UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D C 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE DECOMMISSIONING AND DISMANTLING OF FACILITY AND

DISPOSITION OF COMPONENT PARTS

BRIGHAM YOUNG UNIVERSITY RESEARCH REACTOR

FACILITY LICENSE NO. R-109

DOCKET NO. 50-262

1.0 INTRODUCTION

By letter dated June 28, 1990, as supplemented on July 2, 1991 and March 9, 1992. Brigham Young University (BYU or licensee) submitted a request for authorization to decommission, dismantle and dispose of component parts of the BYU L-77 Research Reactor, and to terminate Facility License No. R-109. The BYU L-77 Research Reactor (BYURR) has been shut down since May 1982 and was defueled in May 1987.

2.0 EVALUATION

2.1 Introduction

The "Decommissioning Plan for the L-77 Research Reactor," as supplemented (DP), was submitted by the licensee following the regulations[1] and guidance[2,3] concerning the decommissioning of non-power reactors. The DP states that all reactor fuel has been shipped offsite in accordance with the facility operating license and applicable regulations. Accordingly, the Nuclear Regulatory Commission (NRC) staff amended the facility license in 1987, converting it from an operating license to a possession only license for the unfueled reactor and associated radioactivities.

The staff review considered the discussions in the DP (as supplemented) of (a) management responsibilities and commitments to follow applicable regulations, regulatory guides, standards, and personnel protection plans, including implementing procedures, (b) use of appropriate equipment and instrumentation, radiation survey methods, training, personnel dosimetry, and radioactive waste disposal, and (c) the final radiological survey of the dismantled and decontaminated facility.

For termination of the facility license, the NRC must conclude that sufficient reactor-related radioactivity has been removed to allow release of the facility for unrestricted use. The acceptance criteria to be used by the

staff are stated in the guidance documents referenced above,[2,3] which include limits on potential whole body exposures, radiation fields, and limits on surface contamination, as listed in Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors."[4]

2.1.1 DP Background and Management

The DP briefly discusses the history of the reactor facility and mentions the various ways that the reactor was used. The DP notes that all fuel has been shipped offsite, and no areas in the facility outside of the reactor shield have radiation or radioactivity that exceeds normal background levels. The shield tank water will be disposed of in accordance with 10 CFR Part 20 limits.[5] There has been no known leakage of radioactive material from the reactor core vessel. Also, there have been no known incidents or spills that could have caused local areas of contamination, either within or outside the reactor shield.

The DP outlines the organizational structure proposed to manage and implement dismantlement and decommissioning activities. The DP was developed and written, and will be implemented by BYU personnel. An Associate Administrative Vice President (AAVP) of the University will report directly to the President of Brigham Young University and maintain administrative control over all activities relating to the dismantlement and of the facility. Three individuals and the Decommissioning Committee (DC) will report to the AAVP: (a) the Project Supervisor (PS), who will direct the day-to-day activities; (b) the Radiation Safety Officer (RSO), who will be responsible for the radiological safety of the operations; (c) the Project Safety Officer (PSO), who will ensure that good industrial hygiene and general safety practices are observed; and (d) the DC, who will review, audit, and approve the various tasks necessary to the dismantlement, the radioactive waste packaging and shipping, and the radiological control functions. The overall objective is to complete the dismantlement in accordance with all applicable regulations and standards, and in consonance with the University's commitment to limit radiation exposure to the public, the environment, and the workers to as low as reasonably achievable (ALARA).

The staff finds this overall management plan and the University's commitments to be acceptable and in accordance with the guidelines provided in Reference 2.

2.1.2 Summary Description

The BYU L-77 Research Reactor was delivered by the Atomics International (AI) Division of North American Aviation, Inc., in August 1967. Before this, AI had used the reactor for various demonstration purposes. In September 1967, the reactor was loaded with uranyl-sulfate solution, containing a final uranium-235 mass of 1447 grams. The reactor was licensed to operate at thermal power levels not to exceed 10 W. From August 1967 until operations ceased in 1982, 355 separate reactor runs generated a total energy output of 1779 watt hours. The reactor was defueled on May 5, 1987, and the fuel was shipped to the Idaho National Engineering Laboratory.

