iowa State University.

## RADIOLOGICAL HISTORY AND STATUS

Reactor decommissioning proceeded in four phases. Phase A involved placing the reactor in a standby condition. Conducted from January to September 1978, it included shipment of fuel, coolant and activated reactor parts, removal of experimental equipment and leveling of the secondary system cooling tower. Phase B, removal of readily handled radioactive material, began prior to October 1978 and ran to March 1979. It involved the removal and disposal of control rods, removable parts of the experimental facilities, the top plug, and electrical and electronic systems. Phase C, deactivation, was conducted from April 1979 to late 1980. Activities included removal and disposal of all remaining pump room systems and of the reactor core tank, thermal shield steel and thermal column. Phase D, pedestal removal and cleanup, began late in 1980. Besides the pedestal, it included removal of the hot cell from the staging area, removal of the hot waste tank adjacent to the reactor building, removal of the exhaust system and stack, capping of drain lines, decontamination of the spent fuel storage pool, removal of acoustic material, repair of the reactor room floor, and decontamination of miscellaneous surfaces.

ANL conducted a series of radiological measurements and tests at the Ames Laboratory Research Reactor during 1980 and 1981 while the reactor building was being decontaminated and decommissioned. Measurements indicated several areas of the reactor room had significant levels of contamination (primarily cobalt ( $^{60}\text{Co}$ )). Further decontamination by Ames personnel brought 95 percent of the reactor room floor area in compliance with standards for release.\*

Some low-levels of residual activity (primarily  $^{60}\text{Co}$ ) remains in piping buried in the pump room wall. Because the pipe ends have been

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\*Nuclear Regulatory Commission Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors."

double-capped and the lines are buried in at least 2 feet of concrete, any radiation hazard from this source was considered to be negligible. A smaller amount of  $^{60}\text{Co}$  remains in the drain and fill lines running between the storage pool and the reactor basement area. Samples from the lines met the criteria for unrestricted release, but they were nevertheless capped with concrete. Part of one pipe was removed and disposed of as radioactive waste.

ANL found fission and activation product contamination on surfaces in and around the storage pool and adjacent storage holes. Ames decontaminated these areas to levels as low as reasonably achievable before filling the pool and holes with sand and capping the area with concrete. There is no hazard to the public or site occupants as long as the integrity of this area and the sealed drain lines and other piping remains intact. A condition of release is that health physics practices must accompany any activity that would disturb these structures.

The ANL survey also revealed the presence of soil contamination at the radioactive waste storage area located 300-400 feet east of the reactor building. Maximum concentrations found were 1,400 picocuries per gram (pCi/g) normal uranium, 111 pCi/g thorium ( $^{232}\text{Th}$  + daughters), and 3,100 pCi/g cesium ( $^{137}\text{Cs}$ ). According to the Ames Laboratory decommissioning report, this contamination pre-dates reactor operations. Therefore, cleanup is the responsibility of the University. Most of the waste stored in this area has been removed.

The Ames decontamination effort included the Laboratory wing of the building. ANL surveys confirmed that no contamination remained.

The major hazard in the building following decontamination arises from back-diffusion of tritiated water vapor from the reactor room concrete. The reactor pedestal and the floor and support became

contaminated with tritiated water in May 1977. A leak developed in a line embedded in concrete which carried a small stream of primary coolant. The heavy water, which contained approximately 1.7 curies of tritium per liter, penetrated the concrete and exchanged with combined water in the concrete, remaining bound and undetected until surfaces were exposed during decommissioning. Tritiated water vapor is slowly being released from the concrete to the room air by exchange and diffusion. Although the equilibrium concentration of tritium in the air under normal ventilation conditions would be small, under conditions of restricted ventilation these levels could rise considerably. Measured tritium levels ranged from about  $2 \times 10^{-3}$  microcuries per cubic meter ( $\mu\text{Ci}/\text{m}^3$ ) air to about  $7 \times 10^{-2} \mu\text{Ci}/\text{m}^3$  air. Ames health physics personnel made some additional measurements to determine the increase in tritium concentration in the air under restricted air exchange conditions. They determined that when the building ventilation system was shut down, the tritium concentration in the air increased by about a factor of 10 which would approach or exceed the DOE standard for unrestricted areas.\* When an airtight structure was built over the contaminated area at face number nine (the reactor face with the highest tritium concentration), the tritium concentration inside the structure reached an apparent equilibrium at about a 100-fold increase in tritium concentration.

In general, the decontamination effort resulted in the reduction of contamination in the reactor building to negligible levels. The major exception was the tritium source term remaining in the concrete structural elements of the reactor room. As a result, it was determined that the goal of unrestricted use of the reactor room could not be attained. Therefore, the reactor building was approved for

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\*DOE Order 5480.1A, Environmental Protection, Safety, and Health Protection Program for DOE Operations, Chapter XI, Requirements for Radiation Protection, August 13, 1981.

monitored use that requires continued health physics surveillance and concurrence for future uses of the area. These activities will adequately protect the health and safety of the personnel using the facility.

DOCUMENTS ON RADIOLOGICAL  
CONDITION OF THE AMES LABORATORY  
RESEARCH REACTOR FACILITY  
AMES, IOWA

U.S. Department of Energy, "Environmental Assessment, Decommissioning and Decontamination Activity, Ames Laboratory Research Reactor, Iowa State University, Ames, Boone County, Iowa," (DOE/EA-0026), March 1978.

This document describes the proposed activities required to decontaminate and decommission the reactor, alternatives to the proposed action, and potential environmental impacts.

Shipp, B.D. (Chicago Operations and Regional Office) to W.E. Mott (Environmental and Safety Engineering), "Interim Overview/Certification Activities Report for the Ames Laboratory Research Reactor Facility, Ames, Iowa," letter dated March 9, 1981.

This document is an interim report concerning the radiological overview/certification activities conducted by the ANL Radiological Survey Group at the Ames Laboratory Research Reactor, Ames, Iowa. It recommended that the site shall not be designated as available for unrestricted use classification.

Shipp, B.D. (Chicago Operations and Regional Office) to W.E. Mott (Environmental and Safety Engineering), "Second Overview/Certification Activities Report for the Ames Laboratory Research Reactor Facility, Ames, Iowa," letter dated April 1, 1981.

This document is a second report concerning the radiological overview/certification activities conducted by the ANL Radiological Survey Group at the Ames Laboratory Research Reactor, Ames, Iowa. It

was recommended that the reactor building cannot be released for unrestricted use because of the tritium vapor source from the reactor area.

Langsam, M.A., to R.S. Hansen (Ames Laboratory), "Third Interim Overview/Certification Activities Report for the Ames Laboratory Research Reactor Facility (ALRR)--Contract No. W-7405-ENG-82," letter dated August 3, 1981.

This letter discusses residual radioactivity in the storage pool and adjacent storage holes. The letter confirms the facility will not be released for unrestricted use due to the tritiated water in the concrete and contaminated piping.

Argonne National Laboratory, "Radiological Survey Support Activities for the Decommissioning of the Ames Laboratory Research Reactor Facility, Ames, Iowa," (ANL-OHS/HP-84-106), September 1984.

This document describes a series of measurements and tests conducted during 1980 and 1981 while the reactor building was being decontaminated and decommissioned. It was determined that surface contamination within the reactor building could presumably be reduced to negligible levels. However, the potential for airborne contamination from tritiated water vapor would remain.

Ames Laboratory, "Final Report, Decommissioning of the Ames Laboratory Research Reactor," (IS-4789), January 1982.

This document describes the reactor decommissioning operations, processes, disposition of material, and final condition of the reactor.