The current reactor configuration (Figure 1) includes the empty stainless steel core vessel, three layers of inner shield tanks, a water-filled outer shield tank, miscellaneous piping, a through-tube, beam tubes and auxiliary exposure tubes, and instrumentation thimbles. At this time, neutron activation of the impurities in the stainless steel components of the core vessel is estimated to be less than 20 μCi of long-lived radionuclides. No other significant radioactivities are known to exist.

Because BYU needs the space now occupied by the reactor, only dismantlement (the DECON option) is an acceptable disposition of the reactor. The licensee has estimated the total cost of the project at $35,000. BYU has committed to provide the necessary funding. The staff considers these plans acceptable.

The DP also proposes a schedule for the major tasks and the reduction of radioactivities to levels that will meet the NRC criteria for license termination. The university will implement a quality assurance (QA) plan that is consistent with acceptable QA principles and ANS 15.8, "Quality Assurance Program Requirements for Research Reactors."[6]

The DP includes estimates of the collective whole body radiation doses anticipated during the dismantlement. The licensee has identified no sources of radiation exposure greater than background levels and thus sees no potential for whole body exposure. The NRC staff conservatively calculates that total collective whole body exposure to the public and BYU staff will not exceed 0.5 person-rem. No hot-particle sources are anticipated because there were no recorded leaks of fission products from the fuel solution and no radioactive spills. However, surveys for alpha particles, beta particles, and gamma rays will be performed frequently to limit radiation exposures. Furthermore, personal dosimeters will be worn by appropriate personnel. All radiation-related activities will be controlled by the RSO. The licensee has committed to maintain up-to-date records of personnel radiation exposures during the dismantlement and to plan and perform all activities with exposures ALARA.

The DP describes the tasks to be performed by the BYU staff, including the final radiation survey and the preparation of a complete report of the results. The DP also acknowledges and commits to perform accurate measurements of low-level radiation fields to show compliance with the NRC release criteria of 5 μR/h at 1 meter from the surface of measurement for radiation fields and Regulatory Guide 1.86, Table 1,[4] surface contamination requirements.

The staff considers the discussions and commitments in the DP appropriate and acceptable.

2.1.3 Facility Operating History

The DP states that no fission products were released from the fuel solution and no spills of radioactive materials occurred. Thus, the neutron-activated

materials and components are considered to be the predominant source of radioactivity. The DP addresses this status, and the staff finds these conclusions acceptable.

2.1.4 Current Radiological Status of the Facility

As indicated in previous sections, there are no areas in the facility outside the reactor shield where radiation or radioactivity levels are readily distinguishable from normal background. A 0.5-Ci plutonium-beryllium neutron source was transferred to the Physics Department under Special Nuclear Materials License UT 2500091, and radiation survey results were documented. The DP categorizes the remaining radioactive sources associated with the reactor as fixed activity resulting from neutron activation, identifies the radioactive components of the core vessel, provides estimates of concentrations (in Ci), and estimates of potential exposure rates. The DP commits that the DC will review and audit specific tasks on the basis of potential cumulative doses and dose rates.

The DP indicates that the licensee is adequately knowledgeable and prepared to make additional pre-dismantlement radiation assessments as necessary. The staff considers the licensee's planning acceptable for these tasks.

2.1.5 Decommissioning Alternative

The DP states that decontamination to the levels required by NRC for termination of the license (the DECON alternative) is the only acceptable option because BYU needs unrestricted use of the facility. The licensee has not considered the alternative methods of removing the reactor from service, such as SAFESTOR or ENTOMB. It does not appear that these alternatives will have a lesser effect on the use of available resources than the DECON alternative and they need not be evaluated. The staff concurs with the licensee's DP on the DECON method of decommissioning.

2.1.6 Decommissioning Organization and Responsibilities

The DP discusses the overall organizational structure by which the licensee will manage the facility dismantlement leading to decommissioning, identifying key positions for both implementation and oversight of the project. The licensee appears to be adequately aware that an experienced and highly competent staff is required to dismantle a research reactor, while protecting the public, the environment, and the workers from significant radiological exposure. The staff considers the licensee's DP acceptable in this respect.

2.1.7 Regulations, Regulatory Guides, and Standards

The licensee acknowledges responsibility for compliance with all applicable regulations. This implies the intent to follow all applicable regulations (although the DP does not specifically list all of them), such as 10 CFR Parts 19, 20, 30, 50, 51, 61, 71, and 140; 29 CFR Parts 1910 and 1926; and 49 CFR Parts 170 through 199. Furthermore, the DP indicates that the licensee accepts the obligation to follow the guidance provided by the NRC in

Reference 2, which contains the criteria under which NRC will terminate the license. This guidance document also references regulatory guides and ANSI/ANS standards that are applicable.

The staff judges the licensee's awareness of responsibilities to be acceptable.

2.1.8 Training and Qualifications

The DP discusses the need to train the dismantlement staff in specific functions. The licensee provided a summary and outline of the training program in the March 9, 1992, letter. The DP states that the Project Supervisor, RSO, and PSO will be qualified to perform training in their specialties. The licensee indicates that all personnel, who will be involved with, or who will be in the vicinity of, radioactive materials, will be given relevant training. The staff considers the DP's discussion of personnel training to be acceptable.

2.2 Occupational and Radiation Protection Programs

2.2.1 Radiation Protection Program

The DP discusses the licensee's radiation protection program. It is clear that both industrial and radiological health and safety are considered by the licensee to be high priority for the entire dismantlement and decommissioning project. The DP delegates direct responsibilities and oversight functions to key positions in the decommissioning organization. It also stipulates that the RSO shall make appropriate surveys and radiological measurements to direct the selection of protective equipment and work practices in order to maintain occupational exposures ALARA, which will be well below regulatory limits. Because there is no irradiated concrete shield to demolish at the BYURR, no airborne radioactivity is expected to be released to the environment as dust. Therefore, neither the public nor the radiation workers would reasonably be expected to receive radiation exposure from such a source during the reactor dismantlement. The staff considers that the licensee's DP adequately emphasizes the control of radiation exposures, and is, therefore, acceptable.

2.2.2 Industrial Safety and Hygiene Program

The DP discusses specific procedures to control and limit potential non-radiological risks and hazards. The staff considers these steps to be acceptable.

2.2.3 Contractor Assistance

All dismantlement work will be performed by BYU personnel without outside contractor assistance. The RSO will supervise and coordinate the activities of a certified waste disposal company. All radioactive waste will be transported to an approved disposal facility.

2.2.4 Cost Estimate and Funding

The DP presents a cost estimate of $35,000 to complete the tasks and a commitment by BYU to provide the necessary funds. On the basis of other decommissioning plans of similar reactors, the staff considers these estimates acceptable to accommodate the work.

2.3 Dismantling and Decontamination Tasks and Schedules

The DP presents task analysis descriptions, radiation dose estimates, and a schedule for completion. The DP discusses segmenting and removing radioactive components and materials, contamination control, local shielding, and radioactive waste disposition. Based on preliminary estimates of contained radioactivity, the DP does not predict significant radiation exposures to the dismantlement staff. Additionally, no mechanism is expected by which the public would be exposed to dismantlement-related radiation. The staff concurs that the data provided indicate that no potentially harmful quantities of radioactivity will be encountered and that monitoring plans provide reasonable assurance that radiation doses to the public and to the dismantlement staff will not exceed applicable regulatory limits.

2.4 Safeguards and Physical Security

Because the fuel has been shipped offsite, physical security will ensure that the facility is controlled and the public will not be inadvertently exposed to radioactive waste. The staff considers that the DP addresses this issue in an acceptable manner.

2.5 Radiological Accident Analysis

Because the fuel has been shipped offsite, the spectrum of potential accident scenarios has been reduced to only those involving inadvertent over-exposures to the small quantities of residual radioactive materials. The DP states that training all involved personnel will limit the frequency and the consequences of such accidents. The dismantlement and disposal activities required for decommissioning the BYURR do not involve unusual hazardous materials, novel equipment, or procedures. Therefore, non-radiological accidents would not pose unusual risks for a small dismantlement project.

2.6 Radioactive Materials and Waste Management

The DP addresses the potential sources of solid, liquid, and gaseous radioactive wastes and discusses their disposal. Solid wastes will consist primarily of the reactor components mentioned previously, such as the core vessel and assorted tubes. These will be packaged and shipped to a low-level radioactive waste disposal facility approved by the NRC. All applicable regulations will be followed. Liquid waste will be disposed of in accordance with the regulations or solidified and disposed of as solid waste. No gaseous waste should be generated during decommissioning. The staff considers these aspects of the DP to be acceptable.

2.7 Technical Specifications

After the fuel was shipped offsite, the facility operating license was amended in 1987 to allow possession only of the reactor systems. At that time the Technical Specifications were modified to be compatible with the facility status. Following acceptable removal of radioactivity, the NRC plans to terminate this existing license including the Technical Specifications, which will allow unrestricted use of the reactor building.

2.8 Proposed Termination Radiation Survey Plan

The DP describes the methodology and instrumentation to be used for the final radiological survey. After the licensee believes that radioactivity has been reduced to NRC criteria levels and before any surfaces are covered or ostensibly nonradioactive materials are removed, grids will be laid out on all surfaces of the reactor room. Radiation levels within these grids will be measured with instruments sufficiently sensitive to provide statistically significant results, and the data will be adequately processed and recorded. All potentially radioactive surfaces and areas will be surveyed in this manner. This proposed method is consistent with guidance provided to the licensee and with NUREG/CR-2082.[7] The licensee commits to obtain radiation results with 95 percent confidence levels, and therefore accepts that accurate measurements with appropriately calibrated instruments are required.

The licensee will report all relevant results to NRC and request license termination when results show (a) no areas where the reactor-related radiation levels are greater than 5 μR/h above background at 1 m from the surface of interest, (b) no reasonable likelihood that the maximum annual individual dose will exceed 10 mrem above background, and (c) no surface contamination above the limits in Table 1 of Regulatory Guide 1.86.[4]

The staff finds this aspect of the Plan acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

The staff has prepared an environmental assessment (EA) of the issuance of an order authorizing dismantling of the BYURR and disposition of the component parts. This EA led to a finding of no significant impact on the quality of the human environment.

4.0 CONCLUSION

Based on the review of the BYU Decommissioning Plan, the staff concludes that the licensee is adequately cognizant of the responsibility to protect the health and safety of workers and the public from undue radiological risk until NRC has terminated the reactor facility license. The DP provides reasonable assurance that the licensee is prepared to dismantle the reactor and to dispose of all significant reactor-related radioactivities in accordance with applicable regulations and applicable NRC guidance.

The staff concludes that the dismantling and decommissioning operations can be conducted without undue risk to the health and safety of the workers or the public and without any significant impact on the environment. The staff, therefore, finds the licensee's DP to be acceptable and will verify its acceptance with a termination field survey prior to terminating the license.

5.0 REFERENCES

1. Code of Federal Regulations, Title 10, "Energy," Part 50.82, Office of the Federal Register, Washington, D.C.

2. Nuclear Regulatory Commission, "Guidance and Discussion of Requirements for an Application to Terminate a Nonpower Reactor Facility License," Revision 1, September 15, 1984.

3. Nuclear Regulatory Commission, "Standard Format and Content for Decommissioning Plans for Nuclear Reactors," Draft Regulatory Guide DG 1005, 1989.

4. U.S. Atomic Energy Commission, "Termination of Operating Licenses for Nuclear Reactors," Regulatory Guide 1.86, June 1974.

5. Code of Federal Regulations, Title 10, "Energy," Part 20, Office of the Federal Register, Washington, D.C.

6. American Nuclear Society, "Quality Assurance Program Requirements for Research Reactors," ANS 15.8, 1976.

7. C. F. Holloway et al., Monitoring for Compliance with Decommissioning Survey Criteria, NUREG/CR-2082, Oak Ridge National Laboratory, 1981.

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Attachment: Figure 1

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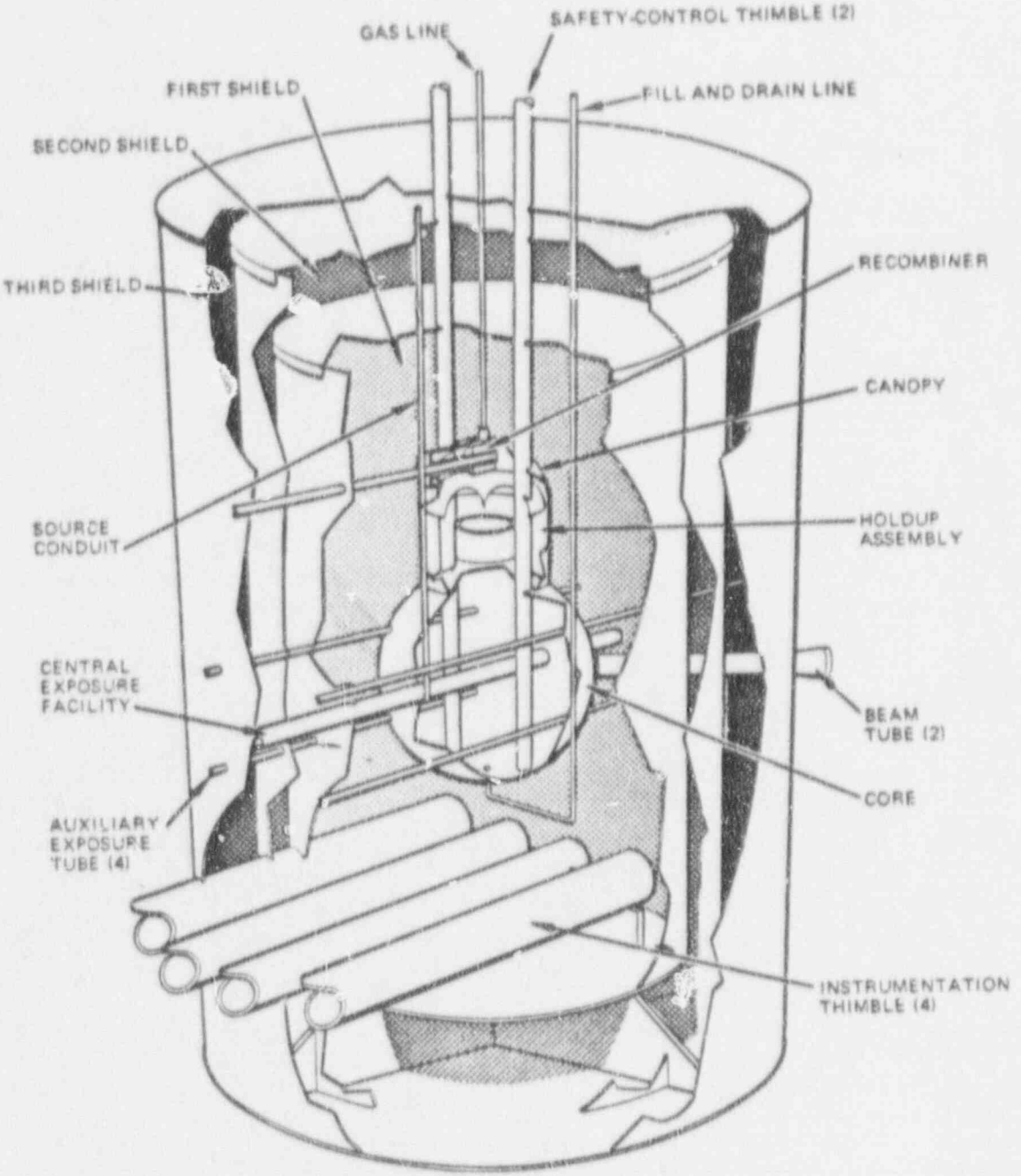

Figure 1 Cutaway of Core-Shield Assembly